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PROCEEDINGS
OF THE
AGRICULTURAL CONFERENCE

HELD IN THE
REVENUE AND AGRICULTURAL DEPARTMENT

SIMLA

ON THE
6th, 7th, 8th, 9th, 10th, 11th and 13th October 1890.

WITH APPENDICES.



SIMLA :
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1891.

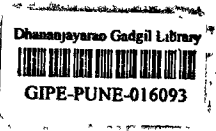
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Resolutions passed at the Agricultural Conference.

[For Resolution convening the Conference, vide Appendix A, page i.]

SECOND MEETING.

Resolution I.—That the first appointment of an Agricultural Chemist should be made for seven years.

Resolution II.—That travel is, for the reasons given by Dr. Voelcker, an essential part of the duties of the Agricultural Chemist, but that it is premature to lay down now any conditions as to the selection of special districts for close study.

Resolution III.—That the Agricultural Chemist should be given a well equipped laboratory, in a suitable place, and, looking to the desirability of utilizing the services of his Assistant for educational purposes, the Conference agrees that the laboratories should be at Dehra and Poona.

Resolution IV.—That he should be given a competent Analytical Chemist as Assistant. That the Agricultural Chemist should not, but that the Assistant should, be employed in the actual work of teaching.

Resolution V.—That the salary offered for the Agricultural Chemist should be sufficient to secure the services of a really first class man, and that the salary be left to Her Majesty's Secretary of State.

Resolution VI.—That the salary of the Assistant be Rs500 rising to Rs700 a month.

Resolution VII.—That the Agricultural Chemist should be debarred from taking fees under all circumstances.

Resolution VIII.—It should be the duty of the Agricultural Chemist to give his advice on agricultural questions submitted to him by Local Governments.

Resolution IX.—That the Conference express no opinion on the remaining suggestions in parts 'Conditions for success' and 'Laboratory' of Dr. Voelcker's paper.

THIRD MEETING.

Resolution I.—That if any attempt is to be made by Government to further agricultural improvement, it is highly desirable to maintain in each province a system of farms for enquiry and experiment; and that for the proper conduct of them, for securing continuity of enquiry, and for communicating information to officials and the public, the services of a competent adviser of the character recommended at the meeting of this Conference on the 7thth instant is indispensable. the second meeting

FIFTH MEETING.

Resolution I.—In considering the question of agricultural education and progress, the Conference desires to express the opinion that it is most desirable to extend primary education among the agricultural classes.

Resolution II.—That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend *exclusively* on separate special institutions.

Resolution III.—Resolved that it is most desirable that the Universities should recognize the science of agriculture as an optional subject in the course for a degree.

Resolution IV.—That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with the view of creating more interest in agricultural improvement amongst the cultivating classes.

Resolution V.—Resolved that, in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and "readers."

Proceedings of the Agricultural Conference.

First Meeting, Monday, the 6th October 1890.

PRESENT.

- SIR E. C. BUCK, K.T., *Secretary to the Government of India, Revenue and Agricultural Department.* } President.
- HON'BLE W. C. BENNETT, *Secretary to the Government of the North-Western Provinces and Oudh.* }
- H. F. CLOGSTOUN, Esq., *Commissioner of Settlements and Agriculture, Madras.* }
- DR. T. COOKE, *Principal, College of Science, Poona.* }
- M. FINUCANE, Esq., *Director of Land Records and Agriculture, Bengal.* }
- J. B. FULLER, Esq., *Commissioner of Settlements and Agriculture, Central Provinces.* }
- J. B. HALLEN, Esq., *General Superintendent, Horse Breeding Department.* }
- T. H. MIDDLETON, Esq., *Professor of Agriculture, Baroda College.* }
- E. C. OZANNE, Esq., *Director of Land Records and Agriculture, Bombay.* } Members.
- F. A. ROBERTSON, Esq., *Director of Land Records and Agriculture, Punjab.* }
- E. B. STEDMAN, Esq., *Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab.* }
- R. G. THOMSON, Esq., *Officiating Revenue Secretary to the Government of the Punjab.* }
- DR. J. A. VOELCKER, *Consulting Chemist to the Royal Agricultural Society of England.* }
- J. W. P. MUIR-MACKENZIE, Esq., *Under-Secretary to the Government of India, Revenue and Agricultural Department.* }

THE PRESIDENT'S OPENING ADDRESS.

GENTLEMEN,—In opening this Conference I desire to explain that its proceedings must be based on the correspondence of the Government of India with the Secretary of State on the subject of an Agricultural Chemist, concluding with the mission of Dr. Voelcker to this country, and with the Resolution,* dated the 25th March 1890, in pursuance of which this Conference has been convened.

The latter Resolution deals somewhat briefly with the duties and work performed by Agricultural Departments since the foundation of the Imperial Revenue and Agricultural Department in 1881, and with the present position of these Departments throughout the Provinces of India. I propose to deal with these subjects still more briefly now.

The new Departments were the outcome of the recommendations of the Famine Commissioners which Her Majesty's Secretary of State summarized in a despatch of 1881 as requiring the establishment (1) of a system of "agricultural enquiry;" (2) of measures for "agricultural improvement" and prevention of famine; and (3) of measures for famine relief on the occurrence of famine or scarcity.

* Appendix A

The Government of India was in pursuance of this despatch required to suggest the broad principles on which action should be taken to secure the above objects, and fulfilled this duty in the opening Resolution of December 1881, which sketched the general policy that would be followed in the development of Agricultural Departments and in the conduct of their duties, and that policy has been steadfastly and continuously maintained to the present date. General principles were laid down for the conduct of agricultural enquiry in (more or less) connection with the work of land settlement and the provision of annual land records; and instructions were issued as the basis of a code of famine relief for each province. On the other hand, positive measures in connection with agricultural improvement were to be postponed until enquiry and investigation had reached a more satisfactory stage. Earlier action was deprecated because it was foreseen that Agricultural Departments could not undertake the expenditure of public money for agricultural improvement without a greater knowledge of agricultural conditions than then existed, or without the assistance of first class experts; and it was considered prudent to defer any material expenditure which would be involved by practical action (1) until arrangements in connection with land records for a thorough investigation of agricultural conditions had been completed; (2) until the Agricultural Departments had proved that in carrying out this duty they could be of direct financial service to the State independently of any indirect advantages which might subsequently be obtained by agricultural improvement. It was well this course was taken. The Departments created by the Famine Commission of 1880 were challenged by the Finance Commission of 1889 to show that the cost of them was justified, with the exception of Madras, of which the circumstances were exceptional. The work of the Agricultural Departments (now called Departments of Land Records and Agriculture) in connection with land records was found to result in direct financial gain—in some cases very large—to the State Exchequer. It is right that this fact should be thoroughly appreciated. For if the Departments had followed the policy not unnaturally dictated by certain sections of the public and of the Press in the direction of anything like lavish expenditure on attempts at agricultural improvement, which could only have been of a crude and unscientific character, instead of confining their chief efforts to administrative duties of an immediately useful kind, they could not have outridden the storms which have been raised by the financial difficulties that have occurred at intervals since 1881. They would have justly shared, indeed, the condemnation which the Madras Government has bestowed on expenditure prematurely incurred upon attempts at agricultural improvement in that Province.

But the work of the Departments in connection with land records, although primarily useful to the State for purposes of Land Revenue administration, has at the same time provided an important and continuous supply of information concerning the agricultural conditions of every section of the country, which was one of the objects demanded by the programme of 1881. With this basis, and with the knowledge that they have secured, and are continuing to secure, an important improvement in the financial position of land administration, Agricultural Departments are now justified in claiming that means should be given to them to fulfil the duties in the direction of agricultural improvement imposed upon them by the orders of Her Majesty's Secretary of State in 1881. This was the position taken up in the despatch to Her Majesty's Secretary of State, No. 197, dated 21st July 1888, which is before you. We have now to consider how far the proposals which were embodied in the despatches to the Secretary of State require, in the opinion of the Conference, to be modified by the report which Dr. Voelcker has submitted, or by the discussions which may be held during the sitting of the Conference on the various issues concerned. Dr. Voelcker was sent out—and it may be admitted was wisely sent out—to India by Her Majesty's Secretary of State in order to secure a more accurate judgment upon the policy urged by the Government of India in accordance, I may add, with the general recommendation of the Delhi Conference of 1888. The main duty of this Conference is undoubtedly a serious reconsideration of that policy in the light of Dr. Voelcker's evidence and advice.

It seems desirable to point out that the Government of India is restricted by its position to the enunciation of general principles which should, in connection with agricultural improvement as well as with other subjects dealt with by the Famine Commission, be adopted by the Provincial Governments and Departments. It cannot deal with details concerning executive management and administrative arrangements. The object of the Conferences which have been held, and which it is the policy of this Department to maintain in connection with agricultural questions, is to secure the enunciation by the Government of India of those general principles which it is required to lay down in such form as will be *prima facie* acceptable to Local Governments. The views of the delegate from any one province are accepted, therefore, not as the final opinion of the Government of the Province represented, but merely as views which are not likely to be at variance with those of the Provincial Government, and calculated therefore to lead to the final establishment in correspondence with Local Governments of a policy more sound and less open to subsequent alterations than would be the case if the general principles upon which it is to be based were to be originated solely by the Government of India on a subject in connection with which advice on technical matters is essentially needed. This was explained in the Resolution of the 25th of March last.

The above remarks have been made, as I have explained, partly with the object of pointing out to the Conference the desirability of confining discussion as far as possible to general principles and issues of such wide character that they can be held to be applicable to all parts of India. In this view it would, in connection with Dr. Voelcker's note, be the function of the Conference to consider the leading features and principles of the system which should be adopted to secure the development of agricultural improvement rather than to discuss any of the detailed issues raised in Dr. Voelcker's note, such as, for instance, whether dairying is capable of development in large towns. Issues of the latter class must be dealt with in each case by the Agricultural Departments under the instructions of the Local Governments concerned. It is the duty of the Government of India only to enunciate the principle that such agency should be established, whether in provincial or national centres, as will enable the Local Government to carry out those investigations and experiments which will lead to a sound decision on *questions* of the kind.

In this view the most important function of the Conference in connection with Dr. Voelcker's mission is to consider generally, without special regard to any subordinate issue, firstly, whether the possibilities of improvement are sufficiently important to justify the gradual establishment of a sound system of scientific investigation as well as of education in connection with agriculture; and, secondly, what the general character of that system should be. The last despatch of Her Majesty's Secretary of State, dated 7th November 1889, implies that Dr. Voelcker's advice is required on the second rather than on the first of these questions; and although it will be useful that the Conference should pronounce a definite opinion on both subjects, yet it is to the second that its deliberations should be chiefly directed. A further question relating to the principles upon which the statistics and data annually provided by village establishments can be most effectively utilized for the purposes indicated in the Resolution of 1881 has also to be considered by the Conference; but this is one which is not affected by Dr. Voelcker's mission, and may be dealt with independently.

Assuming for the present that the Conference will confine the importance of the object held in view in the despatches of the Government of India in relation to scientific investigation and agricultural education—an importance admitted by Her Majesty's Secretary of State—I ask permission to make a few suggestions for discussion in connection with the system which should be followed to secure these objects. A forcible remark occurs in the 30th paragraph of Mr. Nicholson's admirable note on the Madras Agricultural Department that it is not merely poverty that prevents increase of produce, but ignorance of possibilities and a low order of intelligence. Accepting,

as I think we may, this proposition as sound, it is clearly the duty of Agricultural Departments in the first place to ascertain possibilities, and in the second to improve the intelligence of the agricultural population. Some people urge that the performance of the second duty would be sufficient; that if the intelligence (including a knowledge of scientific agriculture) of the agricultural population be gradually raised to a higher level, the time must come when they would discover for themselves the possibilities which are now beyond their grasp. This may be admitted. At the same time there can be little doubt that much time would be lost; and few will be found to deny that a long continued series of investigations and experiments conducted under really competent direction will be of very great value to the educated farmers of a future generation. It may also be urged that a series of experiments scientifically directed in each province will be in itself a valuable, if not a necessary, aid to popular education in agriculture. If we are to look to the people of India to work out eventually their own agricultural salvation (I am quoting these words), it is essential that they should be taught among other things how to make experiments on a sound and intelligent method. For these reasons it seems desirable that side by side with the gradual education of the agricultural classes, a system of investigation and experiment should be inaugurated. I will venture to give an illustration. Thanks to Lord Reay, there has now been established a Bacteriological institution at Poona under the general charge of Dr. Cooke, to which is attached a selected Veterinary officer, and (we owe this to Dr. Cooke's personal and self-sacrificing efforts) a first class Bacteriological expert from Europe. These officials will commence and continue over an extended period a series of careful experiments and investigations in connection with the diseases of cattle and other animals in India. It may be expected that in the course of a few years a considerable amount of knowledge as to the nature of animal diseases and their effectual treatment will have been obtained, and that some at least of the "possibilities" in connection with the treatment and cure of cattle diseases will have been discovered. At present the Legislature, the Veterinary officials themselves, and the native owners of cattle are groping in the dark. Without scientific investigation they do not and cannot know the real character of the diseases which decimate the cattle—much less how to treat them—any more than they now know the exact nature of agricultural soils or understand the possibility of improving them by the application of imported or special manures. Our investigations of the next few years will provide a material amount of useful facts and information: our education of the next few years will enable the native agriculturists to utilize it. The following is an amusing illustration of the costly results of ignorance of local conditions.

Only a year or two ago an account was given to me by a Veterinary officer of some standing in connection with a mission on which he was sent to Natal armed with a supply of vaccines and medical apparatus for the purpose of dealing with a serious outbreak of anthrax which had broken out in that Colony. The first application of the microscope resulted in the discovery that the disease was not anthrax at all. The germ was another germ, though the mischief it caused was very similar to that effected by the anthrax germ. Vaccines and apparatus were useless, and the expenditure devoted to the mission was, except so far as it served to supply a valuable lesson, incurred in vain.

To return to Poona and its Bacteriological College. While the experts there are carrying out their investigations and enquiries during the next 10 or 20 years, a certain number of native scholars will be so instructed as to qualify them to serve under Local Governments as cattle inspectors and doctors for the purpose (1) of conducting enquiries required by the central experts; (2) of carrying out the treatment prescribed by them; and (3) eventually, when the educational system has been sufficiently reformed, of themselves continuing the bacteriological investigations for which the initial enquiries of the European experts will have provided a basis.

So in agriculture. A series of investigations and experiments should now be undertaken under the general direction of first class experts, at

the same time that the education of natives should be provided for in such a way as to enable them to utilize the results and continue the enquiries for themselves at a future period. Investigation conducted under the guidance of first class experts (I won't admit that it will be so with second class experts) must yield results. What those results will be—what, in other words, are the possibilities—I do not think we can pretend to define or prophesy. Who, for instance, in Natal could have predicated that a scientific investigation of their animal diseases would have resulted in the discovery that *anthrax* was *not anthrax*? We must proceed on the broad argument, which is apparently accepted by Her Majesty's Secretary of State, that investigations directed by scientific men of first rank must yield results. Who can prophesy whether those results will be great or small; or who can estimate now their financial effect? The point is that no one is justified in asserting that they will not be of vast importance to the Empire. This is the view taken by the two most practical nations of the world—America and Germany,—and we shall not be far wrong in following their lead. They proceed on the assumption that knowledge means money and power—both. In the fierce strife which is imminent—which has indeed already begun—among the nations of the world in the field of production, those whose agriculturists are most fully trained, or, to borrow an useful phrase, “equipped with knowledge” at the earliest date, will have the best chance. Agricultural improvement was defined in our Resolution of 1881 as the process of raising agricultural conditions to the highest level of efficiency, and that goal can only be reached by slow and gradual steps. The first of these is scientific enquiry; the second is practical education.

I have concluded my remarks, and now propose that the Conference should deal with the subjects before them, so far as they are connected with agriculture, in the following order:—

- (1) The appointment of an Agricultural Chemist and staff for purposes of original investigation.
- (2) The duties of an Agricultural Chemist in connection with experimental farms.
- (3) Agricultural education, and the relation of an Agricultural Chemist thereto.

I would add that any member of the Conference who desires to do so is invited to submit a note on each or all of these subjects

Dr. Voelcker said he had nothing of much importance to alter in his preliminary notes, with the exception of that relating to agricultural education, which he was disposed to regard much more favourably than when he concluded his first tour. He had also some eight or nine additions to make to the “list of possible improvements” mentioned in the memorandum. These were read.

The *President* next proposed the order in which the subjects mentioned in the programme provisionally drawn up for the Conference should be discussed. He suggested that the meeting should in the first instance confine itself to Part II, Agricultural Experiment and Improvement, under the heads A (Scientific investigation) and B (Investigation by means of experimental stations or other similar agency), and Part III, Agricultural Education. If time allowed, the other subjects mentioned in the programme might be taken up.

This having been agreed to, a general discussion took place upon the appointment and functions of an Agricultural Chemist. The Conference was unanimously of opinion that, apart from the requirements of agricultural education, the appointment of a chemist was necessary for purposes of scientific investigation. It was agreed that he should occupy the position of a referee

and adviser to the Government upon agricultural questions. It was then determined to postpone further consideration of the duties, functions, and qualifications of the Agricultural Chemist until the following day, when the question could be taken up in detail under the first head suggested by the President.

Proceedings of the Agricultural Conference.

Second Meeting, Tuesday, the 7th October 1890.

PRESENT.

SIR E. C. BUCK, KT., <i>Secretary to the Government of India, Revenue and Agricultural Department.</i>	} President
HON'BLE W. C. BENNETT, <i>Secretary to the Government of the North-Western Provinces and Oudh.</i>	
H. F. CLOOSTOUN, Esq., <i>Commissioner of Settlements and Agriculture, Madras.</i>	} Members.
DR. T. COOKE, <i>Principal, College of Science, Poona.</i>	
M. FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal*</i>	
J. B. FULLER, Esq., <i>Commissioner of Settlements and Agriculture, Central Provinces.</i>	
J. B. HALLEN, Esq., <i>General Superintendent, Horse Breeding Department.</i>	
T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i>	
HON'BLE P. NOLAN, <i>Secretary to the Government of Bengal.</i>	
E. C. OZANNE, Esq., <i>Director of Land Records and Agriculture, Bombay.</i>	
F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab</i>	
E. B. STEEDMAN, Esq., <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab.</i>	
R. G. THOMSON, Esq., <i>Officiating Revenue Secretary to the Government of the Punjab.</i>	
DR. J. A. VOELCKER, <i>Consulting Chemist to the Royal Agricultural Society of England.</i>	
J. W. P. MUIR-MACKENZIE, Esq., <i>Under-Secretary to the Government of India, Revenue and Agricultural Department.</i>	

SCIENTIFIC INVESTIGATION.

The *President*: To-day we will take up the first of the four subjects decided on for discussion: *i.e.*, the appointment of an Agricultural Chemist and staff for the purposes of original investigation. Dr. Voelcker's note on the subject will furnish the basis of the discussion, and it is proposed that Dr. Voelcker's proposals as they stand now should be submitted for the criticisms of the Conference. I will ask any member, beginning with the member on the right, whether he has any remarks to make tending to modify or alter Dr. Voelcker's proposals.

Mr. Ozanne: It is extremely satisfactory to find that, after his enquiry during the past year, the grounds put forward by Dr. Voelcker for the appointment of an Agricultural Chemist are almost the same as were urged in the Conference of 1883; in other words, that the officer deputed by the Secretary of State has strongly supported the proposals made in 1883, *viz.*, that, first, investigation should be taken up; next, that the Agricultural Chemist should advise on the programme to be followed on the farms; and, finally, that he should publish the results of experiments made. I think specially well of the suggestion that is made to ask for two Agricultural Chemists in order that one may be free for investigation and advice, while the other, besides performing his duties as Assistant, may possibly be utilizable for other important purposes. The only alteration I should like to see made in the preliminary note by Dr. Voelcker is that, instead of saying "special or typical district" (second paragraph of the Conditions of Success, page 5), it will be well to suggest that the districts first chosen for close study should be those in which experimental farms now exist, so that the experimental work on those farms (which must be guided by the particular wants of the district concerned) may be put on a proper footing at the very beginning. Another point that I wish to bring out

clearly is the suitability of Poona as one of the places in which the Assistant should be resident for a certain number of months in the year. The Bombay Government has already offered to pay the salary for three months in the year to secure the presence of the Agricultural Chemist at Poona for that time at least.

That was done when the intention was to have only one man, but as we have now the hope of securing two men, I think that the year might be divided into six months for Poona and six months for Dehra. I think it extremely suitable that Dehra should have the laboratory for Northern India and Poona for Southern India. There is a report* by a Bombay Committee, which will be put before the Conference, in which the laboratory facilities at Poona are described. Poona is the very centre of a typical agricultural district, and also at Poona we have the Imperial Bacteriological Laboratory already established. It is expedient that investigation should be concentrated even though the investigators will not work together. I therefore think that a great deal is to be said for Poona as the location of one of the laboratories. There is another reason. Poona has an extremely good climate in the rains, while Northern India has rather a poor one; and as it is very advisable that the men should be in the best climates for work, that result can well be obtained by having Poona and Dehra as the two centres. I do not wish to make any further remarks except to support very strongly the proposals made by Dr. Voelcker.

* The *President*: I should be glad to know if the members agree that the Agricultural Chemist should combine or not the functions of agricultural investigation and agricultural teaching.

Mr. Robertson: I certainly think that the Government of India should obtain the services of an Agricultural Chemist of high attainments. He should be employed mainly as an investigator, and should have every facility for visiting all parts of the country and making himself acquainted with Indian agriculture. Such a man is much wanted in India; there is no body such as the Royal Agricultural Society of England who could employ such a man, and I think it is the duty of the Government, who alone *can* do so in this country, to do so.

Such a man would also be very useful as an adviser on agricultural experiments and experimental farms, and generally as an adviser and referee to Government on all questions connected with Agricultural Chemistry, and he would be able to enquire into many questions which call urgently for such enquiry as only an expert can undertake satisfactorily.

We should give such a man to a considerable extent a free hand, allow him to work very much on his own lines, and not press him too early for results.

I do not think he should be employed at all in teaching; his time will be very fully occupied in other ways.

I quite agree that he should have an Assistant fully qualified, who would work in the laboratory, and could be also usefully employed as a teacher. I think it would be well to have two laboratories on the whole—one for Northern and one for Southern India,—and the second expert might spend half his time at each place; but I am not so clear upon this point as upon what I have already said.

The Agricultural Chemist would be useful as an adviser on the practical portion of any educational scheme, but from what I have seen of scientific experts while studying science, as I did for a long period, I would say that there is nothing in the training of a scientific expert which would justify our predicating that he would be a valuable adviser on any general questions of higher education in the direction of Agricultural Science, and I think the expectations of some of the members of the Conference on that point are not well founded.

* *Vide* Appendix B.

The *Hon'ble Mr. Benett* considered that one of the greatest uses of having a really good Agricultural Chemist in this country would be for agricultural education. The people of the North-Western Provinces have a very strong desire for technical education; they do not care so much for literary as for technical education. For this purpose the Talukdars of Oudh have promised very liberal subscriptions. But in order to start an Agricultural College competent advice is needed.

The *President*: I quite agree, but we shall have a further opportunity of discussing the educational functions of the Agricultural Chemist.

The *Hon'ble Mr. Benett*: I do not think he ought to be used as a teacher. It is indispensable that agricultural education be connected with an University. Without that there is not the slightest prospect of it being a success, and pupils won't come over in any great numbers. But if we get a local school supported by local direction and attached to our University course, we shall want the advice of an Agricultural Chemist; he would offer advice, not teach himself.

The *Hon'ble Mr. Nolan* observed that the appointment of an Agricultural Chemist appeared desirable, provided a gentleman could be found for the office who had, like Dr. Voelcker, a practical acquaintance with English agriculture as actually carried on. In Bengal there were already a Professor of Chemistry, several members of the Medical and Opium Services possessing special acquirements in that line, and Cirencester scholars, who, as natives of India, could readily apply their general knowledge of agriculture to the circumstances of the country. If further academic attainments were necessary, they could be more cheaply obtained by deputing the best of our University chemical students to complete a course in Europe. What we required was a man who had what could not be found in India at present—that is, a real knowledge of English farming. The chemist should, moreover, be employed on practical work, and in this connexion the *Hon'ble Mr. Nolan* suggested that some procedure should be devised for submission to him of questions on which Local Governments required guidance. In Bengal these might probably be connected at first with the cultivation of tea, indigo, opium, and the production of silk—industries which had made such progress as to be at the stage in which the assistance of an expert is required. Too much stress had, perhaps, been laid on the inventions and original discoveries to be made by such an officer, and with his assistance by the Agricultural Department generally. Such additions to human knowledge came not from Departments or officers retained by Government for the purpose, but from those gifted with rare talent or genius known as the faculty of invention—a gift which the State could never confer.

Mr. Fuller thoroughly agreed in the proposal to bring out to India a highly qualified officer who would fill the position of Agricultural Adviser and Director of Agricultural Enquiry. He thought it most important that such a man should be able to deal with the practical side of agricultural questions, and would prefer a scientific agriculturist to an Agricultural Chemist pure and simple. The direction of agricultural enquiry with a view to practical improvement should be kept distinct from the teaching of Agricultural Chemistry, and an attempt to unite both functions in one man would probably result in failure. For instruction in chemistry a separate man would be required, and in his case too some acquaintance with practical agriculture would be desirable. There could be little doubt as to the utility of an Agricultural Adviser in this country, provided that he was capable of grafting on his scientific attainments a practical acquaintance with Indian agricultural conditions. More was to be done by the development of already existing resources than by the introduction of exotic products or processes. The investigation of local agriculture with a view to improvement was, of course, much more required in some parts of India than in others. Some tracts were already so far advanced that they were hardly capable of improvement, whereas other tracts were extremely backward. If the Government could secure the services of a man who could direct efforts to raise the standard of agriculture in these backward tracts, his salary would be repaid a hundredfold. But time would, of course, be required for local investigation, and results could not be expected till the Agricultural Adviser had gained some Indian experience. He should be assisted in his local

enquiries by trained men working under the provincial Directors of Agriculture. Unassisted he could, of course, do but little in so large a country. As for the separate question of education, it was of the utmost importance that it should be practical and not based on book work only, and it should be one of the functions of the Agricultural Adviser to see that this condition was practically enforced. Mr. Fuller agreed with the description of the functions of the Agricultural Adviser as given in Dr. Voelcker's note. He was convinced of the desirability of keeping the question of agricultural or chemical teaching distinct from that of agricultural enquiry. There should be a separate man for instruction who might be given the official position of Assistant to the Agricultural Adviser, and might be employed on laboratory work in addition to his instructional duties.

Mr. Hallen: I think it is very necessary that the Agricultural Chemist should have a practical knowledge of farming. I go about India, as you are aware, a great deal, and I see that a man holding that position will have great power and influence with Local Governments in being their adviser as to the utilizing of measures perhaps not known in the district he happens to be in, and which he has seen carried out successfully in other districts. I think also that he may be used in collecting information of a practical kind, and in giving it out to India generally in the form of simple primers. I venture to put on the table just a short précis* with regard to the making of hay, which is, I think, one of the most important fodders we have in India, and ought to have. Except in the Madras Presidency, much attention does not seem to have been paid to this subject hitherto. The fact of the matter is that people imagine that hay making is a difficult process, whereas it is a simple process. I think that if it was only commenced in the way indicated in the pamphlet, that by and by the Director of Agriculture or the Agricultural Chemist will be able to improve on the simple measures I have recommended, and no doubt in course of time we shall have good hay instead of the dry brittle grass produced now.

Mr. Steedman: I most thoroughly agree with the proposal to have an Agricultural Chemist, and I have only to add to what Mr. Ozanne has already said and Dr. Voelcker has sketched out in his note, that it is essential that the Agricultural Chemist to be brought out should have some practical knowledge of farming at home: he should not have done all his work in a laboratory; he should be something more than a Laboratory Chemist. It is essential that we should not fix any time for the employment of the Agricultural Chemist. He will come out with a certain amount of knowledge of farming at home and a knowledge of Chemistry. He would have to acquaint himself with the circumstances of local agriculture of every part of India; and to gain acquaintance with one province would take him some time. It would therefore, I think, take him very much longer than five years to gain a knowledge of the general requirements of India. Then as to his Assistant, I think it is absolutely necessary that he should have an Assistant. A certain number of questions will be taken up as soon as he comes out, and meanwhile the most important part of his duties will be learning; and to enable him to do this, he should have some competent man to assist him. As to his position as regards education, I think, whatever it is, it should be entirely subordinate, and entirely secondary to his position as Agricultural Adviser to Government.

Mr. Clogstoun: I think the Madras Government would cordially second the proposal to have an Agricultural Chemist and Assistant to work in the laboratories at Dehra and Poona. We cannot utilize the chemist for the purposes Dr. Voelcker has given, and I think the purposes for which we should use him ought to be specified by the Conference. We might utilize him in all these ways, but I think some of them should be modified. As regards clause (8) on page 4 of Dr. Voelcker's note, watching at Government experimental farms, &c., the objects might be revised. I do not see how he would be in a position to control the experiments, and I do not see why the publication of the results should be through the chemist's authority only. There are a very large number of experiments in which the chemist as

* Vide Appendix C.

chemist is not interested at all, such as experiments with ordinary farmyard manures, experiments with new implements, &c.

The *President* thought that Mr. Clogstoun's question was connected with experimental farms, which would be discussed at a later meeting. He asked Mr. Clogstoun to state his views as to the connection of the chemist with experimental farms, because his relations with experimental farms will not be much modified.

Mr. Clogstoun : I think the duties of the Agricultural Chemist are very clearly and correctly laid down by Dr. Voelcker as given at page 4 of his note. With regard to clause (8), I wish to remark that I do not see that the Agricultural Chemist could control experiments in Madras with any advantage. I do not see how he could enforce control on any experiments. There are a very large number of experiments. They are specified at page 8 of the Madras Agricultural Committee's report. There are other experiments mentioned by Mr. Benson, the Assistant Director of Agriculture, in which a chemist would have practically no concern as chemist. I do not see that the control of experiments should be entrusted to him, or that we should look to him for sanction to the publication of the results of experiments which are mainly the experiments which we shall now be conducting in Madras. I should propose that we should only look to him as an advising or consultative officer with regard to the results of any experiments in which chemical advice is necessary. I would strike out the words "advising, &c." I would like Dr. Voelcker to tell us what special object he had in view that we are likely to undertake which would require watching.

Dr. Voelcker : My view on that point, and what made me put this in, is practically expressed in a note which I have written in connection with questions on experimental stations. In the past there have been only reports by experimental farmers, and the number of results to which publication has been given are, to any one critically examining them with scientific knowledge, incorrect in themselves; and I consider that more harm is done by publishing a large series of these results, which no one can carry in their heads, than is done by having really good experiments, which may be adopted, and from which definite results may be got and definite knowledge gained; and, with all due respect to practical farmers even in England, I should never think of accepting off-hand the so-called experiments of farmers, because they all want subjecting to scientific methods, and no one, except he is of a scientific turn of mind, is able to deal with these matters, and to say which of them there is truth in, and which of them it would be advisable to reject. That is really what I had in view.

The *President* suggested that this question would be better discussed when Section B, Part II, of the programme on the subject of the investigation by means of experimental stations or other similar agency came to be discussed.

Mr. Finucane : I entirely agree with what has been said, especially by Messrs. Nolan, Fuller, and Bennett, and I agree with Mr. Fuller in thinking that the Agricultural Chemist should be separated altogether from the teaching staff, whether at Dehra, Poona, or elsewhere, and that each Local Government should be left to make its own arrangements for teaching Agricultural Chemistry. If they find it necessary to have an agricultural teacher for Chemistry in Calcutta, they should be allowed to have one without reference to Dehra or Poona. Bengalis will not go to Dehra or Poona to learn Agricultural Chemistry, and therefore it will be necessary to make arrangements for teaching Agricultural Chemistry at Seebpore.

The *President* asked Mr. Finucane if he objected to the scheme for the appointment of an Agricultural Chemist and an assistant teacher who shall teach at Dehra and Poona? Mr. Finucane said he did not object.

Mr. Robertson : I wish to add a remark on the question of getting an agricultural expert out from home. I am not a Cirencester man, but at one-time I saw a good deal of a certain number of men who stand high in scientific circles, and I think we are expecting too much if we expect all that seems to be considered necessary by some members of the Conference from a scientific expert.

Scientific men, as far as I know them, are men of high attainments *in their own line*, and what we require is an Agricultural Chemist who is a man of such attainments in that particular line. I think I am right in saying (Dr. Voelcker can no doubt correct me if wrong) that all the men who could at present be said to stand high as Agricultural Chemists are more or less connected with or in charge of experimental farms or stations. This is the class of man I think we want in this country—a man who is at once a good chemist in the laboratory and acquainted with practical farming in its scientific side. He should be employed in enquiring into agricultural conditions in this country and in making or superintending experiments and researches both in the field and in the laboratory, and he could no doubt give useful general advice on subjects connected with scientific education in agriculture.

But to expect an expert of this kind to draw up schemes of higher scientific education is, I think, to expect too much, and to expect something somewhat foreign to his avocation.

I think we should keep such a man to the work of investigation, experiment, and general advice on agricultural questions, and we should, as far as we possibly can, give him a free hand to pursue his proper work.

Mr. Middleton : I think that what Mr. Robertson has just said explains the Hon'ble Mr. Nolan's difficulty about salaried men and the making of scientific discoveries. Salaried men have to do what their employers ask them to, and when no good results follow their work, it is very often because of the multitudinous duties they are expected to perform. The experience of Germany—in fact, of all countries that have gone in for investigation—is that salaried men do make original discoveries when given time and opportunity to specialize in some particular branch.

The *Hon'ble Mr. Nolan* : I do not know whether it is worth my adding by way of explanation that I do not maintain that the receipt of a salary is a special disqualification for making inventions. I merely hold that it could not confer that power, which is rare, and, where it exists, manifests itself without a salary.

Mr. Muir-Mackenzie : I beg to instance the discovery by Dr. King of the manufacture of quinine as that of a highly salaried officer who effected a notable discovery.

The *Hon'ble Mr. Nolan* : Was he salaried to invent ?

The *President* : I have one or two remarks to make on what has been said. As to the suggestion about procedure, some procedure should be laid down for the Local Government making references to the Agricultural Chemist. The Government of India would be just as glad as any Provincial Government could be to see every province equipped with a staff of its own; and we have only made this beginning of having one man in two national centres because, so far as we have gone, we have been unable to get even one man, and it is not intended that the Agricultural Chemist or his Assistant should be Imperial in his functions so much as national in his functions, and it would be open to any Provincial Government which wishes to make use of his services to apply for them. Rules will be laid down to that effect. It is not intended that the operations of the Local Government in connection with the researches connected with Agricultural Chemistry should be controlled by the Imperial officer, or that they should not be able to utilize the services of the officer whom I prefer to call national and Imperial. This officer should be of equal relative service to all provinces. Rules will be laid down by which all officers as far as possible shall have an equal share in his services, so that I think that what the Hon'ble Mr. Nolan wishes will entirely fall in with the wishes of the Government of India and the Local Government on the subject. As regards the character of the chief officer whom it is proposed now to ask for, the position has been, of course, a good deal altered by the fact that two officers are proposed instead of one. The original proposal was initiated by the requirements in the first place of the Debra Forest School for a teacher of Agricultural Chemistry; in the second place, by the requirements of the Poona College for a similar officer. The Government of India said that if an officer is wanted at all, cannot we combine these two requirements and get a first class man instead of two

second class men? Now, we have come to the modification of the original proposal by asking for one first class man and one second class man. In that case the first class man can, of course, be relieved of educational duties, and be made available for other duties; and it will be open for us to expect from him further duties than were expected from the man whom we originally asked for, whose time would have been a great deal taken up by his educational duties. How far under these new conditions the chief man is to be a practical agriculturist, and how far he is to be a pure Agricultural Chemist, I think we had better leave open until our further discussions have taken place. But I quite agree with what has been said that in one respect we should insist on his being a first class Agricultural Chemist. I think there would be great danger of Provincial Governments resenting a proposal to make any one officer a Director of Agricultural Departments and Farms, and we want a highly scientific man who should be competent to be an adviser to Local Governments; but I think it is for this Conference to decide, as far as they can do so, on what points they wish this advice to be given. I think we should be able to determine that after our further discussions, and we will reopen it at a further stage of the Conference when we have discussed our experimental farms and our agricultural teaching. I will read the conditions for success, and assume that they are agreed to, unless any objections are taken to them. Dr. Voelcker writes as follows:—

“Time must be allowed, say five years at least, to see if the plan of having an Agricultural Chemist be a success.

“He must first acquaint himself by travel with the main conditions of Indian agriculture; in other words, he must at first be regarded as a *learner*. Each year a special district might be selected for close study.

“He must be given a thoroughly well-equipped laboratory in a suitable place.

“He should be given a competent Analytical Chemist as resident Laboratory Assistant—a man at a salary of say £800 a year. He must be an *investigator*, not a teacher. The two duties should be separate. The time of an expert investigator should not be taken up for months at a time in teaching Elementary Science at one fixed place when the investigation of some question or conduct of some experiment may require his presence in another part of the country.

“The question of teaching Agricultural Chemistry, whether at Poona or Dehra, could be met by the employment of the Assistant named above, who should, under the Chemical Adviser's guidance, take the classes and direct the study and laboratory work.

“It must be clearly understood that confidence must be rested in such a Chemical Adviser to do the utmost he can to justify the existence and continuance of such a post as he would occupy, and that no Department can lay down lines for the exact employment of his time. To attempt to regulate his work with a view to seeing that his time were fully employed, or that he “earned his salary,” would be to put an entire stop on his usefulness as an investigator. The appointment, if made, must be experimental, and time should be given to test its success. If successful, the system may be extended.

“At first such an adviser must be Imperial, not local. Only one such man should be appointed at first; if after trial the advantage of having such a man be shown, the system may be extended to the various provinces.

“Such a man should be paid a high salary—one sufficiently high to secure a first class man, and to ensure his being retained in the particular work undertaken, and not render him liable to drift into any other branch by reason of considerations of “pay.”

“Such a man should be entirely paid by Government; he should not be allowed to receive any emolument from private practice as an Analytical Chemist.

“At the same time there need be no reason why investigation should not be carried out by him for any industries, such as coffee, tea, indigo, &c., growing, provided these come to him through Government, and be undertaken at Government's request, and provided he have leisure for conducting them.”

The *President*: With reference to the first proposal, shall we specify any time?

The Conference were unanimous in thinking that five years was too short a time, and that it should be extended to seven years.

The following resolution was then adopted:—

Resolution I.—That the first appointment of an Agricultural Chemist should be made or seven years.

With reference to Dr. Voelcker's second suggestion, the Conference agreed to the following proposal:—

Resolution II.—That travel is, for the reasons given by Dr. Voelcker, an essential part of the duties of the Agricultural Chemist, but that it is premature to lay down now any conditions as to the selection of special districts for close study.

The *President*: In connection with the third paragraph, it is proposed that thoroughly equipped laboratories should be formed at Dehra and Poona.

The *Hon'ble Mr. Nolan* agreed that a well equipped laboratory was necessary, but could not see that two were needed, or that Dehra and Poona should be specified as the sites. These stations were somewhat out of the way of all business, and were particularly remote from Bengal. There might be reasons for selection, but he would prefer to leave these to the judgment of the Government of India, as they had no special relation to agriculture. He moved as an amendment that all specification of the site of the laboratory should be omitted.

Mr. Fuller: Is the proposal backed up by questions of economy?

The *President*: There is a small laboratory at Dehra, and it is arranged that under the new scheme it should afford training to Forest students, admitting native students to higher chances.

The *Hon'ble Mr. Benett*: It will be a school for candidates for Ranger and Sub-Assistant Conservators for the whole of India, and I believe students will come from Bengal and Burma. These men will provide 20 per cent. of the whole of the superior staff all over India. They will meet for three or four months in the autumn every year, and they will have a course of training in Forestry and Agricultural Chemistry.

The *President*: What Dr. Voelcker insists upon in his note is that this man should have a thoroughly equipped laboratory at his service at some suitable place. We require two thoroughly equipped laboratories in two places at present—Dehra and Poona. Calcutta may require one. We are willing (I speak on behalf of the Government of India) that there should be one at Dehra. Therefore the condition asked for by Dr. Voelcker as a condition of success is met.

Mr. Robertson objected to the retention of Dehra, but withdrew his objection on the *Hon'ble Mr. Benett* explaining that the educational functions of the officer in charge of the laboratory would be extremely useful, and that it is absolutely essential that there should be a laboratory at Dehra. By putting him at Dehra there would be the additional advantage of having him as lecturer at the Forest School.

Mr. Fuller put in the following amended resolution, which was finally adopted by the Conference:—

Resolution III.—That the Agricultural Chemist should be given a well equipped laboratory in a suitable place, and, looking to the desirability of utilizing the services of his Assistant for educational purposes, the Conference agrees that the laboratories should be at Dehra and Poona.

The following resolution, based on Dr. Voelcker's note, was also passed:—

Resolution IV.—That he should be given a competent Analytical Chemist as Assistant. That the Agricultural Chemist should not, but that the Assistant should, be employed in the actual work of teaching.

The *President* considered that in view of Sir James Caird's opinion that the salary offered by the Government of India (*viz.*, Rs. 1,000—1,250) being insufficient, the salary should be left to the decision of the Secretary of State.

Dr. Voelcker : I made some enquiries at home, and I find that any man of considerable knowledge in this branch of science is able to earn a large income by private analytical work. Both in Germany and in England he will obtain a large income.

Mr. Ozanne proposed that the resolution "that the salary of the Agricultural Chemist should be sufficient to secure the services of a competent man and the salary should be left to the Secretary of State" be accepted with the rider "that the Conference as advised is of opinion that a competent man cannot be obtained at a salary materially lower than Rs. 2,000."

The President, *Dr. Cooke*, and the Hon'ble *Mr. Nolan* were in favour of *Mr. Ozanne's* amendment. The Hon'ble *Mr. Benett* and Messrs. *Middleton*, *Robertson*, *Hallen*, *Thomson*, *Steedman*, and *Clogstoun* voted against it.

Mr. Thomson then proposed the following amendment :—

"That the Conference is of opinion that the initial salary should be over Rs. 1,000 rising to a maximum either of Rs. 1,500 or Rs. 2,000 in seven years."

Mr. Robertson proposed the following amendment :—

"That the Conference think that such a man could be obtained for Rs. 1,200—1,500, but are willing to go as far as Rs. 2,000, if necessary, to secure a thoroughly competent officer."

This resolution was withdrawn in favour of that eventually carried.

Mr. Fuller proposed that the original resolution be allowed to stand with the modification "a really first class officer" instead of "a competent officer."

The following resolution was then carried :—

Resolution V.—That the salary offered for the Agricultural Chemist should be sufficient to secure the services of a really first class man, and that the salary be left to Her Majesty's Secretary of State.

The following resolution was also passed :—

Resolution VI.—That the salary of the Assistant be Rs. 500 rising to Rs. 700 a month.

The Hon'ble *Mr. Benett* : As regards the question of fees, the Agricultural Chemist should not be precluded from taking private practice, but the extent to which he is to be allowed to take private practice ought to be under the control of Government. Government would decide what fees he should take, and how far he should be allowed to be consulted by private individuals. The practical needs of private individuals would be a very good indication of the direction which his investigations ought to take.

In the discussion which followed on this point, the Hon'ble *Mr. Nolan* and Messrs. *Fuller*, *Hallen*, *Thomson*, and *Steedman* agreed with the Hon'ble *Mr. Benett's* views. *Drs. Cooke* and *Voelcker* and Messrs. *Middleton*, *Robertson*, and *Clogstoun* disagreed.

The following resolution was then put to the vote, and carried :—

Resolution VII.—That the Agricultural Chemist should be debarred from taking fees under all circumstances.

The Hon'ble *Mr. Nolan* observed that *Dr. Voelcker's* note contemplated reply to references from Local Governments only on certain subjects, and provided the chemist was at leisure. This appeared by no means sufficient; indeed, no duty of the chemist would be so important as that of giving prompt and full reply to references from Local Governments which would embody the practical requirements of the country on broad questions.

He moved the following resolution, which was adopted :—

Resolution VIII.—It should be the duty of the Agricultural Chemist to give his advice on agricultural questions submitted to him by Local Governments.

The *President*: It is not necessary that we should take up each of these details. I do not know that it is necessary for us to discuss the work to be done at a laboratory.

It was then resolved:—

Resolution IX.—That the Conference express no opinion on the remaining suggestions in parts 'Conditions for success' and 'Laboratory' of Dr. Voelcker's note.

Proceedings of the Agricultural Conference.
Third Meeting, Wednesday, the 8th October 1890.

PRESENT.

<p>SIR E. C. BUCK, K.T., <i>Secretary to the Government of India, Revenue and Agricultural Department</i></p> <p>HON'BLE W. C. BENNETT, <i>Secretary to the Government of the North-Western Provinces and Oudh</i></p> <p>H. F. CLOGSTOUN, Esq., <i>Commissioner of Settlements and Agriculture, Madras.</i></p> <p>DR. T. COOKE, <i>Principal, College of Science, Poona.</i></p> <p>M. FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal.</i></p> <p>J. B. FULLER, Esq., <i>Commissioner of Settlements and Agriculture, Central Provinces</i></p> <p>T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i></p> <p>HON'BLE P. NOLAN, <i>Secretary to the Government of Bengal.</i></p> <p>E. C. OZANNE, Esq., <i>Director of Land Records and Agriculture, Bombay.</i></p> <p>F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab.</i></p> <p>E. B. STEEDMAN, Esq., <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab.</i></p> <p>R. G. THOMSON, Esq., <i>Offg. Revenue Secretary to the Government of the Punjab.</i></p> <p>DR. J. A. VOELCKER, <i>Consulting Chemist to the Royal Agricultural Society of England</i></p> <p>J. W. P. MUIR-MACKENZIE, Esq., <i>Under-Secretary to the Government of India, Revenue and Agricultural Department.</i></p>	<p>} President.</p> <p style="font-size: 2em;">}</p> <p>Members.</p>
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The proceedings were opened by Dr. Voelcker, who on the President's invitation read a paper regarding the principles upon which agricultural experimental stations should be established, and the operations upon them be conducted.

INVESTIGATION BY MEANS OF EXPERIMENTAL STATIONS OR OTHER SIMILAR AGENCY.

The following are the heads of Dr. Voelcker's address. Dr Voelcker did not wish it to be reported, as it would be embodied in his official report:—

- (1) The need of experimental stations or farms.
- (2) The supervision required.
- (3) Size of farm.
- (4) Situation of farm.
- (5) Experimental field
- (6) Situation of field.
- (7) Kinds of lands suitable for experimental farms.
- (8) Setting out the plan of experiment.
- (9) Size of plots.
- (10) Arrangement of plots.
- (11) Advisability, if there is an idea of continuing experiments for any length of time, to have duplicates of all experimental plots.
- (12) Selection of manures.

Mr J B Hallen did not attend this and the subsequent meeting.

- (13) Space for the extension of experiments.
- (14) Recording of abnormal occurrences or features in the cultivation.
- (15) Comparison of results.
- (16) Cost of manurial treatment.
- (17) Cost of cultivation.
- (18) Financial success of experimental farm not to be made the criterion.
- (19) Care in not starting fresh stations before existing ones have proved a success.
- (20) Need of direction and examination of results.
- (21) Necessity of patience and time to obtain results on any experimental stations.

The *President*: I will now ask the members of the Conference to make any remarks they would wish on the subjects contained under head 2 (b), Investigation by means of experimental stations or other similar agency, in the Conference programme. I think one of the most important points on which we want opinion is regarding the number and size of experimental stations, as it will be necessary to give some sort of idea what the cost of establishing a system of this kind would be. We want to know, for instance, whether the Madras Government scheme of five farms of 30 acres each is sound. The Madras farm schools will be educational institutions, and the farms, so far as they are institutions for enquiry, will be managed by the Director of Public Instruction. The question, I think, will be a suitable one for discussion as to how far it will be possible to set apart a sufficient area for experiments on the system which Dr. Voelcker has advocated, and which he will more formally advocate when his report comes to us finally. From the papers which have been before us, I understand that there are three classes of farms or three functions which they have to perform: one is education, another demonstration for agriculturists, and the third is experimental. One is to be used for school purposes, another in demonstrating results of experiments to agriculturists, and the third for purely experimental purposes.

Mr. Ozanne: Dr Voelcker has given us a general sketch as to the manner in which we should be guided in experiments, and I think his remarks have been followed by us with great interest, and will be of great benefit. I wish now first of all to say what the Bombay Government has recommended as regards experimental farms, and to show reasons why I personally think that the recommendation should be carried out. We have in the Bombay Presidency only one experimental farm at Bhadgaon. At Poona there is a farm intended to be an adjunct to the Agricultural College so that students may have practical instruction. In Sind there is another farm which is temporarily taken away from the Agricultural Department, because we had no means of supervision owing to the death of one of our Superintendents; but that farm we wish also to revive. But I will read first of all what the Committee appointed by the Bombay Government have sketched out as to their intentions. They write as follows in their report:—

“This brings us to the subject of agricultural improvement. Without anticipating the result of the deliberations of the Conference to be held at Simla in October, we may say that there appears need for establishing experimental farms in the Southern Mabratta Country and in Gujarat, and also, later on, in the Konkan. The principles which have been laid down—*viz*, that such farms should not be of large area; that the field of experiment should be as small as is compatible with the nature of the experiment; and that, the cost of pure experiment deducted, such farms should be made to pay their working expenses—are sufficient to prevent any extravagant expenditure. The necessity for more farms arises from the necessity of testing results obtained in one locality in other localities, for without this to recommend imitation would be dangerous. The expenditure will consist in the small initial outlay on the purchase of land if Government land is not available, and on the erection of a few farm buildings. And the recurrent expenditure will be only the cost of the Superintendent (say about Rs. 100 to Rs. 150 per mensem) and his clerical staff required to keep the strictest record of the cost of cultivation and outturn. The varying outturn of the staple crops of the Presidency cannot be said to be known with accuracy, and it is thus

highly desirable that the farms should afford the necessary information. While the farms are called on to pay expenses and to show a profit, except on the purely experimental area, it is only fair that the Superintendents should be allowed relaxations of the account rules as far as possible. No farmer can make his farm pay if he is not at liberty to turn his capital over as often as he can do so with profit."

Again they say:—

"To sum up our proposals for agricultural improvement—

- (1) The number of experimental farms should be increased.
- (2) They should be also cattle farms to breed plough cattle for the cultivators
- (3) They should be used for the purpose of growing pedigree seed for distribution.
- (4) As far as possible, they should be adapted to receive apprentices of the cultivating classes.
- (5) The Agricultural Department should have a liberal annual grant for the purchase and distribution of seed, whether locally or from abroad.
- (6) And a similar grant for the purchase of improved machinery and implements requisite under the present conditions of husbandry
- (7) On this farm and on others the improvement of sheep and goats should, when possible, be studied.
- (8) The farms on their non-experimental areas should, in the first instance, grow the staple crops of the locality in the best local method before attempting innovations. The objects should be to thoroughly understand local practices, to try modifications suggested by experience and the principles of scientific agriculture on the experimental area, to test the results of modifications, and, when they prove beneficial, to demonstrate them to the cultivators
- (9) The Agricultural Department should be enabled to encourage cattle and agricultural shows."

The sanction of the post of Superintendent of Farms for the Presidency, which has lately been accorded, will make it possible for the Director to undertake the duties which we have sketched out, and the recommendations of the Committee will at the same time enable him to provide overseers for the farms at a moderate rate of pay.

Then, summing up the reasons for farms and for the extension desired, Mr. Ozanne read the following extract from a representation made by the Poona Agricultural Association:—

"The farms should be not as they are at present, in which the cultivator has scarcely to learn anything, but model farms in the true sense of the word, in which the different operations, processes, raising, reaping, and thrashing of crops and rearing of useful plants should afford to the visitor ocular proofs of the superiority of the methods and the results, and should induce him strongly to try them on his own lands. Every facility and encouragement should be afforded to the agriculturists to visit these farms, and the improved methods of culture should be explained to them. Annual reports of these farms giving results of experiments should be published in vernacular and distributed for the information of the people, and copies may be given as prizes to the children of agriculturists in schools.

"We think the provincial farm should be under the management of a European well trained in the theory and practice of agriculture and horticulture and having Indian experience. He should have one or two native assistants under him educated in Indian agricultural schools, and preferably belonging to the agricultural classes. The zilla farms should be under the management of natives who shall have served as assistants for some time under the Superintendents of provincial farms, and certified to be qualified to have independent charge of zilla farms. We feel sure that by study, practice, and experience natives will in time be able to take charge of provincial farms."

Mr. Ozanne then went on to say this is a general scheme for Bombay, and it will be seen that our so-called experimental farms are, or in places will be, more than experimental farms: in some places partly cattle farms, and in all they would be seed distributing farms, and farms for the acclimatization of seed which has been proved on the experimental area to be wanted in the locality. Therefore I think that the minimum area which Dr. Voelcker has put at 25 acres will of course, as he says himself, have to be modified if other objects than pure experiment are taken up; 25 acres may be sufficient for purely experimental stations, but we have also to consider whether we can justify the necessary superintendence on so small

an area; and as we must have even for small experiments a plot of 25 acres, we must have a man thoroughly competent to supervise. It will be in my opinion very unwise to begin with such small areas as Dr. Voelcker contemplates. We should have 100-acre farms, confining of course experiments to a small area, but utilizing the other area for any purposes it may be best suited. Now, there is one point which I wish to notice, that is, that Dr. Voelcker seems to advise generally that we should not hurry about extending our experiments; that we should wait till the Agricultural Chemist, in consultation with the Director of Agriculture, has completed his enquiry to a further degree, and then put farms when enquiry shows that they are needed. Well, I agree so far as to the general principle. But as on these experimental stations the land will have to be equalized (this work of equalization will take two or three years at least) in beginning our extension now in order that we may have the farms ready for future experiment, I think that we shall not anticipate the advice of the chemist, but that we should prepare for experiments to be begun two or three years hence.

Dr. Voelcker explained that he was not in favour of waiting for the opinion of the Agricultural Chemist before experimental farms were started in the various provinces.

Mr. Ozanne: I will give the definite object in each particular locality. We have the Bhadgaon farm, as to which I need make no remarks. In the Southern Mahratta Country the definite object is to acclimatize American cotton and to test the results of the various cottons and to distribute seed in other parts of the country, because we have already found by experiment that, unless we acclimatize in the Southern Mahratta Country, we cannot use the seed anywhere else, and the proposed farm here would first be a seed farm. Next, as regards the Konkan. Since I have come out, I have been able to make certain experiments with the system of cultivating rice largely confined to Bombay, by which on the seed bed cowdung and other substances are burnt. It is the local system. The localities are very extensive on the whole, and the system is one which comes into direct competition with the Forest Department, and one which the latter very strongly object to. So far we have been able to come to the conclusion that the experiments that I made were sufficient to prove that the system is the best system for the cultivation of rice in certain localities, but it seems to me very essential that these experiments should be continued more carefully and repeated more carefully. They were then done in various areas something like the experiment which Dr. Voelcker mentioned yesterday, which was duplicated in five or six localities. The general result was satisfactory from my point of view. I think that *rab* cultivation, which is so extensive, requires most careful watching and examination on an area which would be purely experimental. That is one of the definite aims, because the trees which the Forest Department desires to conserve are the very ones most used for *rab*. That is one of the most important points. But also in the Konkan I have very strong reason to believe that ensilage may have a very valuable benefit to the country. The rainfall is good, and grass grows very rapidly. I think that by cutting early we may be able to get a double crop, and the first crop may be saved without greatly diminishing the yield of the second one. There are experiments which we can begin now without the help of the Agricultural Chemist. We will want his help later on, when we want to see if we cannot improve on the *rab* cultivation. In Gujarat the reason why I want a farm is that it is by far the most advanced portion of our Presidency, and, strange to say, we know very little about its ordinary cultivation and outturn. But there we also have another definite aim. This farm would be established in a locality where tobacco experiments have been going on for a long time, and very large sums have been spent by private individuals, and it is now time that Government should take up the point where private individuals left off. I have endeavoured here to justify the proposals submitted to the Government of India by the Bombay Government.

The President: Do you not consider that any larger number of purely experimental farms are needed?

Mr. Ozanne: We have already established in the Bombay Presidency agricultural classes attached to High Schools, and each of these little classes has an experimental area (it is educational). These I have not actually tried to abolish simply in the hope that in time we may be able to utilize these small areas as experimental stations in the manner Dr. Voelcker has described.

The President: Could you give us your opinion as to the relation of the Agricultural Chemist to these farms?

Mr. Ozanne: My hope is that he will be a man to whom I shall go for help in all difficulties, and that he will help me to carry out the work in a duly scientific manner.

Mr. Middleton: I have listened with interest to Dr. Voelcker's remarks, but I think that detail with regard to the carrying out of experiments should be deferred until we have decided something as to their nature. I have read Circular No. $\frac{149}{77}$ -A. containing a summary of the recommendations of the Statistical Conference which the President put in our hands last night, and in connection with what is contained therein, and also with reference to the subjects laid down on the Conference programme, I would like to say something.

Agricultural experiments may be (1) for the purpose of discovering fresh scientific truths or of testing the import to India of theories which seem to be of general extension, and (2) made with the object of ascertaining under special conditions the value of some process or crop or manure successful elsewhere. Experiments of the first class deal with such questions as the causes which influence the flavour of tobacco, or the quality of the juice of sugarcane, or the powers of our agricultural plants to assimilate nitrogen and mineral matter. Some such experiments may be undertaken by our Agricultural Chemist at an early date, but for a time India must be content to leave most investigations of this class alone. The expense, the want of a high order of agricultural intelligence to co-operate with the chemist, the probability of better and more paying results where others have led the way may be given as reasons. Experiments of the second class, imitating those of other workers who have been successful, should form the chief part of our programme on Government farms at present.

As our experiments will chiefly be of a commercial nature, cost should be a point for first consideration in planning methods. Obviously, if the prime cost of the improvement is to be considerable, as where manures or better seeds have to be bought, the results must not be microscopic; and, in the first instance, no great expense need be incurred in weighing, &c. A rough preliminary experiment ought to be made, and the Farm Superintendent should judge from it whether or not a detailed experiment should be conducted.

The publication of the results—It must be confessed that the mere statistics of experiments are very unsatisfactory, and may be misleading to persons unacquainted with local conditions. They are of most value to, and can only be interpreted fully by, the men who make them. For this reason I think that we should ask and expect the men in charge of Government experimental farms to give us the lessons of the experiments they make rather than columns of figures.

From the opportunities his position gives him, the Superintendent of a farm should have a wide experience and an exact knowledge of detail. This being so, his general education and attainments ought to be sufficient to enable him to co-operate with the Agricultural Chemist in the drawing up of reports and the framing of schemes of experiment. We have in India at present no class corresponding to the educated British farmer, but we hope that ere long the Superintendents of farms may be their representatives, for without an intelligent and educated farmer class, the labours of the chemist must be comparatively valueless.

Whilst I approve of Mr. Ozanne's proposal to establish several farms in the Bombay Presidency, I think the salary he names too low to secure the kind of men we require as managers.

I cannot admit that the energies of a man drawing higher pay would be wasted on a 100 to 200-acre farm, because we should not look upon the Superintendents merely as men who have to manage our farms—though this, of course, they will do,—but rather on our farms as stations on which to educate agricultural experts. The knowledge we want in these experts will be better gained by the close study of one small farm than by the rapid survey of larger districts; for in agriculture it is the man who has a complete knowledge of one place—not he who knows the district generally,—whose opinion is of practical value.

In Britain few men who farm more than 2,000 acres of arable land are commercially successful, or are noted for their skill in any particular branch of agriculture. The very best farmers are found amongst those who, though possessing the capacity and capital of men cultivating larger areas, confine themselves to a few hundred acres of land. This I think points very plainly to the conclusion that farm and farmer are alike benefited by attempting little, and by doing that little well. At the same time I think it would be a pity to limit the Government farms to the 25 acres Dr. Voelcker says would be enough for experimental purposes.

The Superintendent could manage 100 acres more without loss to Government and with profit to himself and to the cause of agricultural enquiry, for the whole farm would be to him experimental in the same sense as his holding is to our best type of British farmer.

To limit the farm to 25 acres would take away opportunities for the getting of experience which the Superintendent might otherwise enjoy.

If we employ inferior men on a low salary to manage farms, they may conduct experiments carefully and submit accurate figures giving the results; but these figures must be analysed and the conclusions drawn up by others. Instead, I should prefer to have highly qualified Superintendents, so placed that they themselves might learn as much as possible—men whose practical knowledge of agriculture could be relied on by Government, and who would not only carry out experiments, but, in conjunction with the Agricultural Chemist, would record the lessons of the past and indicate lines of action for the future.

Dr. Cooke had no remarks to offer.

Mr. Robertson: I should not have had much to say on this subject, as we have no experimental farms in the Punjab, had it not been for the note at the end of the Conference programme which runs:—“Local Governments have been asked to send their delegates provided with a definite scheme for agricultural experiments for discussion at the Conference.” I have received no such instructions from my own Government, and I hold no commission to represent that Government, but under the circumstances I wish to make a few remarks.

It may be assumed that experimental farms should by their results justify the expenditure upon them. In one of the last despatches from the Secretary of State, it is distinctly laid down that any large expenditure on agricultural experiments is not to be incurred in the future. When such farms are already established the case is different, but it seems to me that in reference to places where they have not yet been in existence, we are a little putting the “cart before the horse.” We have just decided that it is desirable to have an Agricultural Chemist in this country, one of whose principal functions will be to advise on the general arrangements and management of such experimental farms, their size, and the manner in which experiments should be started and conducted on them. This being so, I think that where no farms now exist, it would be best to wait for the advice of this expert before incurring expenditure on the establishment of an experimental farm.

Subject to all correction, I am bound to confess that from all I can learn I do not think that the actual practical results of the experimental farms which have been tried in various provinces have as yet been at all commensurate with the expense incurred. This is, I think, the experience of the past: let us hope the experience of the future will be different. There is to my mind a very

suspicious sound about such an expression as "the farm must be large enough to justify the salary of the Superintendent," and it is a curious remark to make that a farm has paid its expenses when the whole cost of the Superintendent's salary, perhaps the chief item of expenditure, is excluded from the calculation. But I lay little stress on this, because I think experimental farms cannot be expected to "pay" in the ordinary commercial sense.

One great difficulty, especially true of the Punjab, is that the results which may be arrived at on an experimental farm, and which may be perfectly sound for that farm and its immediate neighbourhood, are utterly valueless for totally dissimilar tracts of country 50 or 100 miles away. If our experiments, therefore, are to benefit the Province generally, we must very much extend our operations. I think a number of rough experiments made in various parts at the same time through zamindars and district officials are likely to be useful as indicating the lines upon which more careful and scientific experiments might be made. I think too that heretofore a good deal has been attempted in the direction of high scientific experiment without the necessary knowledge and experience. Speaking for myself only, I would like to have the advice of the agricultural expert before submitting any scheme for experimental farms to my own Government for the Punjab. I think myself that we ought to do something in that direction, but not in the way of large and expensive experimental farms. Several small experimental stations would probably be more useful. Cattle-breeding is a totally different matter, and should not, I think, be attempted on an experimental farm, but, if attempted at all, should be an entirely separate undertaking. Thus, while agreeing that we should do something in the direction of agricultural experiment, I think we should pause till we have further advice before embarking on increased expenditure. Those provinces which already possess experimental farms will no doubt continue to make good use of them, but we should not be in too great haste to establish new ones, and, when we do so, we should be very careful that we are doing so on the right lines.

The *Hon'ble Mr. Nolan* desired to pass over the first four points specified in the programme under heading B as forming matter more suitable for comment by Mr. Finucane, observing only that he hoped centralized control would be confined to the scientific experiments tried at the farms, leaving Local Governments and Directors a free hand in regard to demonstration and tuition. The sixth topic, "Measures for widely disseminating knowledge acquired at farms," might, he thought, be extended to include useful information acquired in other ways. The farms had justified the moderate expenditure incurred on them, but progress had come mainly from the people themselves—that is, from the ablest of those engaged in practical agriculture. The most useful work of the Department consisted in extending to the more backward districts methods already proved profitable in the more advanced, as the cultivation of jute, the use of the Beheea and other sugar mills. Experiments by private individuals had been spoken of with scant respect, but after all this had been the source of all improvement in the past. Every effort should be made to publish the results obtained on the more prosperous farms or plantations, with which object agricultural exhibitions were to be encouraged. In regard to greater liberality in grants for special expenditure, much depended on the provisions made in the Provincial contracts which would come under revision in the ensuing year. The difficulty lay not in devising projects for increased expenditure, but in getting the money. In Bengal at least there were no funds at present available for the purpose; even popular education, which might be regarded as one of the necessities as distinguished from the luxuries of administration, had to be restricted for want of funds.

The *Hon'ble Mr. Bennett*: I regret to say that I have not been favoured by my Government with any instructions on the subject.

Mr. Fuller said that experimental farms were, of course, not the only means of effecting improvements in agriculture, but that they were certainly one of the means for this purpose, and a reasonable expenditure of money on their maintenance was justified. It might be that hitherto not many positive results had been obtained. But the experiments had often been of the very greatest use

in proving a negative. Government has constantly been urged by theorists to embark on some project of improvement which careful experiment had shown to be unsound, and by doing so had saved the Government from wasting large sums of money. Then there was another consideration which made a farm an almost indispensable adjunct to an Agricultural Department. It was admitted that careful enquiry into existing processes must precede the suggestion of improvement. Now in his opinion the maintenance of a farm was necessary to such enquiry, as without it the officials of Government would never obtain a sufficiently practical acquaintance with the agriculture of the country to enable them to sift the information they acquired, or indeed even to acquire information. It was exceedingly difficult to extract information from native agriculturists unless the enquirer started with some practical knowledge regarding the subject of his enquiry. Information had to be collected in shreds, and the shreds then pieced together. In enabling a man to collate information gained from different quarters, the practical lessons which a farm afforded were of very great advantage. Mr. Fuller agreed with Mr. Ozanne in thinking that from this point of view it was inadvisable to restrict the size of farms to a very small area. He quite agreed with Mr. Middleton as to the absolute necessity for really good supervision. He understood from Mr. Middleton that it was as difficult in England to get a really competent Farm Superintendent as it was to find a native qualified for the post out here. Government could never expect to get really competent Superintendents for a number of farms, and this made the appointment of an Agricultural Adviser a necessity, if farm operations were to be conducted with uniform efficiency. Such an official could visit farms each year, examine the scheme of experiments and the method in which they were conducted, and give advice which would be of immense assistance. Again, the appointment of an Agricultural Adviser would secure the proper criterion of experimental results. There had been very little effective criterion in the past, and experiments had suffered from its absence. Experimental farms might often be usefully made use of for educational purposes. This was the case with the Nagpur farm, and afforded an additional justification for its existence.

Mr. Thomson: As Mr. Robertson has called attention to the Note II-B. in the programme, and as the Hon'ble Mr. Benett has also noticed the absence of instructions from his Government, I think it advisable to recall attention to the fact that the officers from the Punjab here represent no one but themselves, and that they are in no way delegates of their Government. I do not think that the results of experiments at farms or stations will be of any practical use unless they are capable of application to the general cultivation of the country. To make attempts with manures which the ordinary farmer cannot procure, or with implements which he cannot purchase, is labour and time thrown away. Similarly, experiments on small plots differentiated by numerous special conditions are clearly of such limited application, and require so much intelligent explanation before they can be applied at all, that their usefulness is evidently very small. They are at best indications for further experiments, and not in themselves positive results. We can never argue from results on small plots of special character, and under special conditions, to the general promise on ordinary village fields. The only useful practical results we can hope for therefore are results from large farms under ordinary zamindari conditions. Such results on a really useful scale we are not likely to get, and I therefore think that we should restrict our Government attempts to purely scientific experiments, such as the introduction and acclimatization of new staples on small plots or experimental gardens. For general agricultural improvement, I think we should trust to the people themselves, at any rate for the present. The difference between different villages in agricultural knowledge and practice is often enormous, even in the case of villages in near proximity to one another. These differences are certainly much greater than between our experimental farms and good zamindari villages. I therefore think that we should attempt to use the good villages as schoolmasters for the bad. Here we secure identity of circumstance under absolutely practical conditions, and we are more likely to achieve useful results than in any other way. I do not, however, expect much even from these methods, and I demur altogether to large expenditure on Government farms or experimental stations.

Mr. Steedman : The question before us is investigation by means of experimental stations or other similar agency. The discussion was commenced by Dr. Voelcker laying down the general principles for the conduct of investigations. I am not able to give an opinion of much value on the points noted by Dr. Voelcker. The question is one for experts. But I hardly think it is within the province of the Conference to discuss the general and detailed principles laid down. No doubt they will be extremely useful to officers in charge of farms or to the Director starting the experiments.

I think that in discussing this question, we have to look back to past experience, and I notice the Madras Government in the Resolution they have recorded on the Agricultural Committee's report write as follows :—

"It will be seen from the foregoing summary of the Committee's investigations that the amount of real good secured by all the efforts of the past has been infinitesimal, and that the greater part of the money which has been spent on agricultural improvement and education has been wasted. With the best intentions on the part of various Governments, all endeavours to advance practical agriculture have failed, and the only result of the operations of the Department has been the awakening of an interest which possibly might have sprung up independently."

Again, *Mr. Fuller* in his note on Agricultural Improvement says :—

"Successful experiments have been made with a number of novelties, such as ensilage ; but the only practical result which the farm can claim in this direction is the acclimatization and introduction of a new variety of cotton which has found some favour with cultivators in the Wardha District.

"The farm has been of use in adding to our knowledge of the produce of the land, and now fulfils a most useful educational purpose as a practical training ground for the students of the agricultural class."

As Director of Agriculture in the Punjab, I studied reports on the Cawnpore farm and others, and I must say that what struck me in respect to experiments was that there was a want of practical object about them. I think that all experiments should have a direct practical object, and that our efforts should be restricted to experiments the results of which, if successful, are likely to come within the reach of the average ryot of the particular province. For instance, what is the good, as Dr. Voelcker pointed out, of conducting elaborate investigations with reference to the use of shoddy ? The Hon'ble Mr. Nolan has said that there will be no serious improvement except such as comes from the people. I do not think in the Punjab, where we have such a large number of small peasant proprietors, we are likely to get any direct improvement from them. I think the people to whom we are to look are the larger landowners.

Mr. Clogston : The Madras Government proposes at once to have five small farms attached to five agricultural schools to be opened at the headquarters of five of the principal districts. In these farms the different processes of agriculture will be taught to the students, but they will also be utilized for purposes of experimental cultivation, and, where processes are successful, they will be used as farms of demonstration. They will also be of very great assistance to us in enquiring into native systems of cultivation. Our proposal is to have 30 acres of land round each farm, and to cultivate the crops which the ryots themselves cultivate ; ryots will be hired themselves to cultivate, and we will try our improvements side by side on the staple crops of the district. The experiments which we propose to try immediately, and the improvements in processes of culture which can be at once demonstrated, may be seen from paragraph 34, page 8, of the Madras Agricultural Committee's Report. I have already referred to them once or twice. They are as follows :—

"(1) The results of shallow tillage, especially in years of drought, and the prophylactic effects of deep tillage ; (2) the thorough tillage rendered possible with a moderate rainfall by reason of the rapidity in action of improved ploughs ; (3) the crop results, especially in years of poor rainfall, from the power to utilize scanty rain to the best advantage by the rapidity of the improved ploughs ; (4) the use of the country seed-drill as effecting a probable saving in seed, and permitting economical after-cultivation ; (5) the possibility and effects of cheap green-manuring upon dry soils deficient in humus ; (6) the proper management of customary manures, the use of neglected manures, and the possibility of growing cheaply green-manure for wet lands ; (7) the results of new seed ; (8) the causes of low produce, and the proper

methods in the cultivation of cotton, cereals, and general produce; (9) ensilage; (10) the better manipulation of wet lands, especially in the matter of the subsoil and use of water; (11) the ploughing of land immediately after harvest, whether on wet or dry lands, to enable the growth of a catch-crop or a thorough fallow, (12) the better management of cattle in health and disease, including the growth of fodder crops, hedges, trees, and shrubs. The possibility of improvement in these practices is indicated both in the extract from Mr. Benson's reply to the Famine Commission contained in paragraph 87 of Appendix C and in his examination before this Committee on the 26th March (Appendix J, pages 262 and 263 *vis à vis* of the Agricultural Committee's Report)."

There do not seem to be any of these experiments which Madras is not able to carry on without the aid of the Imperial officer, and the proposal to require the sanction of the Imperial officer to the conduct of such experiments seems unnecessary. We have got Mr. Benson, who is a graduated Assistant, and who has been at the Saidapet farm for the last 12 or 15 years. The failure of the Saidapet farm has been alluded to, and Dr. Voelcker argues from it that it is unwise to extend experimental farms. But Saidapet was situated in a "hole and corner" of the district; and, as Dr. Voelcker has admitted, it was composed of infamous soil on which nothing would grow, and, if anything did grow, we were not in a position to show it to the ryots. Where we should want the aid of the Agricultural Chemist, the Imperial officer referred to above, is particularly shown in the letter of Mr. Gill* regarding the cultivation of sugarcane. He has made a large number of experiments to test the yield of sugar (he is Manager of one of the great sugar factories), and he finds that they vary very much indeed; and he also points out that if we do not take measures to improve the sugar cultivation and introduce the canes which give the best sugar, the cultivation of sugar in India will be driven out by the importation of German-grown sugar. The Agricultural Chemist might very usefully be utilized in making experiments as to the yield of sugar and sugarcane, and even that single experiment would, in my opinion, justify the appointment of an officer. In further justification of small farms of 30 acres each, I would refer to Mr. Benson's opinion, which is given at page 254 of the Agricultural Committee's report. As regards superintendence, he suggests that each of the five farms be headed by a man who has been educated for two years at the Saidapet College, and then, in reply to an enquiry of the Committee, he says:—

"If the farms were my own private property, I would be content to start them under the above Superintendents if under due supervision."

The cost of working would be Rs 10 per acre per farm. There is nothing on the ground of expense to prevent these five farms being established. I think the proposal of the Madras Government to start these farms at once is a very suitable one. There is one other experiment I would like to refer to. As Commissioner of Settlement, I am just now reassessing the Tanjore District. It is very rich, and grows nothing but rice. We propose to increase the assessment by about 15 lakhs; but if the lands yield as they ought to, and as the lands in the neighbouring district do, we ought to get another 15 lakhs. We are losing 15 lakhs a year, and the ryots are losing an equal amount. In manure and cattle it is exceedingly poor, and we propose to try an experiment in the way of growing a green crop and ploughing it in. The superiority of the land in the neighbouring districts is due mainly to the fact that they manure with the leaves of the wild indigo.

Mr. Finucane: I agree with what the Hon'ble Mr. Nolan has said that the extension of experimental stations is entirely a matter of money. There is no difficulty in indicating ways in which improvement and investigation can be made, but it is entirely a question where we are to get the means to make that investigation? I read the following extract from my report to the Bengal Government on agricultural enquiry and improvement:—

"It appears to me that the direct action of Government in the introduction of changes in the agricultural practices of a country like India cannot at best have any great effect for many years to come unless and until Government is prepared to expend very much larger amounts on this branch of administration than it is at all likely to spend, or perhaps than it would be justified in expending, in the permanently-settled districts of Bengal. It has been already stated that where primary education is spreading and intelligence is awakened by communication with the outside world, and reasonable security of tenure prevails, there

* *Vis à vis* Government of India Circular to Local Governments, No 21-A., dated 29th July 1890.

cultivators do not want only to waste the manurial resources at their disposal, and are even resorting to artificial manures. Where, on the other hand, as in Behar and Chota Nagpur, the body of the cultivators are ignorant and the tenure of land is insecure, there cultivation is backward, and attempts to introduce improvements are, and will be, futile. The cause of this poverty and backwardness in the latter instances appears to me to lie more in the ignorance of the cultivators and in the apathy entailed by insecurity of tenure than in the number of the population pressing on the resources of the soil. For this reason, I am of opinion that it is of cardinal importance in connection with the question of improvement of the agricultural practices of the country that primary education should be spread, and that reasonable security of tenure should be guaranteed. But while thinking that spread of education and security of tenure will ultimately have more effect on improvement of agriculture than any direct efforts of Government by way of encouragement of improved practices shown in experimental farms to be beneficial, or by fairs, agricultural shows, or the like, I am at the same time of opinion that much may also be usefully done at a moderate cost in the latter directions.

"It is obvious that without some sort of agency possessed of an agricultural education and training, it is impossible for an Agricultural Department to effect any substantial agricultural improvement, and it seems equally obvious that, given such educated and trained agency, it will be impossible for Government to reach the masses of the agricultural community in the matter of agricultural improvement unless the sympathies are enlisted of those who are looked to by the cultivating classes as their natural leaders. Bengal at present stands almost alone in being absolutely without the means of imparting agricultural education and training of any kind, either to the servants of Government who may be employed in the agricultural Department and in the management of estates, or to the sons and agents of zamindars and cultivators who may be desirous of such training and education. It appears to me to be eminently desirable that the means of imparting such education should be provided, for there is no part of India in which there is more likelihood of such education and training being appreciated, and subsequently taken advantage of. Bengalis have surpassed the inhabitants of other provinces in other walks of life, as pleaders, doctors, engineers, and there is no reason to suppose that they would not take advantage of opportunities to acquire and make use of a knowledge of agriculture, and of the sciences connected with it, if such opportunities were placed in their way. Those who maintain that agricultural education is useless, and that the ryots' practice admits of no improvement, are consistent in refusing the means of an agricultural education; for if such education leads to no useful results, then the Bengali will not be slow to find this out, but for those who believe that existing practices are susceptible of improvement with profit, it is difficult to overrate the importance of imparting to the better-to-do classes connected with land an agricultural and practical education which will divert their minds from chimerical literary and political pursuits, and give them important practical subjects on their own estates, on which they may interest themselves. Proposals have already been made for the establishment of an Agricultural College or School at Seepore at a moderate cost. I would take this opportunity of renewing and inviting attention to that proposal.

"The proposals made for imparting education of a high character to Bengalis and others at Dehra do not affect the necessity of having an agricultural school at Seepore, for the education at Dehra cannot be agricultural, and, even if it were, I do not think that Bengalis will go there. Attached to the agricultural school at Seepore it is necessary that there should be an experimental station, where well-devised experiments may be carried on with scientific accuracy, and a demonstration farm in which the students may take a part in the actual work of farm operations.

"In addition to the higher class of agricultural education provided in the proposed College, elementary instruction may be given in primary schools. An Agricultural Primer has lately been adopted as a text-book in these schools.

"Over and above the Agricultural College, and the experiments conducted in the station attached to it, experiments should be conducted under skilled supervision in the various parts of the country of which the soil and climate and systems of cultivation are broadly and distinctly different from those prevailing in Calcutta and its neighbourhood. The requisite for the proper conduct of these experiments are:—

- 1st—The sites of the experimental station should be so selected that they may be typical of as large areas as possible.
- 2nd—The soil of the various plots on which experiments are made at each experimental station should be uniform.
- 3rd—The experiments should be devised with a definite object after enquiry into the system of agriculture practised in the locality, and they should be made with a view to the introduction of definite and practical improvements if the experiments show profitable results.
- 4th—They should be carried on continuously for a number of years on the same plots.
- 5th—The soil should be analysed.

"With the establishment at present available, I do not think it desirable to open any new experimental stations. The three small stations already established are quite as much as can be

supervised by the agency now employed; but if funds were available, and this agency were strengthened, it would, in my opinion, be desirable to establish additional experimental stations in Eastern Bengal, Orissa, and Chota Nagpur. Provision should be made for the permanent retention in the Agricultural Department of the officers engaged in the supervision of experiments, and their number should be increased."

Mr. Finucane continued: I am strongly of opinion that greater liberality is requisite in grants in Bengal mainly for agricultural education leading up to a University degree, and also for the moderate extension of experimental stations; and that these stations should in Bengal be supervised by the Cirencester graduates, whom I have found to be most practical supervisors. But it is absolutely necessary that some arrangement should be made under which these graduates are to be permanently retained in the Department. The Agricultural Chemist or Adviser would, as a matter of course, be most useful in criticising, directing, and advising on the experiments conducted under the immediate supervision of the Cirencester graduates.

The Hon'ble Mr. Bennett: In my opinion the Cawnpore farm has been in many ways a very useful institution to Government, and there is not, as far as I know, any intention of closing it or modifying its constitution. For one thing it has been useful in providing a cheap method of demonstrating the utility of various agricultural processes to outsiders. The farm has also provided an admirable basis for conducting all sorts of experiments. The only question is whether they can be done cheaply enough to repay cost. Another useful thing we have done is in the collection and distribution of great quantities of seed. I have no doubt that the agriculture of the Province has improved by the varieties of seed which it has sent broadcast all over the Province. The seeds are paid for by agriculturists, and cost nothing to Government. The farmers have to find out what the best sorts are, and give them notoriety. There is no doubt that the farm has been useful for creating an interest in agricultural improvements. We have a society of three or four hundred members, all men of intelligence and good position. They collect in large numbers, and are always paying visits to the farm and watch the experiments with interest. It is advantageous even to create the idea that experiments can be made and improvements are possible. For all these reasons, I think that the Cawnpore farm has done very good work indeed. It certainly, however, has failed in the matter of continuity of experiments. These experiments promised well under the direction of Mr. Fuller; and if he had remained there, the results would no doubt have been as good as at the beginning. Since then there have been all sorts of people, each with different ideas; and experiments, I am afraid, are not of very much use now. But if we had an Agricultural Chemist, his services would be invaluable in giving continuity to these experiments by reviewing the Director's report on the experiments in the farm. He would compel the Director to keep to one line. He would visit the farm too, and give him guidance in that way. I think the farm hardly can be of much use as an experimental station unless it has a thoroughly good practical Agricultural Chemist to give a direction and consistency to experiments which are carried on. This is absolutely essential. Another use is in connection with education. My idea of agricultural education is that the only way by which you can get people to take it up in any numbers is by attaching it to the University Course. I hope we may get a large sum of money from private contributions to establish an agricultural branch in Science which will lead up to the B. A.; and perhaps to get out a professor or two—one to be attached to the Muir College. This man will teach the agricultural classes. But they will want a practical farm to give point to their instructions. The farm at Cawnpore may be made extremely useful as auxiliary to the instruction given at the University; and, if it is too far off, it would probably be possible to start small demonstration areas wherever a College may be—say, one at Lucknow and another at Allahabad. The Cawnpore one may be used in that way; students might be sent there. I think a great deal is to be said for keeping up the farm, and at the same time I think that, from an experimental point of view, it is not likely to be of any real service unless we have the services of a good Agricultural Chemist.

The President: I have a few remarks to make on what has been said to-day. I wish to explain that in taking up this section (B-II) on the system

of experimental farms, we are practically dealing with Dr. Voelcker's suggestions on the subject, which suggestions he has made in accordance with the desire of the Secretary of State that he should visit India in order to advise the Government of India upon the best course to be adopted for the teaching of Agricultural Chemistry and for effecting improvements in Indian agriculture. I think that I agree with Mr. Steedman that it is premature for us at present to attempt to lay down or to accept any final system or programme for the conduct and method of experimental farms; but I think that sufficient has been said to show that there are many points on which the members of the Conference are in agreement, and therefore that these points of agreement should be formally put forward and expressed. Also it is very important that the Conference should declare as positively as possible their opinion as to the utility of an Agricultural Chemist in connection with whatever system is finally adopted for experimental farms. There is no doubt that each province should be, as they must be, allowed a considerable latitude in their own provincial arrangements; but there are certain general principles which it would be as well that all should commonly adopt in carrying out these provincial experiments, and it is in introducing and maintaining the application of these general principles that I think an Agricultural Chemist is so much wanted, and I understood that to be the feeling of the Conference from the various statements made to-day.

I am, as you have all expressed yourselves to be, very much obliged to Dr. Voelcker for explaining at such length what his opinion is as to the system of experimental stations which should be adopted. We have now further to consider the scientific section of the work (*ie*, purely scientific) and the corollary, demonstration farms. I think that I should review what Dr. Voelcker has said with reference to the headings given under II-B of the programme. We can only say that the general opinion is that there should be a certain number of experimental stations in each province. That has been practically accepted in some provinces by the establishment of such stations, and we are not prepared to lay down any definite rules as to size and number. As to the system of management and control, I think we are all agreed with Dr. Voelcker that they must be controlled by competent experts; also that the work controlled by these competent experts should be further regulated and supervised by the visits of the central officer, and that the objects to which the experiments should be restricted should be regulated also under his advice. It is unnecessary for us to state now what these objects should be. The use of farms for seed growing agencies may be left as outside the present subject of discussion.

Measures for securing continuity.—This, I think, the most important of all. I agree with what the Hon'ble Mr. Benett said on that point that many useful experiments were begun at the Cawnpore farm, and they would have been continued, I am convinced, if the system adopted on that farm, and the reports sent in from that farm, had been brought under the supervision and direction of some central official. He would have brought to the notice of the Local Government on what points and in what directions experiments that had been begun were likely to fail from want of continuity, and his reports would; I am convinced, have had great effect in securing the desired continuity. There is another point, I think, on which we much want the criticism of some first class competent referee. That function can only be fulfilled by an officer of the kind for whom we have asked the Secretary of State. Another very important function which this officer would have to perform would be to assist in disseminating knowledge not only acquired in science, but existing in one province, which does not exist in another. I am glad to find several officers have given evidence on this point. Mr. Ozanne has told us that he has got cotton seed most likely to be useful in some Bombay districts from Berar. It is an accident Mr. Ozanne's visiting Berar, as it is not the function of an officer to travel in another province. Now the officer whom we now desire to obtain will obtain in one province all information regarding the system of the agriculture of the country and the experiments being tried, and it will be a natural function of his to carry from one province to another the last results of successful experiments. Mr. Finucane gave us an example of a practice which exists in one part, and which may be applied

to another, but which for want of carrying agency was not done. In connection with his functions as disseminator of knowledge, we ought also to expect from an agricultural adviser some general publication in which the public as well as Government officials and the Agricultural Departments would receive information of all that may be useful in connection with the information that he has received during his tours and from reports that he reviews, and in connection with the encouragement and utilization of experiments of private individuals. I think there is no doubt that during his tours an officer such as we contemplate would by degrees acquire the confidence of the farmers and private experimenters, if you can call them so, in the various provinces with whom he will confer, and to whom he will give very valuable advice, as well as to Government officials. These are points, I think, in reviewing the headings under this section, in which it is patent from the evidence received to-day and from what has been said that the Agricultural Chemist is, if we are to undertake any attempt to improve agriculture at all, a necessity. The primary function of this officer in connection with experimental stations will be to establish, in communication with Provincial Governments and Provincial Departments, the system, or so much of the system as Dr. Voelcker may put forward, as that which he considers as primarily suitable to the country. Dr. Voelcker's proposals, so far as the purely scientific sections of the farms are concerned, do not appear to me to be prominently at variance with the general views expressed by any officer here present; but, so far as they may be so, those minor points of difference would be settled in the course of communication with the officer who comes to the country, and a satisfactory scheme could be arranged in accordance with the rules and orders of the respective Governments and with the wishes of the provincial officers. The point which, I think, we want to lay stress on in bringing forward our application for an Agricultural Chemist and his Assistant is that experimental farms of a scientific character, and requiring scientific supervision, are a necessary adjunct to the education of the people in agriculture. Mr. Finucane, I think, made some remarks on the subject of education in connection with experimental farms, saying that experimental farms would be of no use until the people were educated, or rather that education was the chief necessity in aiming at agricultural improvement; and I understand Mr. Finucane to say that education is to be our primary aim in agricultural improvement, and experimental farms occupy a subordinate place to the primary end of education. As I said in my opening remarks, we must educate the people to effect their own improvements, but at the same time we should establish a system of experimental farms side by side with their education, so that as they become educated they might have some sort of results to look to which they could at once apply; and in connection with those remarks, I think the Hon'ble Mr. Benett has confirmed that view of the subject in saying that the experimental farm which was established for some years in Cawnpore has had a very decided and marked effect in inducing interest in experimental work. I may assume that the Conference consider unanimously that experimental stations, the method of management and control of which may be settled hereafter, are, if we are to undertake agricultural improvement at all, a necessity, and that, if such experimental stations are established, it is equally necessary that there should be some officer competent to perform those functions which I have enumerated. As I have said in my present address, in the first place we must have experimental stations, and, in the second place, that if these experimental stations are to fulfil the objects for which they are established, we must have superior supervision. These are the results which I draw from what has been said to-day, and I would ask whether the Conference think it desirable to frame any resolutions to that effect, or whether it will be sufficient that what has been said be put on record.

The Conference then passed the following resolution:—

“That if any attempt is to be made by Government to further agricultural improvement, it is highly desirable to maintain in each province a system of farms for enquiry and experiment; and that for the proper conduct of them, for securing continuity of enquiry, and for communicating information to officials and the public, the services of a competent adviser of the character recommended at the meeting of this Conference on the 7th instant is indispensable.

Proceedings of the Agricultural Conference.

Fourth Meeting, Thursday, the 9th October 1890.

PRESENT.

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| SIR E. C. BUCK, Kt., <i>Secretary to the Government of India, Revenue and Agricultural Department.</i> | } President. |
| HON'BLE W. C. BENNETT, <i>Secretary to the Government of the North-Western Provinces and Oudh.</i> | |
| H. F. CLOGSTON, Esq., <i>Commissioner of Settlements and Agriculture, Madras.</i> | } Members. |
| DR. T COOKE, <i>Principal, College of Science, Poona.</i> | |
| M FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal</i> | |
| J. B. FULLER, Esq., <i>Commissioner of Settlements and Agriculture, Central Provinces.</i> | |
| T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i> | |
| HON'BLE P. NOLAN, <i>Secretary to the Government of Bengal</i> | |
| E. C. OZANNE, Esq., <i>Director of Land Records and Agriculture, Bombay.</i> | |
| F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab.</i> | |
| E. B. STEEDMAN, Esq., <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab.</i> | |
| R. G. THOMSON, Esq., <i>Officiating Revenue Secretary to the Government of the Punjab.</i> | |
| DR. J. A. VOELCKER, <i>Consulting Chemist to the Royal Agricultural Society of England.</i> | |
| J. W. P. MUIR-MACKENZIE, Esq., <i>Under-Secretary to the Government of India, Revenue and Agricultural Department.</i> | |

AGRICULTURAL EDUCATION.

The President opened the meeting with the following remarks :—

GENTLEMEN,—In opening to-day's meeting of the Conference, I desire to make a few preliminary remarks, as I consider that the subject which we are to discuss this morning is the most important of all with which the Conference has to deal, and it has been satisfactory to learn from the allusions which have already been made to agricultural education by many of the members present that the Conference is disposed to share in this view.

It was implied in the remarks with which our first meeting was opened that the Agricultural Departments, Imperial and Provincial, in 1881 were charged with a serious duty by Her Majesty's Secretary of State, *viz.*, that of securing, as far as possible, the development of agricultural improvement. I may go further and say that this duty was imposed upon them by the people and Parliament of England, for the instructions which were received nine years ago from the India Office were the outcome of a Commission appointed from home for the purpose of deciding what measures were necessary for placing the agricultural system of India upon a more secure footing.

I have already explained why, until the Agricultural Departments should have established themselves as a financially useful section of the administrative organization of the country, serious consideration of the policy which should guide any attempts at fulfilling the special duty with which they were charged should be postponed. But the time has now come at which its fulfilment can no longer be deferred, and in dealing with the question of providing India

with an agricultural expert of first rank, we should take the opportunity to give strong expression to our opinion as to the general policy which underlies that measure, and of which it only forms a subordinate part.

In 1886 I considered it desirable to place on record my own views on this subject; and although the note which was then written has not been officially published, yet the principles which were formulated therein formed the basis of the recommendations which were made to Her Majesty's Secretary of State in connection with the appointment of an Agricultural Chemist. In referring to that part of the recommendations of the Famine Commissioners endorsed by Her Majesty's Secretary of State, that the introduction of measures for agricultural reform was to be the special duty of selected Government officials, the following remarks were made in my note of 1886, which I will now ask your permission to read, hoping that the length of my quotation will be considered to be justified by the importance of the subject.

Before reading them, however, I would ask that it may be borne in mind that when the note was written the country was suffering under financial difficulties which do not now seem likely to recur, and that the system of education necessary for the improvement of the agricultural classes need not be subjected to the extreme financial starvation which was contemplated as imperative at a time when we, in common with all Governments and Departments, were commanded to reduce expenditure to the very lowest limits. I would also remind the Conference that since the note was recorded a new obligation has been placed upon Agricultural and Educational Departments to give serious attention to, and to take positive measures for, the education of the rural classes in the direction of agriculture by the Resolution on Technical Education issued in 1888 by the Home Department, from which I will make important quotations at the conclusion of this address. The extract from my own note of 1886, which I ask permission to read, is the following:—

"My views on the policy of a State Agricultural Department have recently been to some extent modified by the enquiries which I have made on the Continent in respect to the agricultural institutions of France, Italy, and Germany. I may specially instance those of Italy, where I visited the Agricultural Colleges at Portici (near Naples) and Milan. I found that after some years of experiment the idea of teaching farmers at these colleges appeared partially to have broken down, especially in the south of Italy, where the land proprietors were small and without capital. The conclusion at which the authorities appeared to have arrived was that the direction in which State influence could be most usefully employed was in that of education. Nearly every student at Portici, and a great number of those at Milan, were destined to be village schoolmasters, through whom elementary instruction was to be conveyed to the rising generation of peasant proprietors in the country villages. The Imperial policy might take in India a similar direction. We have an enormous educational machinery already at work in teaching to the masses of the agricultural population, who have to gain their livelihood by agriculture, everything else in the world except agriculture, and that which has to do with agriculture. The agricultural element is practically eliminated from the educational course. Now and then an Agricultural Manual, generally written by some amateur, is translated and circulated as a text-book, but the village schoolmaster, who gives it to his pupils to read, is just as ignorant as they are about the subject with which it deals. What I would suggest is that, without any material addition at present to the cost of the administration of the country, we should substitute agricultural instruction for a certain section of the educational programme as it now exists, and that we should at the same time cut down, or at any rate curtail and repress, expenditure on agricultural experiment. In this way we should without considerable cost perform the national duty, from which no Government of India can escape, of laying some foundation for future agricultural progress. The immediate step to take is that of educating teachers. There seems no reason why for some few years to come the teaching need be of a very high class or standard, but it must be sound. A preliminary step that might be taken would be to utilise those natives who have received, or may still be allowed to receive, an education at Cirencester for the instruction in agricultural subjects of the candidates for village schoolmasterships, or for the instruction to all, even of those village schoolmasters now employed, who are not too old to learn, in order to enable them to impart an useful education of an elementary character to the agricultural children who come to their schools. The earliest measure would therefore cost little or nothing. But as time goes on more than this may be done. Teachers of Natural Science and of other subjects connected with agriculture may be substituted for teachers of subjects not connected with agriculture, and the educational programme of the State may be gradually modified to the same end. Even this second step need involve but little expenditure. The only measure that would involve money, and this need not be taken for some three or four years, would be the importation of one very first class Agricultural Chemist for the whole Empire (one of the crying wants of the country) and the expansion of our best colleges so as

to include a first class diploma for sciences connected with agriculture. But the whole scheme would cost less than the present scheme for agricultural improvement, and would, with the exception of the Agricultural Chemist, be worked entirely by educated natives."

This last conclusion must now be materially modified by the present financial condition of the country as well as by the obligation since placed upon all Governments in connection with technical education. It is, however, rather for each Provincial than for the Imperial Government to decide how far funds can be supplied. I wish now merely to draw attention to the principles involved in the note, which proceeds as follows:—

"16 I have more than once expressed my belief that the present system of education, which excludes subjects connected with agriculture altogether, is doing considerable harm to the agricultural interests of the country by diverting the most intelligent and most ambitious portion of the cultivating population from agricultural interests. We have awakened in their minds intellectual cravings which under present conditions they can only satisfy by seeking professional or official employment. They have never been taught that it is possible for them to find intellectual interest and excitement in the pursuit of agriculture. The consequence is perhaps that the best part of the agricultural population is, on account of the impossibility of obtaining sufficient employment in other directions, becoming politically discontented, and it only requires a perusal of the numerous vernacular newspapers, which give expression to their feelings, to show that their thoughts and aspirations have never been directed to that great work of agricultural improvement which might at the same time satisfy their intellectual aspirations, and provide occupation sufficient to divert their thoughts from political questions with which they are incompetent to deal, but to which (rather than to the fields) they are led by the literary character of their instruction, too closely restricted as it seems to be to History, English Classics, Mathematics, and other subjects of an academical character.

"17. I do not suppose for a moment that the elementary education of the masses will have any immediate or early effect on the agricultural system of the country. I have, however, immense faith in the ultimate results of a widespread education in any given direction. Men of intellect and ability, forced by their educational bias to turn their thoughts or to seek for their intellectual excitement in the direction of agriculture, will sooner or later come to the front to lead the less intellectual masses in an upward path. The lower classes having had their sympathies developed in the same direction by their education will comprehend their leaders and be willing to follow, and the impulse towards progress will become in time irresistible.

"18. If, however, the educational policy which is now advocated is to have any immediate economical effect, it would become necessary to persuade Provincial Governments that they must abandon for the present any idea of establishing Agricultural Colleges and Schools of a high class. They must content themselves with allowing Elementary Science of the simplest kind to be taught in village schools, and with directing the agricultural mind to the study of Field Botany, and to the acquisition of some knowledge of those natural objects with which the daily life of the cultivating population is concerned or surrounded. In short, the object aimed at in the immediate future must be to teach in an elementary fashion "how a crop grows." This is what may be called the first process in the cultivation of the agricultural intellect, the first manuring of the mental field in which agricultural progress is to be developed. The development may be slow and immediately disappointing to the aspirations of zealous officials in the provinces—disappointing, indeed, to myself. I had looked forward to the early establishment of high class Agricultural Colleges; to the study, under skilled direction, of the Agricultural Chemistry of India; to the education of native students at Madras and Dohra instead of at Cirencester; to the maintenance of experimental farms under native management; to the establishment of cattle-breeding operations under that system which has been so successfully adopted by the Horse-Breeding Department; and to the general utilization of educated natives in the work of agricultural reform. To develop such plans is in fact, under the existing orders from the Secretary of State and His Excellency the Viceroy in Council, the positive duty of the Revenue and Agricultural Department. But the continuance of such a programme seems to be beyond the present financial resources of the country, and we can only hold up such schemes as these as the possible aim of future efforts in years to come (The first of those years I hope has now come.) It is at least impossible to keep up the present position in which this Department and its offshoots in the provinces are required by the advocates of State action (represented prominently by the Famine Commissioners and these high officials who have adopted their policy) to take positive action in the direction of agricultural improvement, while they are thwarted at every step, either by the influence of those who hold opposite views or by the exigencies of finance. The only alternative, unless the agricultural interests of the country are to be altogether neglected by the State, is to declare a more humble programme. Therefore I suggest that, working for the present on a lower platform, we must be content with collecting agricultural facts, with giving the agricultural mind a bend in the right direction, and with awakening aspirations in the masses of the agricultural population which will find an easy satisfaction in the natural pursuit of their lives. When the soil has been thus manured and the seed thus sown, it may reasonably be argued that there will grow up sooner or later the vigorous plant of sound agricultural reform, with deeper roots and more certain nourishment

than can perhaps be the fate of what is now accused by unsympathising critics of being an exotic importation, transplanted from England to shallow and unmanured soil, to be watered and trained by official amateurs.

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"20. The plan under which the agricultural element should be introduced into the educational system should, as I have said, be formally discussed and decided by Agricultural and Educational Departments in consultation. I would now only ask leave, at the risk of iteration, to point out in another aspect the drift and object of the proposed policy. I can do this best, perhaps, by indicating what seems actually to take place in respect to the effect of existing education in regard to some other professions. If it is true that, on the one hand, our system of primary education leads to the acquisition of literary rather than of scientific tastes—tastes which are best satisfied by the profession of the lawyer, the schoolmaster, or the Government official—it is equally true that, on the other hand, the largest array of prizes held up for the temptation of educated youths is to be found at the bar or in district schools. Boys are brought up to be pleaders, teachers, or Government clerks because few other professions will give them such a good chance of utilising their education as a means of livelihood. It is a common occurrence now to meet with the sons of ryots or village barbers whose one ambition is to be a pleader or a Government official. The education and the prizes work, therefore, to one and the same end—an end laudable in itself, but detrimental to agricultural interests and fruitful of discontent, because where a large number of students aspire for a limited number of prizes, there must be many disappointed candidates. The policy now advocated would require instruction to be given in a new direction, namely, that of agriculture, and would require also the prizes of education to be so far increased in number, or so far to be modified, as to attract voluntary work in the direction of agriculture. For, if village schoolmasters and district schoolmasters are required to be teachers of Elementary Agricultural Science, and if Government officials are required, as they should be, to pass an Elementary Science test, then many students will readily apply themselves to the acquisition of Agricultural Science in the hope of a tangible reward in the form of a schoolmaster's chair or a writer's stool. Their exertions in the same direction will be increased if, at the end of the measurable period, the establishment of higher class agricultural schools or the introduction of a more difficult science test before admission to official employment should open out to them a prospect of the more highly-paid appointments. But a further advantage of perhaps still greater importance may be claimed for the policy in that those students who will have devoted themselves to Agricultural Science in the hope of a positive reward will not in the case of failure be left, as they are now, without any object in life except that of either persuading some friend or patron to get them into a Government office, or of vilifying authority in scurrilous newspapers. There will grow up, it may be hoped, an increasing tendency for their intellectual cravings to find satisfaction in agricultural pursuits. At present no educated youth will go back from school to hold his father's plough. This result of the educational system, however lamentable, is not surprising, since nothing in the scheme of instruction sufficiently connects the knowledge to be acquired by the son with the cultivation of the paternal acres. Is it not then time to counteract the hurtful tendency which the educational system thus has to divorce the better classes of ryots from their fields? Is it not time to give an agricultural complexion to the educational scheme which should grow in strength and depth in proportion to the growth of the newly awakened knowledge and interest in matters agricultural?

"21. It may briefly be suggested in passing that coupled with, and forming part of, the agricultural education of our schools should be instruction in village accounts, statistics, and records, partly with the object of leading up to the prizes offered by the official establishments which deal with those subjects, and partly with the object of training the agricultural population to learn how to protect their own interests in Revenue and Civil Courts, and also to answer to the call made by their commercial brethren for accurate information about the crops of the country.

"22. In support of the views expressed in the preceding paragraphs, I ask leave to quote from a paper by an educational officer of high position published in the April number of the *Calcutta Review* for 1883—

"The education that we give makes the boys a little less clownish in their manners, and more intelligent when spoken to by strangers. On the other hand, it has produced two evils—(a) it has made them more litigious, that is, less inclined to settle their disputes privately, and more prone to waste their time and money in the atmosphere of the Government Courts; and (b) it has made them less contented with their lot in life, and less willing to work with their hands. It might be said with truth that discontent with one's present lot is the first necessary inducement to improving it. But the form which discontent takes in this country is not of a healthy kind, for the Natives of India consider that the only occupation worthy of an educated man is that of a writership in some office, and especially in a Government office. The village school-boy goes back to the plough with the greatest reluctance, and the town school-boy carries the same discontent and inefficiency into his father's workshop. Sometimes these ex-students positively refuse at first to work; and more than once parents have openly expressed their regret that they ever allowed their sons to be inveigled to school. It is not generally known that the education given at our vernacular schools has this effect on the student's character, but it is true, and there is overwhelming evidence to

prove it in any village or town where schools have existed. Even the sons of grain-dealers (bamas), if they attend our schools (which is not often), become sometimes so demoralised as to despise the paternal trade, and consider that the education which they have received is too good to be thrown away on keeping an account book in bād Kaithi or Mahajani penmanship.

‘It may not be out of place to point out that the same tendency is not confined to India. The danger of educating the agricultural classes in England in a wrong direction has been brought to notice by the Royal Commission, whose report on Agriculture was published in 1882, and from an abstract of which contained in the 18th volume of the Journal of the Royal Agricultural Society of England the following passage is taken.—

‘There is a very general complaint amongst farmers that the present system of education operates prejudicially to the interests of agriculture. Boys, it is said, are kept at school at an age at which they might be usefully employed upon the farm, and he thus acquiring habits and tastes which would fit them for farm service. As it is, the standard of education is so fixed that not only are the first years of industrial training lost before a boy can attain it, but when he does attain it he acquiesces with it a desire for what he regards as more suitable occupation, so that the class which was formerly trained into farm service is now gradually absorbed into other industries. Farmers very naturally complain of this, as in districts in which there are school boards they have to pay for education, which not only deprives them for the present of the labour of boys, and obliges them to pay men’s wages for work, but tends to drain from the land the sources of future labour.’”

I will now read the quotations from the Resolution in the Home Department on Technical Education to which I have already alluded. They are as follows :—

“ 23. The second class of considerations which have forced this question into prominence is concerned with the need of industrial occupation for a population rapidly outgrowing the means of support supplied by a too conservative system of agriculture. It is also concerned with the need for scientific methods to develop the material resources of India and to improve its agriculture, its products and manufactures, so that they may better hold their place in the markets of the world, where competition is carried on with an intensity of purpose, which has been compared to the conditions of warfare. But technical education in this latter sense—that is, in the sense of industrial education—is a matter not so easily dealt with as the technical education of the general preliminary character referred to in the preceding paragraph; and it therefore seems desirable that if the present impulse in its favour is to be successfully directed, the conditions the questions should be clearly understood.

“ The subject is of such extreme importance, and the insignificance of what has been attempted in India is so conspicuous, that the Governor General in Council is deeply impressed with the necessity for action in whatever way may be practicable and sound. Some Local Governments have indeed recently taken practical measures to promote technical education, and these measures have been viewed with much satisfaction by the Government of India. But as it is desirable that the steps best calculated to promote technical education should form the subject of continuous enquiry and discussion, the Governor General in Council suggests that Local Governments and Administrations should on a convenient but early opportunity take action in two ways. Impressed with the existing want of information at hand as to the extent, character, and circumstances of important local industries in every province of India, His Excellency in Council would, in the first place, suggest that in each province an industrial survey should be completed. In the second place, he would recommend that, with a view to turning the knowledge acquired by such a survey to the best account in the light of the abundant information contained in the report of the Royal Commission on Technical Education, each Government and Administration should form a committee of educational experts and professional men, who should make suggestions from time to time for the auxiliary supply of appropriate means of technical education, for such modifications of the State system of public instruction as may aid and encourage industries and industrial employment up to the full measure of such requirement at each provincial centre as may be found to exist; and, when the circumstances are opportune, for the establishment of a Technological Institute, for the enlargement of the provincial Schools of Art and Design, and for the larger co-operation of the University in the promotion of the object in view.

“ In furtherance of these suggestions, much valuable aid can be rendered by the various Provincial Departments of Land Records and Agriculture upon which the Resolution No. ⁶ 340-50 of 8th December 1881 laid the duty of promoting new industries, and of leading the people to a fuller knowledge of Agricultural Science.”

The Agricultural Departments are thus placed under a distinct obligation to suggest and, by placing themselves and their agricultural experts in communication with the educational experts, to develop actual measures for the education of the rural classes in the direction of agriculture.

I will, in conclusion, briefly refer to the connection of the appointment of an Agricultural Chemist with a scheme of agricultural education. In

1882, when our first request for an agricultural expert was made, it was urged in support of the application that "as it was only through and by the native community that agricultural improvements could on any important scale be effected," the provision of instructors in Agricultural Science was necessary. It was in reply to that application that Her Majesty's Secretary of State suggested that a consideration of the measure should be postponed until Agricultural Departments had been more securely organized. But the form in which the application was made affords evidence that the view of the Government of India has been throughout that the agricultural expert should fulfil important functions in connection with education. The same view was strongly urged in our despatch of the 21st of July 1888. Doubts were expressed at home, which have been confirmed by the present Conference, whether the time of the expert-in-chief, as I may call him, should be occupied in actual teaching; and an alternative policy suggested by Dr. Voelcker has been accepted that actual teaching should be the duty of subordinate officials more or less under his direction, of whom the first at any rate should be the teacher demanded by the requirements at the Dehra and Poona schools for competent teaching in Agricultural Chemistry. But this modification of the original proposals does not do away with the obligation which will rest upon the expert-in-chief of regulating under the instructions of, and in consultation with, the Provincial authorities the curriculum of agricultural education, and of assisting to secure the development of the highest possible standard of education in sciences upon which agriculture depends. A system of technical education which depends solely upon the guidance of officials or teachers who are either inferior experts or no experts at all is sure to be subject to degeneration, want of continuity, and partial failure. I would therefore ask the members of this Conference to record their opinion whether for the security of a sound system of agricultural education the employment in this country of at least one expert of the highest class obtainable is not essential.

Mr. Finucane expressed entire concurrence in everything that had been said by the President, and with the views held by him on the subject of agricultural education in his note of 10th January 1886. In Bengal there ought to be an Agricultural College at Seebpore on the lines of those at Poona and Saidapet, for which the existing staff of teachers in the Seebpore College should, as far as possible, be utilized. There was an experimental station attached to Seebpore, but an educational farm was required as well. It would not be scientific or demonstrative, but simply maintained for the education of agricultural students. He would also like to see Agricultural Primers introduced into primary schools. One such primer, prepared by one of the Cirencester graduates, had been approved by the Educational Departments, and was in use in some schools. Agricultural teachers should be obtained from the parent institution at Seebpore and employed in middle class schools, which would have farms attached to them. They had no such agency in Bengal at present. He entirely concurred with the President as to the great service the Agricultural Chemist would be to the educational scheme, and emphasized the advantages of giving natives an opportunity of being educated in Physics and Science (including Agriculture) instead of in purely literary subjects. The Cirencester native graduates who were thus educated have done better work than men of the same class who have not had similar advantages, and have proved their superiority whether in settlement work, agriculture, or in the regular line. He also said that he attached great importance to the spread of primary education among the agricultural classes as a means to the ultimate introduction of agricultural improvement, and put in a note* in which his views were expressed.

The *Hon'ble Mr. Nolan* entirely agreed with *Mr. Finucane* in his estimation of the Cirencester graduates. It was, however, to be remembered that they were picked men originally selected from the best graduates of the Calcutta University.

Mr. Muir-Mackenzie mentioned the excellent results obtained by the employment of a Parsi graduate of Cirencester on the experimental farm of Bhadgaon in the Bombay Presidency.

* *Vide* Appendix D.

Mr. Clogstoun, having expressed full concurrence in the necessity for developing measures for the education of the rural classes in agriculture, said that the subject of agricultural education had been exhaustively dealt with in the report of the Madras Agricultural Committee. Referring to the orders of the Madras Government on the report, he quoted the following passages* as illustrative of what they had decided on doing in Madras to advance the cause of agricultural education :—

"10. The question of education, the Madras Government observes, is dealt with at great length in the report, and the importance of it as a means towards agricultural improvement is strongly insisted upon. Dealing first with indirect education, the Committee recommends the abolition of the present system of exhibitions and the substitution of prizes for fields or farms, or specific items of farm management—a subject on which much interesting information is contained in Mr Nicholson's note. It is also recommended that the diffusion of practical agricultural knowledge should be further stimulated by publishing the results of successful experiments and other useful information or suggestions in a popular form by means either of a departmental journal or casual papers.

"But it is to school and college education that the Committee attaches most importance, and more than half of the report is devoted to this subject

"With reference to the Saidapet institution, the Committee lays down the proposition that a central college is absolutely essential for the training of the necessary agricultural experts and teachers and the provision of veterinary education. It recommends that there should be two courses in agriculture, corresponding to the two tests under the Technical Education scheme; that a separate branch of the college should be established for providing veterinary instruction; and that *Forestry* should be added to the list of subjects which are now taught. It suggests the revision of the present course of study, and recommends that the system of working the farm annexed to the College should be radically altered so as to make the practical instruction more varied and complete, and allow of more individual attention being given to the students

"Turning next to the more difficult problem of school education, it is pointed out that *Agriculture* is already an optional subject in Standards IV, V, VI, and VII, and in the Primary, Special Primary, Middle School, and Upper Secondary Examinations; but, owing to the want of teachers, it is taught in very few schools, and even in these the instruction given must be far from satisfactory. The Committee does not recommend that the subject should be made compulsory, but suggests that the efforts of the Government should be directed to encouraging the study of it and providing facilities for the training of teachers. In order to secure this object, the Committee considers that special scholarships must be instituted and full advantage taken of the Grant-in-aid Code, which provides for special assistance being given to persons sent for training as technical teachers; and that *Agriculture* must be taught as an optional or compulsory subject in all District Normal Schools. The Committee acknowledges that the provision of qualified teachers can only be made very gradually, but it is of opinion that, if the policy sketched above is pursued steadily for a few years, marked progress will be made in the spread of agricultural instruction; and, in support of this view, the Committee refers to the rapid extension of the teaching of *Hygiene* since that subject has been regularly taught in elementary Normal Schools.

"11. His Excellency the Governor in Council agrees with the Committee in giving education a prominent place amongst the desiderata for a generally improved agricultural system, and this is being supplied as fast as circumstances will permit; but the long established usages of the cultivating classes, partly founded on ignorance, partly on poverty, and partly on custom to which they adhere with the tenacity of religious conviction, can only be changed or removed when desirable by special teaching and demonstration, and by instructors who can plainly show the people that new methods are real improvements adapted to Indian agriculture, apart from systems sanctioned by Western theories and Western practice. Special instruction in agriculture, however, is almost non-existent owing to the want of men competent to give it. The Committee proposes the system which has been described above; but although a scheme of this kind may become possible in the remote future, it is not practicable now, and must be replaced by something which, though less ambitious, is more in accordance with existing means, and yet not inadequate to existing requirements. The scheme which, in the opinion of His Excellency the Governor in Council, fulfils these conditions will now be briefly sketched.

"12. At or near the head-quarter station of five representative districts there should be established a combined agricultural school and farm. The school should afford general instruction up to the upper secondary grade, and special agricultural teaching up to the standard of the present junior department of the College of Agriculture. The farm should be worked principally in the interests of the school, but should also be available for experiment and demonstration. It should be under the management of the head master of the school, who, as well as the second master, should be a graduate of the Saidapet College, and capable of personally working farm implements and handling cattle. These farm schools will be educational

* The full orders of the Madras Government are printed as Appendix B.

institutions managed by the Director of Public Instruction; but the Director of Agriculture and his Assistant must be freely consulted as to their working, and the farms, so far as they are institutions for enquiry, experiment, and demonstration, will be under the exclusive control of the agricultural officers. The necessary funds will be provided in the budgets of the two departments, the charges common to both being distributed in such proportion as may seem suitable. It will in time become possible to connect these schools with the District Normal institutions, and by this means a class of teachers specially trained in agriculture will become available for supplying agricultural instruction in ordinary Primary and Middle Schools.

"The Board of Revenue should carefully consider the question of the location of the schools, and submit a statement of its views on the matter to the Government. The institutions must be within easy distance of a railway station so as to allow of frequent inspection by the Assistant Director, and for this reason, if it is decided to locate one in the Kistna District, it will be better to have it at Guntúr or Bezváda instead of at the Collector's head-quarters. In determining what five districts should be selected, special regard must be paid to the importance of obtaining conditions of soil, climate, and agricultural practices that are representative of a considerable area, and each farm should, so far as is possible, represent a different set of conditions.

* * * * *

"14. Having now provided for schools and a college, the next matter is to connect them by means of a system of scholarships. The Directors of Public Instruction and Agriculture should accordingly consult and submit proposals for this purpose. The present scholarship scheme is not a very satisfactory one, and it must be considerably modified to suit the altered conditions. Probably the best plan will be a system of district stipends tenable at the five farm schools and a number of College scholarships to be awarded by competition among the students of these schools, but it is unnecessary to come to any decision on this point until the proposals of the two Directors are before the Government."

In addition to the five farms which it had been decided to start in the first instance, the Madras Government also contemplated in time having an agricultural school at the head-quarters of each of the 21 districts of the Presidency.

The *Hon'ble Mr. Nolan* asked whether the students of the Agricultural College were all given Government employment on completing their education.

Mr. Clogstoun referred to page 150 of the Agricultural Committee's report, where information was given as to the number of students of the Agricultural College who had found employment under Government.

Mr. Steedman: I take it that the question before the Conference is agricultural education as a means to the improvement of indigenous agriculture, and that the real issue is whether an extended agricultural education is likely to result in any real improvement in the agriculture of the country. Viewed as an abstract proposition, the substitution in part of an agricultural education, meaning thereby an elementary education in the Sciences, Botany, Chemistry, &c., connected with agriculture, for the purely literary education now given will surely commend itself to every member of this Conference. It must be an improvement quite apart from its bearing on agriculture.

In considering the question of agricultural education as a means to the improvement of agriculture, it will be convenient to divide the persons to be taught into two classes:—

- (a) The cultivating classes—
 - (i) Large landowners.
 - (ii) Peasant proprietors.
- (b) The non-cultivating classes.

I hold that the education of the non-cultivating class will be ineffective in improving agriculture, except in so far as it may provide—

- (a) subordinates for the Agricultural and Revenue Department;
- (b) a body of teachers for the instruction of the agricultural population in Elementary Natural Science, if such instruction is to be given.

Later on I shall touch briefly on the higher agricultural education that has been recommended by some of the members.

With reference to the education of the cultivating classes, I am, and have long been, convinced that the greatest importance should be attached to the education in Agricultural Science of the large landowners. In the Punjab I regret to say we have but few, but the zamindars of Bengal and the talukdars of the North-Western Provinces and Oudh are instances. It is to these men, I believe, that we must look for the most effective assistance and influence in the improvement of the agriculture of this country if it is susceptible of, and if there is any real room for improvement. I do not mean to say that it is not susceptible of improvement. There are few, if any, processes that can be called perfect. This is not, in my opinion, the question. The question is whether, given the existing circumstances more or less unalterable, the small holdings, the want of capital, the indebtedness, the cheapness and abundant sufficiency of labour, &c., there is much room for improvement, and whether such improvement is likely to result from the extension of agricultural education to the cultivators of the soil. Here I would note that in England the two most potent factors in bringing about improvements in agriculture have been an abundance of capital and an insufficiency and dearness of labour. It is insisted on in several papers before the Conference that education to be effective must reach "the actual cultivators of the soil." It is also stated directly and indirectly that the cultivator is apathetic and indifferent as regards improvements. Now I do not agree in this view. So far as my experience goes, the cultivators are by no means apathetic. You have had good cultivators everywhere; in the Punjab the Rajput, proud and lazy, and the Jat, thrifty and industrious; and the good cultivators predominate. By educating the Rajput in Agricultural Science you will not convert him into a thrifty husbandman. I am convinced that if you can prove by example that any new staple, any variety of existing staples, better wheat, improved fruit trees, a new fodder, a new kind of sugarcane, a new implement is an undoubted and a *paying* improvement on old staples or methods, &c., the cultivator will at once adopt it. Examples are—in Bombay improved varieties of cotton mentioned by Mr. Ozanne; in the North-Western Provinces improved seed wheat; in the Punjab oats as a fodder crop at Lahore; improved cotton, better fruit trees in the hill districts. Last of all I will instance the Beheea mill and its numerous adaptations. Here I can speak from personal experience. It was introduced into a part of the Rawalpindi District while I was Settlement Officer there. Wood was scarce and dear, and the *belua* and the *kohla* were most expensive. I was told, and I have not the least doubt as to the correctness of the statement, that the cost of the Beheea mill was recouped by the economy it effected in a single season's pressing.

Now all the above improvements are not improvements in the processes of cultivation in the preparation of the land for production, and, as far as I know—I trust I shall be corrected if wrong—no such improvements have as yet resulted from the work of our Agricultural Department. I mean, for instance, deep ploughing, fallowing, the use of artificial manures, green soiling, &c. I may say that I doubt whether these processes as now practised by the better cultivators can be *profitably* improved on. Here, again, I must remind the Conference that I am speaking from my limited experience of Punjab agriculture. I will give two instances to illustrate my meaning that have come directly under my notice. In Jhang there is practically no rain or dry cultivation. Agriculture is carried on mainly from wells. On a well carefully farmed there is a regular system of fallow rotation. The unmanured land lies fallow for one or two years after it has borne a crop. The manure of the well-oxen is carefully conserved, and a flock of sheep and goats is kept to produce more manure. Roots are grown as a fodder crop. The land closest to the well is highly manured, and grows two crops in the year. The well-water is used with the strictest economy, the land is laid out in small embanked beds, and the larger water-channels are often "leaped" with a plaster of clay, cowdung, and chaff to prevent leakage.

In Rawalpindi, not 150 miles distant, you have a complete change both in the conditions of agriculture and in the agriculture itself. There is no irrigation, and the crops depend entirely on the rainfall. The grazing area is small, cattle are few, and manure is scanty. There is very little wood. The

system is this: The wheat crop is sown in November and reaped in May. As soon as rain falls in July, a crop of *bayra* is sown on the same land and is reaped in November, and then for a whole year, until the succeeding November, the land lies fallow, and is ploughed up as often as the rainfall and the resources of the cultivator will allow. Given the conditions, I do not see how this system is to be improved on. When the wheat is sown, the land is as clean as a garden and in a beautiful condition of tilth.

I give these two instances of how carefully the cultivator adopts his system of husbandry to existing conditions as a protest against the cry oft repeated for agricultural reform, for the revolutionising of indigenous practice, as if the agriculture of the country was just as bad as it can be, and the cultivator utterly indifferent to his own interest in the matter of husbandry.

I would therefore reiterate my conviction that we must look to the large landowners or to the management of Court of Wards' Estates, to persons who have an immediate and personal interest in improving the agriculture of their land, for any real and extended improvement in the general agriculture of the country. And in conclusion I would suggest that, if possible, some of these larger landowners might be given as an experiment a scientific education in agriculture at Cirencester or some similar institution.

Can we hope that any improvement in agriculture is likely to result from the instruction of the peasant proprietor in Agricultural Science? I would draw the attention of the Conference to the views of the Madras Government given in paragraph 11 of their Resolution No. 515 of 4th July 1890, and to the opinion of Mr. Fuller in paragraph 3 (c) of his note. It seems to me that even those who recommend the agricultural education of the actual cultivators have not much faith in its direct action in the improvement of agriculture. At the same time it will be an improvement in existing methods of education, and will so far be a gain, but that it will influence and hasten agricultural improvement I doubt. In the Punjab a very small percentage of the children of the cultivating class pass out of the Primary Schools. The instruction in Elementary Science that can be given to the boys in Primary Schools must be infinitesimal, and will be confined to reading a primer.

On a higher agricultural education, such as has been sketched out by the Madras Committee, I have but few remarks to offer. If we can get the larger landowners to go through the course, and after the course to return to their estates and make use of the knowledge they have acquired, I say we shall have achieved great things. For such an end I would hold out every inducement. What I deprecate is the creation of a B. A. degree in agriculture merely as a distinction to induce students who have no intention to take to agriculture as a means of livelihood to go through a course of Agricultural Science and Practice. Such an inducement will have but little influence on the men who do go back to their estates. I think these higher agricultural educational schemes are perhaps based too closely on English models. Take the English schools and colleges. Who are the students? They are landowners, land agents, tenant farmers' sons, future colonists, and teachers of Agricultural Science. With the exception of the latter class, they all look to a close and direct connection with agriculture and the soil for their livelihood. Now will you find their representatives in an Indian College? If you will, then I say that the college is needed, and must do much good. If not, then I object to the creation, at the expense of the State, of a number of spurious agriculturists, who go through a course or take a degree in Agricultural Science without the least intention, or wish to utilise their knowledge to the advancement of agriculture.

I think with the Hon'ble Mr. Nolan that agricultural colleges must be looked upon more or less as luxuries. More has been done in Madras than in any other part of India, and with little or no success. The Madras member of the Conference has referred to their large surplus, and apparently what has been spent in the development of agriculture in the Presidency is a flea-bite. But for a poor province I think it will be well to consider what I have said.

In any case, if a scheme of higher agricultural education is introduced, I do earnestly trust that it will be something more than mere book work. Make it

really practical. Make the students familiar with their indigenous native system of farming. I look to the advice and presence of the Agricultural Adviser to the Imperial Government as a guarantee that this will not be lost sight of.

In conclusion, I wish to express an opinion that agricultural improvement is more likely to result from agricultural experiments and demonstrations in experimental stations and farms than from agricultural education. Therefore, as far as the Punjab is concerned, I would sooner spend money on the formation of a central experimental farm, with *small subsidiary* stations at each district head-quarters, than in the extension of what is called agricultural education or its substitution for any portion of the present literary curriculum. The head experimental farm should be under a trained agriculturist. The district stations would be under a man more of a head gardener than a trained agriculturist, such as are trained at the Agri-Horticultural Gardens at Lahore and recruited from the Arians, our very best cultivators. The expense of the central farm would be borne by the Provincial Funds, that of the district stations by the Local Funds. I am perfectly aware that the objection can be made that these district stations will not be properly supervised, but I nevertheless would sooner spend money on them than in the agricultural education of the masses, the object being the improvement of agriculture.

Mr. Thomson: Mr. Steedman has already anticipated almost everything which I wished to say, and I need not add that he spoke with much more authority than I can claim. With almost everything that he said I entirely agree. I think it is quite easy to approve as an abstract proposition the statement that agricultural education should be improved. But I prefer to put the more particular questions—Why do you wish to give agricultural education? Whom do you wish to teach? and what do you wish to teach them?

As to these questions, I presume that the only possible reason for imparting agricultural education is to improve agriculture. This being granted, it follows that, unless we are able to teach the actual practical farmers, we are not likely to achieve any result about which the Government of India need greatly care. Now, in the Punjab these farmers are men who hold from 8 to 15 acres a piece, and on these men, I think, any high collegiate education would be thrown away. Either they will fall out of touch with their fellows, and cease to be of service to them, or they will take to other pursuits and abandon agriculture. You may get excellent settlement officials, tahsildars, or managers of Courts of Wards, but improvers of agriculture you will not get.

It follows from this that any education in agriculture in the Punjab must at present be confined to an elementary scale; that is, it can hardly be agricultural teaching at all, but must be confined to such subjects as the manner of the growth and nutrition of plants, and the general principles of Vegetable Physiology. I do not imagine that such lessons will be of much practical utility, at least not immediately. But they would probably be interesting, and would tend to establish a distinct type in education, and vary the unfortunate uniformity of spurious literary culture. In a few cases they might lead to an opening of mind and useful practical observations.

I have no doubt that collegiate education in agriculture may be extremely useful in other provinces. Many able gentlemen seem to be of that opinion, and I have no desire to gainsay them. All I wish to point out is that we are not prepared to adopt such plans in the Punjab, and I would ask the Conference to abstain from what I cannot but think the unscientific process of laying down one set of principles or doctrines to govern a half score of provinces in all varieties of condition, character, and development.

One other thing I wish to add, and that is that the Agricultural Chemist should have no concern with agricultural teaching beyond giving the most general advice. The more the Agricultural Chemist can be confined strictly to his proper scientific duties, the more likely he is to do his duties well and to be really useful.

Mr. Fuller said that he would begin by briefly stating what was being done in the Central Provinces in the way of agricultural teaching. The steps that had been taken there were the direct outcome of the Government of India

Resolution of 1887 on Technical Education, but (he might observe) followed very closely the lines suggested in Sir E. Buck's note of 1886. A Committee was formed to consider the subject of technical education, and the Chief Commissioner recorded a Minute on their recommendations in April 1888, from which the following was an extract:—

"Our funds are too small for comprehensive schemes. But we can, I think, do something to lay solid, and even broad, foundations upon which our successors may be able to build. If we can in our ordinary schools train the pupils to use their eyes and hands by making drawing a necessary part of their education, and if we can stimulate their minds by teaching them the Elements of Physical Science, illustrating the instruction by simple experiments, we shall have made at least a good beginning. Then I think we can with great advantage to the province and to the public service give some special training in the elements of Engineering and in Agricultural Science."

On the receipt of the Government of India Resolution No. 345-55-C.I., dated the 25th March 1890, Mr. Munro, the Inspector General of Education, was asked to report on the progress which had been made on the lines laid down in this Minute. His reply was as follows:—

"I am asked to report to what extent the principle laid down in paragraph 8 of the Resolution of the Government of India, Revenue and Agricultural Department, No. 345-55-C.I., dated the 25th March 1890—12, that the education of the agricultural classes, and especially of the lower classes, should be so directed as to enable them to appreciate and, where expedient, to follow the results of experiments—is acted upon in these Provinces. I would observe that the policy of the Education Department since I have been in charge of it has been to develop and carry out the reforms and improvements laid down by the Chief Commissioner in his Minute on Technical Education, dated the 4th April 1888. The object of that Minute was generally to divert education into a less literary channel, and to make it more practical and useful. As observed by the Chief Commissioner in the Minute—'If we can, in our ordinary schools, train the pupils to use their eyes and hands by making drawing a necessary part of their education, and if we can stimulate their minds by teaching them the elements of Physical Science, illustrating the instruction by simple experiments, we shall at least have made a good beginning.' It is on these lines that we have worked for the past two years. Drawing is now recognized as one of the most important subjects of study. It is taught in all our High and Middle schools with success, and in the majority of primary schools with tolerable success. Special prizes for drawing are offered on the results of the Middle School examination. The study of Physical Science is begun in the upper primary standard, and a special examination for prizes is held annually for candidates who have passed the Upper Primary examination. Prizes for Physical Science are also offered on the results of the Middle School examination.

"Object lessons as preliminary to Physical Science are taught in the lower primary standard. Itinerant instructors in the subject were appointed for a period of two years, and have nearly finished their work. As regards the training of the senses, instruction on the Kindergarten system is given in the first two standards, and a system of manual training as taught in the schools of the London School Board is being introduced in the standards above the second, thus taking up hand and eye training at the point where the Kindergarten leaves it. This system includes wood work, modelling in clay and card board, and is well calculated to develop accuracy of hand and eye. It is based on drawing. Each student is required to draw to scale the object which he wishes to make, and then to make it from the drawing. The engineering and agricultural classes established under the orders of the Chief Commissioner in 1888 have been successfully conducted. As regards agriculture, the vernacular translation of Mr Fuller's Agricultural Primer has been supplied to all Hindi schools, and will shortly be supplied to other schools. The subject is very popular. One of the Inspectors reports that members of School Committees often ask to be allowed to attend during the agricultural lesson.

"An examination for prizes in agriculture open to candidates who have passed the Upper Primary examination is held annually. The main objection to the instruction in agriculture as given in our schools is that it is entirely theoretical. I have, however, attempted to remedy this defect by introducing a system of school gardens, which will not only enable the teachers to illustrate what they teach, but will provide the boys with useful occupation. The Commissioner of Settlements and Agriculture has offered to draw up a scheme which will be shortly introduced. The work of planting and watering, &c., is to be done by the boys themselves. Each student is to have his own plot of ground, and the sale proceeds are to be credited to the boys themselves. I hope by the next cold weather to see gardens containing European and Native vegetables established in a fair number of our primary schools. District Councils have offered prizes for the best school gardens. The scientific training in agriculture of teachers is another question which has engaged attention. Most of our teachers have but a superficial knowledge of the subject. To meet this objection, it is proposed to utilize the agricultural class as a training institution, and to send annually a few teachers from each district to undergo a course of training. By this means I think that in a few years sound and practical instruction in agriculture will be given in our schools. To recapitulate, I think that it may be said that we have done as much as could be done in a short time to give a practical bent to the education of the agricultural and lower classes."

It should be explained that the establishment of school gardens had only just been taken up, and that it was as yet too early to give a definite opinion as to their success. They promised well in some places. The Agricultural Class referred to in the Chief Commissioner's minute and Mr. Munro's letter was started in April 1888, and had been on the whole very successful. The following extracts from the class prospectus were read :—

" 2. The class building and fields for practical instruction in agriculture are situated on land forming a part of the Government experimental farm, which is also made available for practical instruction in agriculture

" 3. The class, though placed under the Educational Department, is directly under the control of the Commissioner of Settlements and Agriculture, Central Provinces. The staff consists of a Principal and two assistants.

* * * * *

" 5. Candidates for admission to the class must have passed the Middle School or the Matriculation Examination, preference being given to the latter. No candidate will be allowed to join who is physically unfit for practical work, or (unless admitted for special reasons) who is under 16 years or over 21 years of age

* * * * *

" 7. No fee is charged to the students for receiving instruction in the class.

" 8. There are no special scholarships for the class, but the scholarships granted by the Educational Department are tenable at the class.

" 9. Students who are not residents of Nagpur are given free quarters, but they must make their own arrangements for their board

10. " The course of study occupies two years, with a long vacation each year from 1st April to 31st May. Attendance at lectures in the laboratory and at practical work in the fields is necessary. Irregularity of attendance disqualifies a student from appearing at the examination.

" 11. The course of study comprises—

Agriculture (theory and practice).
 Surveying (theory and practice).
 Chemistry (theoretical and practical).
 Botany.
 Geology.
 Elementary Veterinary (practice and science.)
 Drawing.

" 12. The following are the text books appointed :—

Agriculture—

First Principles of Agriculture—*Tanner*.
 Elementary Lessons in Agriculture—*Tanner*.
 Agricultural Primer—*Fuller*.

Chemistry—

Science Primer—*Roscoe*,

Geology—

Science Primer—*Geikie*.
 Manual of Geology for Indian students—*Cooke*.

Botany—

Science Primer—*Hooker*.

" 13. To ensure that the students acquire a practical knowledge of agriculture, plots of land are allotted to them which they are required to cultivate with their own hands. They are permitted to keep the produce. The students also maintain a labour journal and cultivation book for the experiments conducted on the experimental farm.

" 14. The course of instruction in surveying largely consists of practical work with the plane table, chain, and theodolite.

" 15. A small veterinary dispensary is attached to the class for practical instruction in the treatment of the more common forms of cattle disease."

Every effort was made to render the instructions thoroughly practical both in the field and laboratory, and a satisfactory measure of success had been attained. The students spent a couple of hours in actual practical farm work most days of the week, and they had taken very kindly to it, although at the outset difficulty was experienced. The result of the examination held last April at the

end of the first two years was very good. Practical surveying formed an important item in the curriculum, which also included Geology, Botany, Chemistry, and the Elements of Veterinary Science. There were at present 24 students in the class.

The students undoubtedly only come with the object of getting into Government service. But they were all wanted in Government service. Those that had been tried had done distinctly better than the general run of Arts students who had read up to the Entrance Examination.

So far as his own opinion was concerned, Mr. Fuller expressed himself strongly in favour of the introduction of agriculture into primary and also into higher education.

In regard to primary education in agriculture, his views had been expressed in a note* which he laid before the Conference. The study of agriculture had been introduced into village schools in the Central Provinces because it was believed that it would lead people to think more of the subject, in which case improvement would surely follow. In the Central Provinces there was certainly great room for improvement if only in the matter of greater industry. While not undervaluing the intelligence or experience of the ryot, he was quite unable to subscribe to the view that the agriculture of the country was the best possible under the circumstances, and was incapable of improvement. One fact to the contrary was the influence of caste, which greatly restricted the agricultural efficiency of a large portion of the population. But education in the broadest sense of the word was undoubtedly breaking down caste restriction.

The *President* remarked that high caste ryots would not at first grow indigo in the North-Western Provinces, but now they do.

Mr. Fuller admitted that the only agricultural teaching which could be given in village schools would be very elementary, and chiefly confined to principles. We could not undertake to teach the details of practical farming. But we might awake an interest in the subject which would lead to practical results. In any case the substitution of an Agricultural Primer for one of the ordinary school reading books could do no harm; and if the agricultural teaching was illustrated by object lessons as was intended, it would turn out better men, if not better farmers. The great difficulty was the training of the teachers. Special Normal Schools were required. A special vernacular class for village schoolmasters was being opened in Nagpur in connection with the agricultural class.

As regards higher education, he observed that the teaching given at the Nagpur agricultural class led to the conferral of no distinction or degree. But it gave a claim to Government service, and the result was the same in attracting students. University certificates and degrees were, of course, in greatest part valued as a means of getting into Government service, not for their own sake. He deprecated the tendency to judge agricultural teaching by the aspirations of the students, and to condemn it if it could be shown that they learnt not to become farmers themselves, but to obtain employment. He fancied that this was a charge which might be brought against any Agricultural College in any country. Even supposing that the men educated in an Agricultural College did nothing but take to Government service, the value of their training to the country might be very great. The present subordinate revenue officials were, as a rule, absolutely ignorant of agriculture, and were quite unable either to second the efforts of their superiors for its improvement, or to strike out ideas of their own. A great deal might be expected if talukdars and men of similar rank were acquainted with some Agricultural Science. He instanced cases in which men in the Central Provinces Settlement Department, who had been trained at Saidapet and Poona, had used their opportunities to stimulate the people to improvement. Finally, he considered that the introduction of agriculture into the higher education of the country would have a beneficial result, in that it would probably exert an influence on public opinion and lead to more attention being given to agriculture as a profession. The natives of this country were very ready to catch up general notions of this sort. But he thought that there was a great risk that higher education in agriculture would miss its mark

* *Vide Appendix F.*

is not being sufficiently practical. He believed that much of the science teaching given in this country was merely arts teaching under another name, as the course was only one of books, and no attempt was made to bring the minds of the students into contact with things. Hundreds of men who had passed in Chemistry here, he believed, never handled a test tube. He had on the preceding day stated that he was much in favour of the appointment of an Agricultural Adviser to the Government of India, and he would make it one of this officer's duties to control and inspect agricultural education, so as to ensure its being practical and not mere cramming up of books and papers.

The *Hon'ble Mr Bennett* thought the scheme for agricultural education should be connected with existing educational institutions and not made separate. He was in favour of agricultural education being given early in the ordinary course taught in Government schools. If agricultural education is not associated with general education, the people will not care for it. He recommended that it should be introduced with the upper primary standard, *i.e.*, after writing and reading have been attained, and that three lessons a week would be sufficient. He also thought that Elementary Agriculture should be taught in Normal Schools. Education on these lines would go on till after the Entrance Examination, which should be raised till it became a test of a general education. They would then take up agriculture as a special branch of science. If this were impossible, the general education with agriculture as part must continue till the First Arts Examination. He thought the scheme laid out by him the only feasible one. He did not anticipate any great advantages from educating the cultivating classes; they know all they want already. The *Kshatri* will always remain a bad cultivator until driven by necessity to greater exertions. His reform would not be effected by instruction in agriculture.

He thought nevertheless that a leaven of officials educated in agriculture would be most useful. *e.g.*, a tahsildar who could advise regarding a water-logged soil. Trained agricultural students would, he believed, be in request among large landowners. In the North-Western Provinces the talukdars had promised them a house at Lucknow and a large sum of money to start a Technical College, but they had no proper agricultural adviser to guide them, and without one they could not make a start. He also thought that the presence of an Agricultural Chemist might lead to some real discoveries, and that the introduction of a scientific element, in addition to the present almost exclusively literary course, would be a benefit to general education.

The *Hon'ble Mr Nolan* observed that Mr. Finucane's suggestions for promoting higher education in Bengal had been favourably considered by Government, and action would be taken upon them if funds could be provided for the purpose in the next Provincial contract. The question is not urgent, there being at present no great demand for instruction of this class, which in Madras is accepted only by students paid to learn, and whose sole object is to obtain Government employment. In the Central Provinces, too, as stated by Mr. Fuller, all agricultural pupils are candidates for the public service, while in the North-Western Provinces the *Hon'ble Mr Bennett* despairs of obtaining any scholars if they are not bribed with the prospect of a Degree at the new University, presumably to be obtained on no very onerous terms.

Much more importance attaches to the suggestion in Sir Edward Buck's note placed that morning on the Conference table that an agricultural bent should be given to primary education generally. In India, as all the world knows, each class has its own industry or occupation, and that of cultivating the soil has been assigned by immemorial custom to the ryots. The great proprietors confined their attention to the collection of the rent, and to certain social or political functions having no connection with agriculture. Now as the sons of ryots did not go to colleges, we could in such institutions teach farming only to those who never farm on their own account, however willing they might be to accept salaried offices under the Department. At the primary schools, on the other hand, the future cultivators may be instructed, and he quite agreed with Sir Edward Buck that this should be our ultimate object. On the other hand, he took exception to phrases in the note,

perhaps inadvertently introduced, which gave expression to the common belief that the sons of ryots as a body are at present educated, indeed over educated. It was said that we are "teaching to the masses of the agricultural population everything else in the world except Agriculture," History, Mathematics, and the English Classics being particularly specified as subjects in which the cultivators are instructed. The Hon'ble Mr. Nolan ventured in contradiction to such statements to assert that to the mass of the agricultural population we are teaching nothing at all; that they are left to grow up in absolute ignorance. What are the facts as ascertained at the last census? Of males above five years 89.6 per cent. could not read or write, and were not under instruction. The remaining 10.4 per cent. is sufficiently accounted for by the classes among whom a desire for learning is hereditary, an examination of the returns showing that these exceeded that proportion; the masses are left untouched. No one intending to occupy a position among the ordinary agricultural population ever learned English Classics, History, or Mathematics. Even to the primary schools in which little is taught beyond the three R's, the literate classes supply in Bengal 33.1 per cent. of the pupils, the Nobosaks 27.7, the artisans 30.4, agriculturists and labourers only 8.8. The latter fraction of the fraction able to read and write, that is, of 10.4 per cent. of the population, indicates in some degree what we are doing for the education of the ryots. The census figures do not state the percentage of instructed for cultivators separately; for aborigines, who have no other resource than the products of the soil, it is .4 per cent. Neither can it be said that the returns afford assurance of immediate improvement, as they would do if they showed a knowledge of reading to be prevalent among members of the rising generation than among those advanced in age. The only tabular statements on this point quoted in the report are for Madras, and they stand as follows:—

Age	Percentage of educated males.
15 to 20	15.41
20 „ 25	16.94
25 „ 30	16.97
30 „ 40	16.42
40 „ 50	17.37
50 „ 60	18.08
60 and upwards	16.77

The educational reports were not before him, but he understood they now gave about 20 per cent. of the male population of school-going age in India as under instruction. It was, however, notorious that a large proportion of these never learned to read or write, merely attending school for a short period to swell the returns. Moreover, the children of school-going age are taken at 15 per cent. of the population, which is too low a standard, and its assumption makes the proportion under instruction appear too high.

The fact is that the cultivators are illiterate and their children are growing up in ignorance, the exceptions being so rare and isolated as to be of no account for agricultural purposes. Now if there is one principle on which modern statesmen in all countries are agreed, it is that popular education is the only means by which the condition of the masses can be permanently raised; and this truth has a special application to India, where these illiterate labourers are left to accomplish without superior guidance the great economic task of the country, that of raising the annual crops on which we all subsist. To the wide induction on which the inference rests that general education is essential to the well-being of the masses, India adds two crucial illustrations. In one of its provinces only is a majority of the population instructed, and in it only is prosperity universal. Elsewhere of those engaged in cultivation there is only one class educated up to the European standard engaged in cultivation, and by that class only are profits realized on the European scale. Agricultural Chemists, colleges, stations, exhibitions, and so forth are very well in their way, but general and decisive effect cannot be produced otherwise than by raising the farmers of the country intellectually to the moderate level now insisted

on in regard to the humblest inhabitant of every civilized country. The question is one of the hour. The Government of Bengal, for instance, has recently submitted proposals for extending education to the masses, even at the cost of special taxation for the purpose. He hoped that the members of the Conference—and exercising, as they did, great official influence—would not separate without lending the weight of their authority to this view by formal resolution, and he begged leave to move—

“In the opinion of this Conference no measures for the promotion of agricultural progress can be regarded as complete which do not include provision for a substantial extension of elementary instruction to the class of cultivators.”

Mr Robertson : I agree with a great deal that Mr. Steedman has said, and I think we must not be too sanguine as to any immediate improvement being produced in the methods of the small farmer by education in Agricultural Science either primary or higher. But I think Mr. Steedman has devoted his remarks too exclusively to one side of the question. Quite apart from its possible immediate effect on the “ryot” or “cottier,” I think it is most desirable that a higher education in Agricultural Science should be obtainable at some place or places in this country, and I would almost go as far as to say that in a country situated as this is, it is the duty of Government to see that such an educational course is provided for. I think, therefore, that wherever sufficient funds are available—and there is a fair demand for it—such an educational course should be provided, and I agree with the Hon’ble Mr. Benett that where it is provided it should be in close connection with the general course of education, and with existing educational institutions. There should be complete reciprocity between provinces in the matter, and if such an education be provided in the North-Western Provinces, it should be freely available to, and made use of by, the Punjab, and in turn the North-Western Provinces might make use of, and give encouragement to, the Punjab Veterinary College.

The circumstances of the various provinces are very diverse, and each should be allowed to proceed on its own lines.

In the Punjab a very good start has been made in the direction of veterinary instruction in the Lahore Veterinary College. The zamindars have taken to it, and it would be well to direct our chief attention to development in this direction, so important in connection with agricultural stock. There is no demand yet for higher agricultural education, and it would not be right for a poor province to launch out in expenditure upon such schemes.

We must all agree that the spread of primary education is most desirable, but the fact that the numbers of pupils in the schools is not as great as we could wish should not prevent our doing all we can for those, especially of the agricultural classes, who do come. If the zamindar can be roused to think for himself that it is possible to improve on his traditional methods, not a little will have been done.

I was much struck by a remark in his report on the jubilee of the Royal Agricultural Society of England on this point by Sir James Caird. He pointed out that the best farming in England is very much as it was in 1851. The main progress has been made in the direction of bringing up the method of inferior farmers to the standard of the best.

These are the lines we should work on out here, and the Agricultural Primer which we have just submitted for adoption in the Punjab is drawn up on those lines, and I think our aim should be rather to bring to the notice of the farmers and cultivators better staples, better seed, and better methods, which are known to have been successful in other parts of the country, than to make expensive experiments in entirely new directions. This, I understand, is very much the direction in which Mr. Ozanne is working in Bombay.

Finally, although I do not say that any immediate improvement in agriculture will necessarily follow from either higher or primary education in subjects connected with agriculture, I hold strongly that the higher education should certainly be available for officials and others at some suitable spot in

the country, and that primary education may do something, and will be at least as useful as any other kind of primary education. We should do what we can in this direction, even if it is only a little that we can do. I think therefore that a good system of higher agricultural education should be provided in India.

Dr. Cooke : Not only has the importance of agricultural education been fully acknowledged by many of the members of the Conference at its present sitting, but for some few years past there has been a cry throughout India for *technical* education as distinguished from the class of education which we have hitherto offered to the youth of the country; and in an agricultural country like India, which derives the chief portion of its wealth from the soil, I think it must be admitted that Scientific Agriculture is by no means the least important branch of that technical education which the country demands.

It does not follow that all the men instructed in Agricultural Science must necessarily follow the profession of agriculture. The course of study necessary for the highest standard in agriculture is one which will supply a most useful and practical education. A course of study which embraces such subjects as Physics, Chemistry, Geology, Botany, Surveying, Veterinary Science, and Agriculture should, I think, be at least as valuable for natives of India as a curriculum including Latin, Logic, and Philosophy.

The former class of education will certainly tend more to produce men of habits of observation and investigation than the latter, and be less likely to swell the ranks of the National Congress.

Moreover, in the proposals for an Agricultural Chemist and for experimental farms which we have agreed to, the necessity has been clearly shewn for scientifically educated subordinates to supervise the farms and conduct the operations thereon—men sufficiently well taught in Agriculture and the allied Sciences, and with their powers of observation so trained as to enable them to make deductions from intelligently conducted experiments.

Mr. Finucane yesterday went so far as to say that he considered agricultural education a primary necessity of greater importance even than experimental stations. The stations in fact cannot progress without the men to supervise them, and the men can only be trained by a properly organised system of agricultural education.

I hope I may be pardoned if I give a brief history of agricultural education in the Bombay Presidency.

Sir Richard Temple, when Governor, was the inaugurator of agricultural education in Bombay about ten years ago.

He established two kinds of classes in agriculture—the first, or higher, for which a high standard of entrance as well as final examination was demanded; and the second, or lower, for which a much less advanced standard was required.

Sir R. Temple considered that he could without much difficulty or additional expense graft the higher class on an existing institution which already gave instruction in certain of the branches required for an agricultural education, and he selected the College, of which I have the honour to be Principal, as the institution to which he would entrust the higher agricultural education of the Presidency.

The College was at the time the Civil Engineering College of the Bombay Presidency, and the course prescribed for Civil Engineering by the University of Bombay included many subjects required for an agricultural education.

The curriculum for Civil Engineering in the University included Chemistry (with Qualitative Analysis), Physics, Geology, Surveying, and Drawing, so that by adding Botany, Veterinary Science, and Agriculture a very fair course of study for agricultural students could be obtained.

A teacher in Botany and Agriculture was provided. Arrangements were made with one of the Military Veterinary Surgeons to deliver a course of

lectures on that important subject, and a small farm of 15 acres was added to the College. This was afterwards enlarged to about 60 acres. Shortly after a Science degree was established by the University for which the College was affiliated. A Forest class was subsequently added, and the title changed from College of Civil Engineering to College of Science.

The College at present contains a large workshop, with steam machinery worked by two steam engines; a chemical laboratory with a qualitative analysis laboratory for students; a botanical garden; a museum of Indian products, and an herbarium; a physical laboratory, which is one of the best furnished in India; a geological museum; an observatory which contains the largest telescope in India (16½-inch reflector); a veterinary hospital, where cattle are treated under a Veterinary Surgeon; and, lastly, a bacteriological laboratory recently established for the investigation of cattle diseases.

Residences for students have been erected on the farm, which at my suggestion has recently been handed over to the Agricultural Department. Shortly after the establishment of a College class in Agriculture, Sir R. Temple instituted the lower classes for agricultural instruction to which I have already referred. These classes were at first eight in number, and, following out the principle already adopted of grafting a class for special education on an institution already in existence, Sir R. Temple attached these eight classes to eight of the High Schools of the Presidency.

Dr. Voelcker yesterday expressed his opinion strongly in favour of attaching institutions for agricultural education to existing educational institutions in preference to isolating them, and I am of opinion that this is the best and most economical method of securing to students the benefits of general as well as special education, as well as continuity in the system of instruction. The plan on which the classes attached to the High Schools were worked is fully described on page 139 of the Madras Committee's Report, paragraph 160 :

"In Bombay the programme of studies for the agricultural classes attached to the High School extends over two years. The first year is devoted to Chemistry; Huxley's Introductory Science Primer, 105 pages of Balfour Stewart's Physics Primer, and Tanner's Agriculture. The second year's course includes Roscoe's Chemistry Primer, the whole of Balfour Stewart's Physics Primer, Wrightson's Agriculture, Hooker's Botany Primer, with Johnston's Botanical Diagrams, Geikie's Physical Geography Primer, and Geikie's Geology Primer. Students may also obtain certificates in Land Surveying, Drawing, Physiology, and a more extensive course of Botany; but the study of these subjects is not compulsory. Students entering the agricultural classes must be learning a High School standard, *i.e.*, standards IV, V, VI, and VII. These standards correspond in a general way with our lower and upper 4th, 5th, and 6th classes. Boys taking up the agricultural course are excused the classical language, and after obtaining a first class public certificate, they are also excused History and Geography lessons. Revenue officers are invited in filling up appointments to give preference to boys holding the second year High School agricultural certificate, and boys who pass are also eligible for admission to the Civil Engineering College in the lower or non-University class. It is perhaps owing to these inducements that the classes are well filled, although the course is an optional one. The annual examination is entrusted to the Principal of the Civil Engineering College. To each school a small piece of land (6 acres) is attached for practical instruction with an initial expenditure of Rs. 70 per acre for stocking, &c., and an annual expenditure of Rs. 60 per acre for working expenses."

The College class was worked for many years on the system according to which the final examination was held and final certificates awarded to the students at the conclusion of their course of study by the College, and during the time that it was so worked it turned out many very excellent men from its classes. Some of the students who passed through the College class have been eminently successful, and the influence of the agricultural branch of the College has been extended into provinces other than Bombay. Mr. Fuller will, I believe, bear me out in my statement that many of the passed pupils of the College agricultural class have been found valuable assistants. But we soon found that a College certificate did not possess in the eyes of the natives the same value as a certificate from the University of the Presidency, and several attempts were made to induce the University to recognize agricultural education by granting a degree in that subject. I am glad to say that after several unsuccessful attempts to influence the University, a signal success was achieved last year, and the University at last has consented to institute a diploma in Agriculture.

The University went further even than this, for it has included Agriculture as one of the voluntary subjects in its new school final examination, so that we have in Bombay at present both the higher and lower grades of agricultural education recognized by the University of Bombay.

From my own knowledge—and I may say that my experience has extended over many years, as I have been Principal of the College for 25 years, and I have on two occasions acted as Director of Public Instruction—I most confidently affirm that, unless a teaching institution is connected in some way with the University, it is sure to fail.

In looking over some papers yesterday, I came upon a memorandum drawn up by Mr. Ozanne, who gave every possible assistance in our mutual efforts to influence the University to establish an agricultural diploma. This memorandum was circulated to all the Fellows of the University, and I will read it—

“The proposal to establish a diploma in Agriculture will be brought before the Senate on the 12th September.

“A curriculum has been drawn up in 1886 by a Committee nominated by the University. The proposal is that the Faculty of Civil Engineering should be extended to embrace agriculture. The curriculum provides for a 3-year course and for an examination at the close of each year.

First year—

- (1) Mathematics. [Algebra and Euclid.]
- (2) Natural Science—
 - (a) Heat.
 - (b) Botany. [Morphology and Physiology of Plants.]
 - (c) Agriculture. [Soils, manures, and implements.]

Second year—

- (1) Mathematics. [Trigonometry and Mensuration.]
- (2) Natural Science—
 - (a) Chemistry, Inorganic and Organic.
 - (b) Systematic Botany.
- (3) Veterinary—Anatomy and Physiology of farm animals.
- (4) Agriculture—Culture of various crops and preparation for the market—Rotation of crops—Fruit culture—Irrigation.

Third year—

- (1) Natural Science—
 - Agricultural Botany.
 - Agricultural Geology.
 - Agricultural Chemistry.
 - Qualitative Analysis.
- (2) Surveying and Levelling.
- (3) Veterinary Pathology, Hygiene and Obstetrics.
- (4) Agriculture—Breeding, feeding, and management of cattle—Parasites of farm animals

“2. The course is sufficiently wide, and there are now facilities afforded for instruction therein. At some of the High Schools elementary training is given to fit those students whose object it is to proceed to the diploma for the higher instruction which is available at the two recognized centres—

- (1) The College of Science, Poona.
- (2) The Baroda College.

“At the College of Science there is little wanting. The subjects which enter into the curriculum for the degree of Civil Engineering are taught in the ordinary course, and there is a special agricultural branch. Much attention has been paid to the proper equipment of this special branch. Theoretical instruction is imparted in the College lecture rooms, and there is attached to the College a well equipped instruction farm managed, as it should be, by the Agricultural Department, where practical instruction is given by the Farm Superintendent. The farm has a small herd of selected cattle of the best milking breeds, and a small Veterinary Hospital, under a qualified instructor, is placed close to the college and farm. In the College and in the Hospital the students receive practical and theoretical teaching from a Veterinary Surgeon. In Bombay there is a Veterinary College and Hospital to which those students of the College of Science who wish to make veterinary their speciality can repair, but the veterinary teaching of the College of Science is adequate for the purposes of the proposed diploma.

"Quarters for resident students on the farm are being erected. The laboratories and lecture rooms are all that can be desired. In short, the College of Science has, under the Government scheme for technical education in agriculture, been amply equipped, and is fit to take its place as the Agricultural College of the Bombay Presidency.

"Two steps are yet to be taken—

"(1) A trained agriculturist from England is required to manage the experimental farms of the Agricultural Department, and especially the instruction farm attached to the College. This officer is about to be brought out.

"(2) An Agricultural Chemist of European reputation is needed; and requisition has already been made for such an officer, who is to spend three months of the year at Poona.

"The Baroda College in its capacity as an agricultural college is following in the steps of the Poona College. A chair of Agriculture has been sanctioned, and a Professor will fill it from November next.

"3. It cannot be held then that it is premature to ask the University to give all the help in its power to further the cause of agricultural education in this country, where the only occupation of the people is agriculture. Rather should it be said that the University has been backward in its action, for it has allowed steps to be taken and hopes and expectations to be raised which cannot be fulfilled till the University has taken the step now proposed.

"4. The reasons, or some of them, why the diploma in Agriculture is necessary are:

"(1) To encourage the study of Agricultural Science in this country, where with the increase of population increased production or emigration must soon be the only two practical alternatives. Emigration is a most unsatisfactory and unpopular way out of the difficulty. Increased production is not only feasible, but it is the duty of the State to foster it. It does not seem necessary to argue the point whether Agricultural Science can be trusted to increase production. It has succeeded in every country where it has had a fair trial.

"(2) To diffuse a knowledge of the principles of agriculture in the ranks of the Revenue officers of the State. These officers are intimately concerned with the condition of agriculture. Their duty is to watch its progress, to help the farmer, and to foster improvements. The advice they now give is as likely to be harmful as beneficial. The Government has to base its administrative action largely on their reports. It is then all-important that a knowledge of the main principles which govern production and stimulate improvement should be diffused among the educated officials of the Revenue Department.

"(3) To aid the Agricultural Department in its slow and patient experiment and research. The want of money demands that this Department should work largely through the Revenue officials. But it needs trained men too, and these it can only secure if the proposed help is given by the University.

"(4) Cattle disease is one of the greatest hindrances to the improvement of agriculture. It cripples the farmers, and there is nothing so necessary as a knowledge of the characteristics of the most prevalent diseases, which would teach the Revenue authorities how to act in the absence of trained veterinarians.

"(5) On these grounds it is contended that agricultural education is essential, and that education cannot be healthy, hopeful, and progressive unless the University extends all the help and encouragement in its power."

I would add a word or two on the importance of Government support to the men who pass through the agricultural course. Unless Government will give employment to these men, they cannot be expected to take advantage of the education offered to them. Government in this country holds in its own hands almost all the posts in which such men could with advantage serve. And I must say that I think that men who have gone through such a course as that prescribed by the University should be at least as useful in the Revenue Department as men who have taken an Arts degree and studied History and Philosophy. I hope that this Conference will express a strong opinion on this subject, and will recommend that a certain number of appointments be annually guaranteed by Government to men who take advantage of agricultural education in the same way that a guarantee is now given to graduates in Civil Engineering by the Department of Public Works.

With some such guarantee of employment to men who enter on the study of Scientific Agriculture, there will be a most healthy competition, which will ensure an ample supply of really good men, and prevent men who have failed in everything else coming forward to take up agriculture as a last resource.

It is to the facts that (1) the Engineering course has been taken up by the University, which was not the case when I first came to the College, at

Poona; and (2) that encouragement has been given by Government to graduates in that branch by the guarantee of certain appointments that no less than 65 candidates will appear from the Poona College of Science for the examination for the Degree of Licentiate of Civil Engineering next month at the Bombay University—a result, I should say, almost without parallel in the history of Indian Universities.

With regard to the education of the ryots proper, there are many difficulties, one of the chief being that when you educate a ryot and teach him to read and write, he immediately wants an appointment in Government service as a clerk. However, I think it would be quite practicable to institute farm classes on the larger farms, such as that at Bhadgaon in Khandesh. Such a class did exist there, and I have always understood did much good. But this is altogether a question which the particular conditions of a district only can decide, and which must be left for the Local Governments to adjudicate on.

The advice of the Agricultural Chemist would be very valuable on questions relating to agricultural education, and would no doubt be asked by Local Governments. His advice to the Universities, however, could only be given to a University if he were a member of that University. Those who are acquainted with the constitution of Indian Universities and the independence of the faculties in the various branches will understand that any attempt at interference with their prerogative would result in failure.

The Local Governments can, and no doubt will, appoint the Agricultural Chemist a Fellow of the Universities in their respective provinces, and he can then always bring forward for discussion any points which may to him seem of importance.

Further discussion of the subject was postponed till the following day.

Proceedings of the Agricultural Conference.
Fifth Meeting, Friday, the 10th October 1890.

PRESENT :

<p>SIR E. C. BUCK, Kt, <i>Secretary to the Government of India, Revenue and Agricultural Department.</i></p>	} President.
<p>HON'BLE W. C. BENETT, <i>Secretary to the Government of the North-Western Provinces and Oudh.</i></p>	} Members.
<p>H. F. CLOGSTOUN, Esq, <i>Commissioner of Settlements and Agriculture, Madras</i></p>	
<p>DR. T. COOKE, <i>Principal, College of Science, Poona</i></p>	
<p>M. FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal.</i></p>	
<p>J. B. FULLER, Esq, <i>Commissioner of Settlements and Agriculture, Central Provinces</i></p>	
<p>T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i></p>	
<p>HON'BLE P. NOLAN, <i>Secretary to the Government of Bengal.</i></p>	
<p>E. C. OZANNE, Esq, <i>Director of Land Records and Agriculture, Bombay</i></p>	
<p>F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab.</i></p>	
<p>E. B. STEEDMAN, Esq, <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab</i></p>	
<p>R. G. THOMSON, Esq, <i>Officiating Revenue Secretary to the Government of the Punjab.</i></p>	
<p>DR. J. A. VOELCKER, <i>Consulting Chemist to the Royal Agricultural Society of England.</i></p>	
<p>J. W. P. MUIR-MACKENZIE, Esq, <i>Under-Secretary to the Government of India, Revenue and Agricultural Department.</i></p>	

AGRICULTURAL EDUCATION.

Mr. Clogstoun took the chair in the absence of the President, and asked *Mr. Middleton* to continue the previous day's discussion.

Mr. Middleton : I hope that the majority of those present consider agricultural education a good thing, not merely because "education," but because it is a means of improving Indian agriculture. That it has done so in other countries must be admitted. In Britain, where primary education has been hitherto neglected, higher agricultural education has been a potent factor in the improvements which the present century has witnessed.

It is very much because of the teachings of such men as Davy, Liebig, Lawes, and Gilbert, and the late Dr. Voelcker that the British farmer has been able to meet such results of new economic conditions as higher rates of wages and outside competition.

In other countries, as Sweden, Denmark, and Germany, where primary education has received attention, the skill attained by the people in the manufacture of dairy products and the management of poultry causes some alarm among their rivals in Britain.

I do not think that the conditions in India differ so essentially from those in Europe as to prevent us concluding that what has achieved success in one Continent may be expected to produce good results in the other.

But when I say that we may expect good results from a system of agricultural education in India, I would add that, in order to obtain the practical benefits which we all desire so much, the system of education must be adapted to the classes to be educated.

In suggesting a scheme, the first question is, where are we to lay the foundation? Are we to begin with primary education and work up to higher, or are we

to "build from the top"? My answer is that the latter is the only practicable course, and that for this reason, much as we might desire the contrary, primary education of a kind which will *really benefit agriculture* cannot now be introduced into village schools all over India.

Mr. Fuller puts a pertinent question when he asks, "Can we safely aspire to teach agriculture to the ryot," and he answers it by saying, "I do not think that we can venture beyond principles."

I am of opinion that we cannot expect practical results from teaching to boys of the ryot class the *principles* of a subject like agriculture. I do not deny that principles will be learned by the boys in the same way as they learn Persian odes and verses of Shakespeare, and, when so learned, the principles of agriculture may or may not have a similar value to the poetry, but that the boys will be able to deduce from these principles a single conclusion that will really affect their practice in the fields, I very much doubt.

Another cause that makes the teaching of 'principles' in village schools impracticable is that, in order to convey the elementary truths of science to young minds, very special attainments are necessary—attainments which we cannot look for in village schoolmasters.

As an example of the difficulty of teaching elementary principles with success in a country where the higher education of the people presents no difficulty, I would instance Ireland (*vide* Madras Agricultural Committee's Report, page 134).

To produce practical effects, the son of the ryot must see rather than hear, and an essential in training him is a model farm.

He must be shown improved processes, and told "this is right and that is wrong," and until we are able to attach to the village schools farms which are better than those of the average ryots, the teaching of agriculture will produce but few results.

As the production of a "model farm" is the highest ambition of Scientific Agriculture, it must be evident that the establishment of a general system of primary education which will *directly* influence the agriculture of India may follow, but cannot precede higher education.

An excellent example is furnished by Nagpur. Mr. Fuller tells us that there successful primary instruction is being given in agriculture; but what could have been done had it not been that Mr. Fuller himself studied local conditions for a number of years, and further, and I lay stress on this, had it not been for the previous establishment of higher agricultural education at the College of Science, Poona?

With regard to higher agricultural education in India, we are often told that it is not wanted, and that the cultured classes will never take to cultivation; but we have the evidence of Messrs. Finucane, Fuller, and Ozanne that men possessing no previous qualifications, if properly trained, make excellent practical farmers, and in revenue and other work equal or excel their fellows who have had a literary training.

The Conference has resolved to recommend that there should be an increase of experimental farms in the country.

The spread of these farms will cause a demand for highly trained Superintendents, and for the education of suitable men I would propose some such scheme as the following (which is illustrated by references to the Bombay Presidency and University): At the University "Previous" examination, five scholarships of Rs. 10 each per mensem should be offered to students; these scholarships to be tenable on condition that the holders spent first of all two years on a selected farm for the purpose of becoming practically acquainted with agriculture, and with the special difficulties which higher education would help to solve. During residence on the farm scholars would be engaged in actual work, for which they should be paid at current rates

At the end of two years, provided progress had been satisfactory, the scholarships should be increased to Rs. 15, and the students allowed to proceed

to some qualified college for the purpose of studying Agriculture and the Allied Sciences, and with the ultimate object of obtaining a degree in Science. The number of years necessary for scientific studies would depend upon the course prescribed by the University. For an examination equivalent to the present Bombay diploma two years would be enough, but in the event of a degree being given, a longer period might be necessary.

At the end of the curriculum, probably two out of the five students who obtained scholarships would graduate with credit and enter Government service. The selected men should again return to farm work, and serve as salaried under-superintendents until the Director of Agriculture was satisfied that they were really competent, when they might be appointed to the charge of Government experimental farms.

A similar course, subject perhaps to variation in the relative duration of practical and theoretical study, would, I think, be suitable for Normal School teachers, candidates for Revenue Service, and others.

In teaching for a University degree, I think that the order of study I have indicated will be found most suitable.

A candidate who passes the "Previous" examination of Bombay with credit possesses the sound knowledge of English Language and Literature, Logic, Mathematics, &c., which all Universities demand of their students, and has reached a stage at which he may with advantage specialize. At the same time the education he has is complete in itself, and his studies need in no way suffer from the interruption rendered necessary by his removal to a farm. On the farm, as I have said, the student would be thoroughly trained in the routine work of cultivation, the care of stock, the keeping of farm books, and the general duties of a manager; he would further be brought face to face with facts which he could not explain, and which would raise within him a desire for scientific training, and he would return to college with mind and body alike invigorated, ready to gather from the lectures of his Professors the explanations of the phenomena which had perplexed him during his practical training. If possible, the college in which scientific training is given should be on or near a farm, so that the student, though not engaged in practical work, may keep up his interest in it. It should be the duty of the teacher of Agriculture to see that each member of his class visits the farm regularly. In support of the view that practical training ought to come before scientific teaching, I would refer to the opinions of Professor Jorgensen quoted on page 152 and of Mr. Benson on page 144 of the Madras Agricultural Committee's report.

Mr. Keess of Saidapet has recommended that practical study should succeed theoretical. His proposal—and it seems to me rightly—does not meet with the approval of the Madras Committee. It is of opinion that "theoretical and practical training should go hand in hand." In the course for village teachers at a Normal School, where time is limited and the standard of education low, it is probable that the best plan is to teach practical and theoretical subjects together. The objection to this method is, that idle students make the farm an excuse for neglecting their studies, and that book-worms make studies an excuse for neglecting the farm. And I must say I think it would be too much to expect that men studying difficult sciences should work on a farm all morning, attend college during the day, and read at night. All the practical work that could be expected from hardworked students would be a daily visit to the farm to see what was being done.

The *President* returned and relieved Mr. Clogstoun of the chair.

Mr. Ozanna: I would like to make a few remarks, particularly with respect to the difficulties I see in the way of primary education in agriculture in village schools. I will read the recommendations of the Bombay Committee,* approved generally by the Bombay Government, on the subject of agricultural education, and then the proposals† submitted to this Conference for consideration by an association of Native gentlemen in Poona, most of whom are directly interested in the practice of agriculture, and all in

* Report, dated 8th July 1890 (*vide* Appendix A).

† *Vide* Appendix G.

the advancement of technical as well as general education. I have already distributed copies of the proposals by these gentlemen, who, I may add, met in Poona on the occasion of Dr. Voelcker's recent visit to discuss the various matters on which Dr. Voelcker sought for an expression of native opinion. The Bombay Committee's recommendations are as follows:—

"As to agricultural education and improvement, we will discuss the former subject first.

"It is within the cognizance of Government that the College of Science, Poona, has been enlarged so as to constitute the Agricultural Branch of that College—the Agricultural College of the Presidency,—and that a similar step is being taken in connection with the Baroda College. Both colleges are now affiliated to the University for the Diploma in Agriculture recently instituted by the Senate. Farms are, or are about to be, attached, which will be to some extent experimental, but primarily demonstration farms, on which the students in agriculture can see the staple crops of the locality grown, and can watch experiments. These farms will be respectively under the Superintendent of Farms at Poona and under the Professor of Agriculture at Baroda, each assisted by qualified Assistants. One of the duties of these Assistants will be to hold farm classes on the farms. At Poona theoretical instruction is imparted by a teacher of Agriculture and Botany, as well as by the Professors of Chemistry, Physics, and other kindred subjects. A veterinary hospital is attached to the College to make the lectures in Veterinary Science more practical.

"Thus provision is made both for the theory and practice of agriculture.

"The students are for the most part Brahmans and Parsis, but many, especially from Gujarat, belong to the purely cultivating classes. They are not always or generally youths who intend to farm themselves, but are candidates for the diploma, seeking thereby an entrance into Government service. It is our conviction that the beginnings in agricultural education should thus be made among the educated classes. The successful candidates for the diploma will seek employment in the Revenue Department after the small demand for the Agricultural and Educational Departments has been satisfied. The posts in the last named Department are those of High School teachers of Agriculture and Physics, who are at present men trained at Madras or Poona. They teach the first principles of agriculture common to all systems, and they give some practical instruction on the plots of land specially attached to the schools for this purpose. It is intended that the agricultural classes in the High Schools should feed the Agricultural Colleges, and in some degree this result is being secured.

"We must instruct the educated classes first, so that they may assist in agricultural enquiry. When that enquiry has sufficiently advanced—and it must advance slowly when we consider the great variations due to soil, climate, and situation—it will, in our opinion, be time to take steps to teach the principles of Agricultural Science in primary schools. We must get abreast of the empirical knowledge of the cultivator before it will be safe or useful to allow any teacher to arrogate to himself the right to teach Indian agriculture.

"There is, however, one way of reaching the real cultivators, as desired by the Supreme Government, and that is by inducing them to come as apprentices to the farms. Something has already been done in this direction at the Bhadgaon farm, and some of the apprentices have turned out superior farmers. Nothing, however, of real importance can be done in the way of teaching apprentices till accommodation is provided for them at the farms, and till the number of farms is increased."

The Poona Association's representations are as follows:—

"To the means enumerated in the foregoing paragraphs it is necessary to add general education to improve the condition of the agriculturist. He is lamentably backward in this respect. Ninety-five out of a hundred cultivators cannot read or write, and very few can count up beyond twenty. Village schools should be more thickly spread than they are at present, and besides the knowledge of the three R's, elementary instruction in agriculture, showing the advantages of ploughing, harrowing, hoeing and manuring, the rotation of crops, and the selection of seed, should be given from books specially prepared on the subject. It is necessary that the village teachers should have received instruction in the principles of agriculture, and the subject should be taught to the pupils of training colleges and demonstrated by the working on the zilla farms, to which they should be taken once a week. If practicable, farms may be attached to training colleges, where the teacher will be able to illustrate his lectures more frequently, and get his pupils to do practical work. We are of opinion that the teaching of agriculture in training colleges, the pupils of which are intended for village schools, and some of whom are sons of agriculturists, will be more useful to the people than the teaching of it in High Schools or Colleges to pupils of higher classes whose connection with the agriculturists can seldom be very great or intimate."

You will see that whereas the Bombay Government would prefer confining education in agriculture, for the present at least, to the educated classes, the Association lays more stress on primary education in agriculture. We have all heard with great attention and interest Mr. Fuller's reasons why

primary education may be undertaken in the immediate present. As to the desirability, I am at one with him. I think that from its very nature such instruction has immense power in opening the minds of the young chiefly because it deals with objects of interest to the ryot's son, and its illustrations must come from objects of every-day observation. So it is a practical application of the principles of the Kindergarten object-lessons system of teaching.

I notice again that Mr Fuller is anxious to confine such instruction to principles. His object is not to teach agriculture, but to use agriculture as a means of educating the mind, and he foresees that it will create an interest in the after-study of agriculture for the sake of improving agriculture itself.

With this object in view, and confining the teaching to these limits, I will raise no objection to agricultural instructions in village schools, provided two conditions are fulfilled:—

- (1) That we wait till competent teachers are available.
- (2) That we wait till a text book can be prepared.

Mr. Fuller with characteristic energy has already provided the text book for the Central Provinces, and he has secured teachers from the Poona College of Science, so that he may begin at once; but I cannot claim to be ready with a text book. I feel that I shall want not one, but half a dozen; for though the principles of agriculture are the same throughout the world, the practice so differs that illustrations, with which the text book must bristle to keep the attention and interest alive, must vary with varying practice. Our enquiries must advance a little. I prefer then to see elementary agricultural instruction introduced into village schools as I advance in agricultural enquiry. When I have completed the minute study of any district, I shall try to follow on with a text book for that district, provision in the meantime being made for the training of a teacher to teach in the vernacular.

I need not say more on this subject, but I think I can assure the Hon'ble Mr. Nolan that we are all interested in primary education. But we are not here dealing with the subject generally, but specially in reference to agriculture. There is no reason why all possible efforts to increase general primary education should not be made. All we say is that as the facilities for extension of village schools increase, so the attempt should be made to make the best use of the facilities by superadding a subject which will induce the ryots' sons to go to school. I might say that it is not in the number of schools that we are behind hand so much as in the number of scholars, and Mr. Fuller's scheme for primary agricultural education will just give the fillip required to fill the schools and make them popular.

I turn now to the subject of higher agricultural education. I fully agree with the Hon'ble Mr. Benett and Dr. Cooke that the most urgent necessity exists that the Universities should recognize the special needs of this country for education of the highest scientific and practical character in agriculture.

The action of the Senate of the Bombay University in instituting a diploma of Agriculture shows that it is recognized by the Bombay University that the higher teaching of agriculture may now be ranked with the teaching of literature.

Till the Universities everywhere recognize the claims of Agricultural Science, all efforts to induce the educated classes to enter the affiliated colleges in order to qualify as scientific agriculturists will be wanting in results. I need not before this Conference try to prove that a degree in Agriculture can, and should, prove as high a standard of education as a degree in Law, Medicine, or Engineering.

The first result of a degree in Agriculture will be that graduates in agriculture will in the ordinary course seek to join the revenue ranks, and I need not repeat the reasons which have already been urged by other speakers for the desirability of leavening the Revenue service with such men.

I am not one of those who think it is a reproach to the country that men will not join the Colleges in their agricultural branch without the

stimulus of Government employment. When the instruction is first-rate and full, the successful students will command respect from practical agriculturists; and it is not rash to say that when educated men are available as land agents in this country, they will find employers other than Government. A capitalist who invests in land has now no other way of managing his lands than through the cultivators as tenants under the many systems which are met with. But when capitalists see that they can get more out of their lands by employing an agent to supervise the tenants, I think that they will readily employ them. It will give them security sufficient to induce greater improvement. Thus, then, the higher education in agriculture will not only supply the men which Government in its various departments either needs or desires, but will make land agents for private employers available. There is no reason to believe that large landholders will not in time prefer to educate their own sons to be competent land agents. This is very desirable in the interests of agricultural improvement, and will come, however slowly, if Government makes provision for thorough education, scientific and practical. But no such result will be evolved without the initiative of Government and the cordial co-operation of the Universities.

The instruction in higher agriculture must be practical as well as scientific. No doctor will get private practice if he cannot himself be trusted to perform surgical operations. The difference between a graduate in Agriculture and in Medicine is that, provided the former thoroughly understands his practice, he need not be called on to perform all operations personally as the surgeon must: we may see some encouragement in this. Educated men in India *have* qualified as surgeons and as veterinarians, and have come forward when the inducements have been adequate; they will come forward more readily to qualify as scientific farmers when Agricultural Science is recognized as not inferior, but as equal in dignity and utility to any of the sciences now encouraged by the Universities.

The resolutions of the Conference on the subject of the appointment of an Agricultural Chemist and on the institution of experimental and educational farms will provide for the practical side of the instruction; and I most fully concur with the decision of the Madras Government that no graduate should be put in charge of an experimental farm who has not served an apprenticeship in practical agriculture. How this can be best effected must be left to the various Departments of Agriculture to study.

I must not omit to notice other important educational functions of Government farms, and I refer again to the recommendations of the Bombay Committee, *viz.*, that *bona fide* ryots should be induced to send their sons to the farms as apprentices. Even here Government may encourage them by giving them posts as overseers and makadams on farms, for the farms need such men; and in making provision for the wants of the farms, it is possible to reach the ryot directly. Many will be tempted by the prospect of Government service, but some will learn that greater profit is possible in farming on their own account, and will leave Government service to farm for themselves.

Mr. Robertson enquired if the Agricultural Primer was taught throughout primary schools in the Central Provinces.

Mr. Fuller thought it was, but that it was optional at present, though it may be made compulsory hereafter.

Mr. Muir-Mackenzie: Observed that the value of agricultural education, more especially of the primary class, had been considered in its relation to the possibility of effecting improvement in the practice of agriculture. The illustrations quoted by Mr. Steedman from the Jhang and Rawalpindi Districts on this head had been taken to imply that there were classes of cultivators upon whose methods little improvement could be obtained. Mr. Muir-Mackenzie, however, understood that these instances were cited to indicate not the impossibility of effecting any improvement, but that the ryot was not as indifferent or blind to the imperfection of his practice

as was alleged, and that, if the way were open to him, he was not less ready to take advantage of his opportunities than any other class of men. The speaker concurred with those gentlemen who had stated their belief that one of the most effectual ways of bringing about agricultural improvement was to teach to the bad cultivators the methods of their neighbours. To show that a wide field existed for such efforts, he referred to the Jain and Mahratta cultivators in the Krishna Valley, the lands of the former exhibiting the most elaborate and careful tillage interspersed among fields of the latter, which often remained unploughed for two or three seasons in succession. Whether much would be soon or directly effected by teaching in primary schools he felt doubtful. It would not be denied, he thought, that the proportion of absolutely illiterate agriculturists was exceedingly large. He had observed when visiting village schools in Bombay that, while the large proportion of scholars were non-agriculturists, the agriculturist scholars were far the most backward, and left the schools before attaining to the higher standards. He also thought it obvious that if agricultural knowledge was to impress itself generally upon the rustic classes, they must at least learn generally to read and write. For the introduction, therefore, of agricultural improvement among the cultivators themselves, he relied more on experiment and demonstration than upon agricultural teaching in primary schools. He did not, however, see the necessity of awaiting fully qualified teachers before introducing Agricultural Primers. On this point he agreed with Mr. Finucane. There was no harm, and there might be good, by learning to read from a book which taught agricultural truths, rather than books which taught him information which received no illustration from the life around him.

As regards both middle class and higher education, he considered that one of its most useful and legitimate objects was to introduce into Government employment a set of men who had received education in the theory and practice of agriculture.

As an exemplar of middle class education, he was ready to take the Nagpur College and Farm, which dispersed over the districts Revenue or Settlement Inspectors trained in agricultural subjects. Such men would not always, or perhaps even generally, make direct use of this knowledge. But the exceptionally zealous among them would have an agricultural foundation to work upon, from which agriculturally useful results would ultimately follow, whereas the ordinary Arts matriculate would have little or nothing to tell the cultivator that he would under any circumstances care to hear. He did not understand why Dr. Cooke had hinted that the demand for agriculturally educated teachers must for some time be small. He ventured to think it should be very extensive, particularly if the introduction of Agricultural Primers was to await the supply of qualified teachers. No large school ought, he thought, to be without some one teacher, Assistant or Head Master, who had passed in agriculture.

With reference to the higher education in agriculture, he wished first to observe that he could not question the strong desirability of agricultural training for the higher class of officers in the Revenue and similar Departments. Such training had lately been prescribed as part of the curriculum for passed candidates in the Covenanted Civil Service. The use of a tahsildar or mamlatdar thus trained he thought obvious. In Bombay at least the mamlatdar had a considerable influence in the distribution of takavi and in the management of local funds. Such an officer, if well educated in agriculture, would be stimulated to use these powers for its improvement. One reason perhaps why there had been hesitation in holding out inducements in the way of Government employment to men whose education had been agricultural was that there was an uncertainty that the tests would be as searching and severe as in other and longer established branches of education. There had been in the past some foundation for this fear. But with the guarantee afforded by the University degree and with the advice of a highly qualified Agricultural Adviser, there should be every security that a course of study comprehensive and exacting enough to satisfy all requirements would be prescribed. His personal experience and observation of successful men at Cirencester

convinced him that the mental application and powers required to obtain the diploma there were in no way inferior to that required to obtain the University Honours with which the diploma was compared. Though at Cirencester there was undoubtedly a great difference between the man who scraped through and the man who came near or got the medal, it did not exceed that between the University 3rd and 1st class men. In short, he confidently maintained that Government could look for as adequate a mental equipment from the men who took a properly instituted Agricultural degree as from those who obtained the existing degrees in Arts, Science, Law, or Medicine. If this was not agreed in, let it be remembered that it was easy to introduce agricultural subjects as part of the test required for degrees in the faculties already existing, such as those of Civil Engineering.

Higher education and University degrees in every subject whatever were admitted to be looked on for good or evil by the natives of this country as stepping stones to public employment. The only material exceptions were Law, and, perhaps to a less degree, Medicine. But even in these two cases how many men looked forward first to a pleadership or private practice? How many of the native doctors or vakils were anything but Government surgeons or mun-siffs "manqués?" This being so, why should any reproach attach to the proposed higher agricultural education because it would at first anyhow be regarded in the same light? He maintained that as it will be useful to have in the public service Art, Law, and Science graduates to increase its efficiency in those fields, so will it be useful for it to contain Agricultural graduates, who would increase its efficiency in the field of agriculture. The Governments need hold out a comparatively small amount of inducement. In Bombay five appointments had attracted 65 candidates for the degree in Civil Engineering. It must be remembered, however, that, but for these appointments, probably not a man would turn his attention to the subject. Every one would have run on in the old groove. This is what it is important to prevent, and for this purpose he hoped the Conference would affirm the principle that Governments should allot a definite number of appointments to men who had passed certain definite high tests in agriculture.

Nothing could be more certain than the danger alluded to by Mr. Fuller that agricultural education might become unpractical. At the Diploma examination at Cirencester each candidate had a whole fortnight's work in the Chemical Laboratory; he was taken on the farm by two practical farmers unconnected with the College, as well as by the Professor of Agriculture, who gave him a raking *visá voce* in all his weak points. He thought nothing less severe ought to be thought of in the courses adopted in this country. In the Poona College, with which he was most familiar, he should like to see students before being passed given a bad half hour or so with men like Mr. Middleton or Mr. Ozanne, assisted by a Committee of good cultivators, such as the neighbourhood of Poona would have no difficulty in supplying.

Lastly, he thought that as for some time to come Universities in this country would not have 1st class agricultural experts of their own to draw up their syllabuses and prescribe their courses, it should be a recognised function of the Agricultural Adviser to assist or, even if it could be so arranged, to prescribe such parts of the course as were essential in every province, to recommend text books, and set at least some of the examination papers, even if he had not time to look them over.

Mr. Finucane thought we should work not only from above downwards, but from below upwards. In the Madras report (page 134) it is stated that in Ireland (which in some respects resembles India in regard to the backwardness of agricultural practice) the study of Agriculture is compulsory in all rural schools of the fourth and higher standards. The Superintendent of Glasnevin and Inspector of Agricultural Education considers that teaching even from mere text books is of some benefit. The boys learn practice in their father's farms and principles at schools. The boys may not understand these principles, but they will carry them away, and turn to them for instruction later in life. This is the testimony of Professor Carrol, Professor Tanner, and Professor

Baldwin in Ireland. He therefore thought that primers should be introduced without waiting for teachers, but he was, as he had already stated, strongly of opinion that teachers should also be trained, and instruction by them would no doubt be better than mere instruction by text books or readers. He was of opinion that a demand for agricultural education is arising in Bengal, and there is no part of India where such education is more likely to be fruitful of good results.

The *President*: Before calling on Dr. Voelcker to address the Conference, I will make a very few remarks on one or two questions which have been raised. It has been implied that because the students at those agricultural institutions which exist go off to other vocations, that so far the institutions fulfil no sufficiently useful end, *i.e.*, no end justifying the expenditure under the head of agricultural education; and Mr. Steedman has in this connection suggested that practical education should be limited to the larger landholding class.

It would seem, however, necessary to bear in mind that students go off to other vocations because there are not at present sufficient openings in a strictly agricultural direction. If, however, a scheme of agricultural education is developed, trained students will be wanted, as Dr. Cooke shows, as instructors. The evidence before us indicates that they will be largely required in this capacity. They will be also needed, as the Hon'ble Mr. Benett indicates, to leave the ranks of native officials on the administrative staff. And in confirmation of this view, it is satisfactory to learn that the officials who have received a practical education are in two provinces considered to have proved distinctly more useful officers in general executive administration than those who have received a merely literary education. There is very little opportunity under the existing system of education for students to acquire the habit of observation and of turning the results of observation to useful account. If this element is introduced into the educational system through the medium of agricultural schools or classes, it will, to use the Hon'ble Mr. Benett's words, tend to leave the administrative staff, not merely in direct connection with agricultural improvement, but rather in providing the Government with officials who know how to use their eyes and hands. Other sections of the educational scheme might, it is true, be utilized for the same purpose, but considering the very close connection of agriculture with the whole of our administration, as well as the fact that the bulk of the State revenue depends upon agriculture, that particular branch of study deserves to be selected as the special one which should be utilized to introduce a practical element into our educational system.

It may also be suggested that the larger landowners would be less likely to accept any offer to accord to them a practical agricultural education if their early training had had no connection with the subject. At the same time it may be admitted that Mr. Robertson's remarks, in which he deprecates the too rapid multiplication of high class colleges, are in this connection useful. We should not attempt to turn out practical agriculturists in excessive numbers. We should consider the demand as well as the supply.

What Mr. Robertson has said on this subject confirms the views of the Government of India as expressed in the fourth paragraph of the despatch to Her Majesty's Secretary of State, dated 21st July 1888, of which I ask leave to remind you by the following quotation:—

"We hold it to be a mistake in the present backward condition both of the technical training of the country and of its financial resources to encourage in any single province excessive expenditure on scientific teaching or experiment of a highly technical character. We consider that for some years it will be sufficient to establish one or more centres at which the more advanced technical sciences of Europe can be taught to the natives of India. As time goes on, men will be found who, born and bred in this country, will avail themselves of the opportunities thus created, and will be of sufficiently high intellectual capacity to enable them to communicate to a larger number of their own countrymen the knowledge which they have themselves been taught. We apprehend, moreover, that the method of confining high-class training of a technical character to single provinces would lead, on the one hand, to the multiplication of inferior training establishments and to unequal results; and, on the other, to the complete exclusion from the country of really 1st class scientific instruction. In this view we are guided by the experience of the larger countries of Europe in which the training institutions of first rank are national, and not provincial or local."

I entirely follow the Hon'ble Mr. Nolan in placing initial importance upon primary education. Any scheme of agricultural instruction must depend more upon establishment of sound and widespread primary education than upon anything else. And it is possible and useful, as has been indicated by many of the speakers whom I follow, to give even to primary education a turn in the direction of agricultural subjects. But primary education is, and must be, in all provinces supplemented by instruction of a higher character, and all that we contend for, I understand, is that agriculture should be one of the most important subjects to which both in the primary and in subsequent stages of the educational course the attention of students should be directed. This is not the case now. The words which the Hon'ble Mr. Nolan has quoted from my note that "everything else in the world is taught but agriculture" are justly open to criticism. I should have said that, "whatever else is taught, it has no connection with agriculture." But in any case I ask that the remark now quoted may be read with the final clause in the next paragraph of the note, in which it is suggested that the minds of our students are led away from agriculture "by the literary character of their instruction, too closely restricted, as it seems to be, to History, English Classics, Mathematics, and other subjects of an academical character."

One of the most gratifying and hopeful facts which has been brought to our notice is that related by the Inspector General of Education in the Central Provinces in connection with the lectures on agricultural subjects, which, he says, if I remember rightly, were not only listened to with interest by the pupils, but voluntarily attended by their friends and relations of an older generation. It is only natural that it should be so. Every human being likes to be told about things which surround him; about subjects in which his thoughts are already interested, and which are not beyond the grasp of his mind on account (to use a word which I have seen coined) of their "far offness." I am a constant visitor to the Indian Museum at Calcutta. Hundreds of country people wander daily through its rooms. But there is no show case so crowded, none round which the country visitors spend so much of their time, as the clay models representing the simple agricultural operations in a village. Although these are nothing more than a representation of what they see every day, the very familiarity of the subject attracts them to a much greater degree than the far more wonderful, but to them strange and unintelligible, exhibits by which the clay villages are surrounded. So with education. Should not our educational scheme seize upon a subject which acts as a bait, as it were, to the uneducated masses, and which will tend to bring within the educational net such sufficient numbers of the rural classes as will swell the percentage of the educated coteries to a level which will satisfy the most ardent advocate of primary education?

In conclusion, I ask you, although perhaps I need hardly do so, to listen with deference to Dr. Voelcker's views and suggestions on the important subject of agricultural education. Dr. Voelcker, has in the opportunity which he has enjoyed of prolonged personal communication with yourselves or other officials of the Agricultural Department in each province, as well as an experience which has for a period of several years brought him into connection with subjects cognate to the question before us, advantages which none of us possess. But more than this. Whatever views Dr. Voelcker has formed will, in regard to the fact that he has been specially deputed to India by Her Majesty's Secretary of State in order that his opinion and advice should form the basis of the agricultural scheme (inclusive of agricultural education), be accepted as carrying with them exceptional force. From what has already passed at this Conference the satisfactory conclusion may be drawn that Dr. Voelcker's views are already in accordance with the general views held by those present, but it would seem desirable that, so far as this is the case, some positive expression of opinion should be placed on record in the form of resolutions. The Hon'ble Mr. Nolan has already expressed his desire to submit one resolution in favour of primary education, and I could invite Dr. Voelcker, and thereafter any other member who may wish to do so, to follow with such other resolutions as they may deem likely to meet with general acceptance.

Dr. Voelcker : The discussions of previous days have been concerned with points to which, according to the programme laid down for my guidance, my

attention was to be specially drawn, and upon which, if I may say it, my opinion after careful study might be looked to as carrying some weight. We have also, I am happy to think, come to an unanimous agreement with regard to the utilisation and teaching of Agricultural Chemistry, and it is with considerable satisfaction that I find the plan I sketched out meets with general approval.

The larger question of agricultural education is one in which I cannot help feeling deep interest; but, though in the course of my investigations I have watched its condition, so far as opportunity was afforded, and formed certain opinions about its further development, it is with great reservation I put these forward, for I feel that in considering agricultural education it cannot be dealt with alone, but only in relation to education generally, and to treat of that necessarily implies a far wider knowledge of the country, of the people, and of systems than I could possibly gain in the short time I have had.

The main points that arise appear to me to be these:—

(1) Is special teaching in Agriculture desirable?

* (2) Should it proceed from above downwards, or from below upwards?

The first point you have already expressed a decided opinion upon, and I concur in the desirability of making the teaching of agriculture part of the system of primary education. The reasons have been so fully given by other members of this Conference that I will not go into them further, but confine what I have to say to the second head.

I am distinctly of opinion that in order to ensure that the teaching given in elementary and middle class schools be of an efficient nature, and if by means of it we hope to reach the cultivating classes, the source from which the teaching power springs must be put on a high level, and we can never look to the stream to flow healthily throughout the country unless the fountain head be pure.

In the course of my second tour I have been considerably impressed by the useful work done by some of the local agricultural classes established through the energy of individuals holding official positions, but I have found these classes to be dependent for their teaching agency entirely on higher educational institutions; so, too, has it been in the case of the immediate supervision of experimental farms and stations. The Nagpur Agricultural Class, *e. g.*, is dependent on the teaching given at Poona; the Cawnpore, Saidapet, Bhadgaon, Seebpore, and other farms on instruction imparted mainly at Cirencester.

For such reasons, I venture to think we need to pay special attention in the first place to the agricultural training at colleges being good, so that wherever agricultural education spreads, it may be good in quality, because good in its origin; and that we should aim at this rather than hope to rise from acknowledged imperfection and error to comparative truth. Similarly, when a subject so essentially practical in nature as agriculture is concerned, we should make it a *sine quâ non* that it should be dealt with *ab initio* in a practical manner.

As to whether special agricultural colleges should be established in greater numbers or not, I think that, seeing we are only just entering, or proposing to enter, on a plan by which agricultural knowledge may be introduced into the present educational system of the country, it would be the wiser policy to make use of existing institutions at which science forms a part of the course, and tack on agriculture as one of the subjects taught, rather than to start fresh colleges purely for the teaching of agriculture. It should be made to form part of the existing scientific instruction of colleges rather than take the place of it. Nor do I think there is a call for such special institutions, nor could they at the present time be properly equipped so as to adequately provide for instruction in the various branches of a complete agricultural curriculum; the expense, too, would be very great, whereas if existing institutions be utilised, the teaching given in each science can at the same time be made use of for those studying agriculture specially. It would be comparatively

easy to provide a well qualified teacher of agriculture as an addition to an existing college staff and system.

Suppose this done, another essential remains, *viz.*, to provide a farm for demonstration purposes, and land upon which the students are to work with their own hands.

From centres such as these we may look for a certain number of men who, as occasion arises for the establishment of local agricultural classes, will be available as teachers, and carry with them the lessons of practice with science which they have learnt in the higher institutions. Going lower down, we may look for some who have gone through such classes to provide the teaching power for schools of various grades, and, finally, by the education in agriculture of the teachers in elementary schools, it will be ensured that the teaching given is on a sound basis, and not merely theoretical but practical. In this way alone we may look to ultimately reaching the cultivating classes. Whether it be a high, middle, or elementary school, wherever it is possible, demonstration by means of a farm or field should accompany the teaching; and it is essential that to every college or agricultural class lands for conducting the actual tillage and cultivation operations by the pupils themselves should be attached in addition. Mere teaching out of a text book by persons practically unacquainted with the subject they assume to teach will avail nothing, and teaching unaccompanied by practical demonstration will fall short too of accomplishing the right end.

It may be said that the great majority of those who will study agriculture at colleges will do so simply in order to obtain Government employ. Though this appeared to me at first a potent objection to the spread of agricultural education, I am not disposed now to consider it as such, but to agree with those who have urged that, even if this be so, it is a great advantage to secure in the Revenue service those who have had an agricultural training, and that they will form far more useful officers than those whose training has been a purely literary one. Unquestionably a scientific training tends to habits of observation that cannot help proving useful to a man so employed; and where, as in the case of the Central Provinces, there is a constant call for men of this class, the advantages must be patent. The call for employment of men of this kind in Government service supplies alone, therefore, sufficient justification for the introduction of agriculture into the educational system.

Nevertheless, in providing for additional instruction in agriculture, we should keep strictly in mind the number of men for whom occupation is likely to be readily found, and where a knowledge of agriculture will be of use to them. There is also to consider that, if the pupils of our colleges and schools do not go into Government employ, they are provided with a training which they can turn to practical account, and they are thus in a better position to utilise what they have learnt than had their education been purely on the lines of the B. A. or similar degrees.

The connection between colleges where an agricultural course exists and a University is a very desirable one, and the students successfully passing through it should be on the same footing as graduates in Arts, &c. A mere diploma, such as exists at Poona, is not sufficient or satisfactory.

As regards agricultural education in colleges, I am inclined to think that where it has been introduced already, there is a tendency to hamper the agricultural course by the inclusion, and for too long a period, of too many subjects not so immediately connected with agriculture. It is certainly right to insist on certain qualifications being reached in Mathematics, Physics, &c.; but this might be done before a student enters upon agriculture as a special subject, and having obtained the necessary qualification in these, he might proceed with the main subject—agriculture—in its more immediate relations.

Thus a *first* year's course might include—

Mathematics.	Elementary Botany.
Physics	Elementary Geology.
General Chemistry ;	

while a *second* year's course might be given to—

Chemistry.	|	Biology (including Plant Physiology).
Practical Chemistry.		Agriculture.
	Drawing ;	

and a *third* to—

Agricultural Chemistry	|	Surveying
Agriculture.		Veterinary Science.

Agricultural education should be in some way connected with the Agricultural Department possibly through the Director of Agriculture. It will also be a useful function, which the suggested "Agricultural Adviser" to Government can perform, to watch the progress of agricultural education, and for him with this view to visit the various institutions where it is provided for.

The following resolutions were then put before the Conference :—

1st resolution.—Proposed by the Hon'ble Mr. Nolan; seconded by Mr. Robertson—

"In considering the question of agricultural education and progress, the Committee desire to express the opinion that it is most desirable to extend primary education among the agricultural classes.

Carried unanimously.

2nd resolution.—Proposed by the Hon'ble Mr. Bennett; seconded by Mr. Stedman—

"That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend *exclusively* on separate special institutions."

Carried unanimously.

3rd resolution.—Proposed by Mr. Ozanne; seconded by the Hon'ble Mr. Bennett—

"Resolved that it is most desirable that the Universities should recognize the Science of Agriculture as an optional subject in the course for a degree."

Carried unanimously.

4th resolution.—Proposed by Mr. Fuller; seconded by Mr. Finucane—

"That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with the view of creating more interest in agricultural improvement amongst the cultivating classes.

Carried unanimously.

5th resolution.—Proposed by Mr. Ozanne; seconded by Mr. Finucane—

"Resolved that, in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and "readers."

Carried unanimously.

6th resolution.—Proposed by Mr. Cooke; seconded by the Hon'ble Mr. Bennett—

"It is highly desirable that the claims of men trained in Scientific Agriculture to appointments in the Revenue and cognate Departments should be as freely recognized as those of men trained in Law, Arts, and Engineering."

Carried unanimously.

7th resolution.—Proposed by the Hon'ble Mr. Nolan; seconded by Mr. Robertson—

"That where appointments in the Revenue or cognate Departments are made on the result of competitive examinations, Scientific Agriculture should be included as an optional or necessary subject in the examination course."

Carried unanimously.

Sixth resolution.—Proposed by Mr. Steedman; seconded by Mr. Thomson—

“Resolved that in any province in which it may be determined to introduce a scheme for higher agricultural education, no arrangements will be satisfactory which do not provide (1) for a thoroughly practical training of the students in the field and laboratory as distinct from theory or practice as taught in the lecture room, and (2) for examination tests of a special and searching character in the above branches of work.”

Carried unanimously

Mr. Thomson proposed the following amendment to the sixth resolution, but it was not seconded.—

“In any provinces in which special facilities are offered to men trained in Law, Arts, or Engineering to enter the Revenue or any cognate Departments, it is desirable that similar facilities should be offered to men trained in Agricultural Science.”

Proceedings of the Agricultural Conference.
Sixth Meeting, Saturday, the 11th October 1890.

PRESENT.

<p>SIR E. C. BUCK, KT., <i>Secretary to the Government of India, Revenue and Agricultural Department.</i></p> <p>HON'BLE W. C. BENNETT, <i>Secretary to the Government of the North-Western Provinces and Oudh.</i></p> <p>H. F. CLOGSTOUN, Esq., <i>Commissioner of Settlements and Agriculture, Madras.</i></p> <p>DR. T. COOKE, <i>Principal, College of Science, Poona.</i></p> <p>M. FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal.</i></p> <p>T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i></p> <p>HON'BLE P. NOLAN, <i>Secretary to the Government of Bengal.</i></p> <p>E. C. OZANNE, Esq., <i>Director of Land Records and Agriculture, Bombay.</i></p> <p>F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab.</i></p> <p>E. B. STEEDMAN, Esq., <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture, Punjab.</i></p> <p>R. G. THOMSON, Esq., <i>Officiating Revenue Secretary to the Government of the Punjab.</i></p> <p>DR. J. A. VOELCKER, <i>Consulting Chemist to the Royal Agricultural Society of England.</i></p> <p>J. W. P. MUIR-MACKENZIE, Esq., <i>Under-Secretary to the Government of India, Revenue and Agricultural Department.</i></p>	<p>President.</p> <p>Members.</p>
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AGRICULTURAL EDUCATION.

The *President* called upon Mr. Finucane for the rider he proposed to the last resolution passed at the previous day's meeting.

Mr. Finucane proposed the following, which was seconded by *Mr. Muir-Mackenzie*:—

"Further, that it is desirable that it should be considered whether a certain percentage of the appointments mentioned in the previous resolution of all grades should not be reserved for candidates who have passed prescribed agricultural tests, or whether at least a preference should not be given to such candidates."

Mr. Finucane, in proposing the above resolution, pointed out there was no security that appointments in the Revenue and cognate Departments would be reserved for men who passed the agricultural tests, e.g., in Court of Wards and private and Government estates in Bengal.

The *President* agreed with *Mr. Finucane*. He thought that, unless *Mr. Finucane's* resolution were adopted, nothing would induce men to go up for agriculture with a view to taking up Government appointments.

Mr. Clogstoun pointed out that the Madras Committee had gone so far as to suggest that "a knowledge of agriculture would be of great advantage to a Revenue Inspector," and to recommend "the gradual introduction of a rule restricting such posts to persons who have obtained the preliminary qualification certificate in agriculture."

The *Hon'ble Mr. Nolan* thought that the resolution should take the form of a suggestion for the consideration of Governments making appointments. The Conference was hardly in a position to arrive at a definite conclusion.

Mr. J. B. Fuller was not present at this meeting.

Mr. Robertson thought the resolution would commit Local Governments to appoint men who had a degree.

Mr. Thomson, seconded by *Mr. Steedman*, proposed the following amendment to the resolution :—

“That after the word ‘desirable,’ the following words be inserted, *viz.*,— ‘in any province in which appointments are reserved for persons who have obtained a degree in Arts or any similar educational distinction.’”

Mr. Finucane thought the proposed amendment would be inapplicable to Bengal, in which appointments are not reserved for persons who have obtained a degree, but are obtained either by competition or favour.

The *President* agreed with *Mr. Finucane*, and thought that the proposed insertion would also be inapplicable to some other provinces.

The *Hon'ble Mr. Benett* did not think that the original resolution would do much harm. It would in his opinion be inoperative.

Mr. Osanne said that in Bombay, in order to secure a high standard of education among mamlatdars, many appointments have already been reserved for graduates.

The *Hon'ble Mr. Nolan* objected to the amendment on the ground that it would have the effect of limiting the consideration of the proposal contained in the resolution to those provinces in, which an educational test of the nature referred to was in force.

The *President* agreed with the *Hon'ble Mr. Nolan*.

The amendment was put to the vote, Messrs. Benett, Steedman, Robertson, and Thomson voting for it. The amendment was rejected.

The original resolution was then put to the vote, and carried by a majority of seven to four. Dissentients : Messrs. Benett, Steedman, Robertson, and Thomson.

The *President* then called upon *Dr. Voelcker* to state before the Conference his suggestions regarding the appointment of Agricultural experts.

Dr. Voelcker : There is one matter which, inasmuch as I intend to make it a prominent feature in the recommendations of my final report, I think it is only right I should bring before the Conference now. It is true that even the scheme which the Government of India, we hope, will now recommend for the fourth time has not yet obtained the sanction of the Secretary of State, and that it is not likely he will be disposed readily to grant further expenditure. But my object in coming to this country is, I take it, not only to indicate what can be immediately done, but also what in my opinion must be the line of future development of agricultural improvement.

For the suggestion I am about to make, I find very strong support in the different memoranda which have been handed in to this Conference ; it is the association with our present Directors of Land Records and Agriculture of trained experts to whom the practical agricultural work of their appointments may after a time be entrusted.

I am sure I shall be allowed to say it even in such an assembly as this that, as a rule, a Director of Agriculture has not, with his many and varied duties, the time, even if he had the technical knowledge, to give to the practical business of the agriculture of his province, and that in all but a few instances the technical knowledge requisite for a study of that agriculture, so as to become really acquainted with its sufficiencies and deficiencies, is wanting, certainly at least for the early part of his assumption of his office. Nor can it, so far as I see, be otherwise, for there is no obligation whatever on those who become in the future Directors of Agriculture to study Agriculture or its Allied Sciences, nor is their training in it after arrival in India made a necessity or even a desideratum. In the course of settling a district, an officer must obtain some amount of knowledge respecting the agriculture of the district he settles, but even this is not made a necessary qualification for holding the post of Director of Agriculture. It is, moreover, something very different from the careful and minute study of the details and systems of cultivation, of agricultural practices, and conditions, which is, in my opinion, the

main thing from which we must look in future for agricultural improvement to take its rise.

Agriculture is distinctly a technical subject, and it is not reasonable to suppose that any man, however able, can successfully deal with it unless he has the requisite technical knowledge. We have clear evidence of this even in India, where some Directors of Agriculture have shown considerable ability in dealing with strictly agricultural matters, and in each case it has been, I maintain, because of their previous study of and love for the sciences closely connected with agriculture, and the practical knowledge they either had before or have specially acquired afterwards. As matters stand, it is hardly likely that this will, or can, be the case in any but a few instances, and when, as now, the appointment of Agricultural Director is a changing one, it is seldom that a special training such as might be acquired by sending Civil Servants home to Cirencester would be justified.

It is allowed, I believe, that for a Director of Agriculture to maintain properly his land records and do his work of inspection, besides seeing to the various administrative matters that fall to his share, his time is, as a rule, fully taken up, and the office work of his appointment is quite enough to prevent him, even had he the inclination, from turning his attention to matters of practical agriculture and agricultural improvement through a better knowledge and understanding of it.

The importance of the acquirement of this knowledge of the agriculture of the country has often been drawn attention to, and it remains still a fact that our inability to improve agriculture arises largely from a want of our knowledge of it, its methods, and its needs.

Some, despairing of its ever receiving treatment at the hands of Agricultural Departments as at present constituted, have suggested the abolition of the Department and the creation of a fresh one where the expert shall be supreme. I do not suggest any such thing, for I recognize fully the administrative needs of the country and the ability of the officers of the Government for discharging their high duties—duties which, even in the position of Director of Agriculture, are many more than that of being practical agriculturists, and could not be discharged by such experts alone. At the same time it cannot be denied, I think, that frequently our Agricultural Directors fail in being what the title would imply from a want of technical knowledge; and were this at their disposal, the position they occupy could very possibly be made much more practically useful, and benefit accrue to agriculture and the country. It is for these reasons I have, on a careful consideration of the subject, been led to suggest not an alteration or remodelling of the existing Agricultural Department or the office of Director of Agriculture, but the *association* with the Director of a trained expert, whose duties shall be purely agricultural and practical, and whose position shall be that of Assistant to the Director, and to whom will in time be entrusted the practical work of agricultural enquiry for which his training has fitted him. Such a man would, I believe, be of invaluable assistance to an Agricultural Director, and would provide him the means of paying attention to the practical side of agriculture, and supply the want of technical knowledge which has often been the subject of comment. Such a man would, to take an instance, be available for being sent (under the Director's orders) into any particular district, there to make a careful study of its agriculture from the practical side of any special mode of culture, and to carry out an investigation as to whether a process found beneficial in one district could be successfully transferred to another. Being unhampered by office work, he would be free to spend his time among the people themselves to get an acquaintance with them and their methods, which few could obtain, and, being directly under the Director of Agriculture, there would be the assurance that he was occupying his time well, and the experience and information he gained would be for the benefit of the directorship, and the making it more practically useful to the people. I cannot help thinking that few things would do so much practical good as stirring up the interest of the people in this way, and by showing them the interest taken in them; while few things would tend so much to make the office of Director of Agriculture really useful and give a practical turn to it.

What I have advocated, and the necessity of it, has already been practically recognized, *e.g.*, in Madras by the employment of Mr. Benson, in the North-Western Provinces of Mr. Muhammad Hossain, and in Bengal of Mr. Sen, Mr. Basu, and other Cirencester scholars. But all of these have worked under difficulties; none have been recognized as set apart for the purely practical work of agriculture; all have had office and multifarious duties to perform, or, as in Bengal, have been after a time shifted to other appointments. What I should like to see is in recognized association with Directors of Agriculture a man who has made agriculture a study, and who will make it the business of his life. The importance of such a man in any continuous enquiry is great, and it would be a real step to our getting a definite knowledge of the agriculture of the country. The various notes placed before the Conference point unmistakably to the utility and need of such experts.

[Dr. Voelcker then read extracts from Sir E. Buck's note, the Bombay note, Mr. Fuller's note, the Madras note, the Bengal note, and the Poona Agricultural Association's note.]

Dr. Voelcker: All these extracts, and many others I could name, point to the need of the employment of such an expert as I have named to act in concert with the Director of Agriculture.

If asked to enter further into details, I would indicate that the kind of man to be chosen for such a post is the class that would have passed through a training such as that given at Cirencester or similar institutions, followed up by—and this is essential—subsequent practical experience on a farm; such men, *e.g.*, as would have passed the Surveyors' Institution examination, and be qualified to act as land agents and managers of estates. The reservation as to practical experience is in my opinion so all-important that it constitutes my reason for advocating the employment, at first at any rate, of European rather than Native Assistants, though it is quite possible that natives will occasionally be found with the necessary qualifications. A Cirencester course alone, not followed up by practical experience on a farm, is not sufficient to qualify a man for duties such as I have indicated.

His course of training in agriculture would be very similar to that of the Forest students in forestry, and I should propose to put him on somewhat similar basis as regards salary, &c. At first he would be Agricultural Assistant, and directly subordinate to the Director of Agriculture. When after some four or five years he had acquired considerable experience, he might be raised to a position such as that of Agricultural Inspector, in which he would be officially subordinate to the Director of Agriculture. A salary of Rs. 400 per mensem rising to Rs. 600 on reaching the higher grade, and then increasing in much the same way as in the Forest service, would, I think, meet the circumstances.

On account of the local knowledge he would possess, it is evident that such a man must of necessity be provincial. There would be a call for Native sub-assistants, and the whole would be subordinate to the Director of Agriculture.

In this way I believe the needed practical turn would be given to the appointment of Director of Agriculture, and by some such action alone can we, I think, expect to get a real understanding of the agriculture of the country, and suggest means and adopt intelligently measures for its improvement where possible.

The *President* said that Mr. Fuller agreed generally with Dr. Voelcker's note, and he invited discussion and proposal of a resolution.

Mr. Finucane said that he entirely agreed with Dr. Voelcker. He was anxious to record his opinion that the agricultural expert proposed as an Assistant for the Director should continue in agricultural work throughout his career. A man like Mr. Sen was in his opinion the *beau ideal* of such an Assistant, and with his qualifications as a Native would be better than an European. He would like to have five such assistants, one for each division, and could employ them usefully in making enquiries into the agricultural practices of districts or the supervision of experimental stations, and in teaching the people of the more backward districts the better agricultural practices which have been proved to be profitable in the more advanced districts. He instanced as a specimen of good work in this direction Mr. Sen's report on the

Agricultural Practices of the Dacca District and Mr. Basu's report on the Lohardugga District. It would be necessary, he said, that the footing of such men should be at least as good as that of a Deputy Collector.

Dr. Voelker said that he had read Mr. Sen's report with great interest, and that he regretted the necessity which had arisen for transferring him from the Agricultural Department. Such men he thought should keep to agriculture throughout their life. It seemed to him that the Forest service offered a model for instituting a service for such men, and he suggested a training also in time and character similar to that of the Forest Department.

The *Hon'ble Mr. Bennett* said that Mr. Lumsden had recommended a similar course, and that they had already an expert at Cawnpore.

Dr. Voelker did not think that the training given at Cirencester would result in any good unless it was followed up by a practical training in India.

Mr. Steedman said that he understood Dr. Voelker's note to imply that enquiry into agricultural practices is the essential of improvement, and that a technical assistant is necessary for this. Seeing that we have such Departments as those of Archæology and Horse-Breeding, and as proposed a Civil Veterinary Department, and in Bengal the Caste and Ethnological Survey, he was certainly of opinion that a trained agricultural expert for each Director was no less justifiable as well as highly desirable.

The *Hon'ble Mr. Bennett* said that the North-Western Provinces Government intend that two of their civilians who are Cirencester graduates should be specially utilized for working out the analysis of districts.

Mr. Ozanne said that if the Assistant to the Director were always an agricultural expert, it would allow of the Director being selected from the Revenue Department, and he thought that the Director should be a Revenue man.

The *Hon'ble Mr. Nolan* agreed generally with Dr. Voelker, and observed that the proposed arrangement would make it practicable hereafter to separate the functions of the Director of Agriculture from that of Director of Land Records or Settlements. He did not see why the expert should always be kept in the position of Assistant to a gentleman of inferior attainments in their special business. This was not the system pursued in regard to forestry or education, where the expert was placed at the head of the Department.

The *Hon'ble Mr. Bennett* thought the *Hon'ble Mr. Nolan's* views would hold in Bengal, where there are no village papers. But in other provinces the village records contained many of the facts in which agricultural enquiry must be based. The supervision therefore of village papers and agricultural enquiry in such provinces must remain in the same hands.

Mr. Robertson thought that Directors were under an obligation to Dr. Voelker for having kept so clearly distinct the duties of the expert and those of the Director. Even if the Director had the scientific training, he would not have the time, however fully trained, to undertake the duties of the expert.

Mr. Finucane said with reference to what fell from the *Hon'ble Mr. Nolan* that the Minister of Agriculture in France is not an expert in agriculture, nor the Naval Minister a great sailor. The Director of Agriculture need not necessarily be an agriculturist, and he did not, therefore, think there was anything inconsistent in Dr. Voelker's proposals; nor was it, he thought, desirable to separate the functions of the Director of Land Records from those of Director of Agriculture.

Mr. Middleton said that the creation of a technical assistantship would be an inducement in aid of Superintendentships of Experimental Farms.

The *President* said that he understood that the sense of the meeting was generally in favour of Dr. Voelker's proposals. They had now to consider what class of men should be employed. If natives are to be selected, it will be all the more necessary to have a high standard of agricultural education in this country, unless it is considered preferable that they should go to Cirencester or any other Agricultural College. In the case of the Forest Department education was being given in this country, and he would ask the Conference to state their opinion whether for the appointment in question the training should be given in this country or at Cirencester.

Mr. Finucane said that he was satisfied with the Cirencester men, but that they themselves considered that training should be given in this country.

Mr. Clogstoun said that the Madras Government proposed to educate their Superintendents of District Farms at Saidapet, and they might in time become good enough for the appointment of Assistants to the Director.

Mr. Steedman said he had no practical acquaintance of Cirencester men, but that he would prefer Englishmen.

The *President* pointed out that the question is whether, if natives are taken for the post, they should be educated here or in Cirencester?

Mr. Steedman said that, having regard to the progress in practical agriculture made at home by the natives sent to Cirencester, he thought they had better be educated here.

The *Hon'ble Mr. Nolan* explained that the high position obtained by the Cirencester scholars in Bengal was in great measure due to the fact that they had received, before leaving this country, the highest education in science which the Calcutta University could give. He also considered that it would be best to obtain the future Assistant Directors in India, if fit men could be trained here. He would not create superior education merely for the purpose of training such Assistants, or regard the existence of Assistants as adding much weight to the arguments in favour of expenditure on higher agricultural education.

The *Hon'ble Mr. Bennett* said that he was thoroughly in favour of training in this country.

Mr. Finucane said that one of the strongest objections to sending natives home to Cirencester is that they are discontented with their position here when they return.

Mr. Robertson said that we ought to have training in India.

Mr. Ozanne concurred, because he thought we would soon have the power of giving a good training in this country, and that local training in practical agriculture is of special importance.

Mr. Muir-Mackenzie said that as a Cirencester man he desired to place his concurrence on record.

Dr. Voelcker drew attention to the passage in his note (page 6) regarding the preferability of an Indian training. He had no desire to create a monopoly of such appointments for Englishmen, but it was worth remembering that Englishmen would be of use to control native subordinates. The expert would be associated with the Director, and he was of opinion that an European expert would be better than a native one. Where there were such men available as Mr. Sen, then he would advocate their employment, and he had no doubt when the necessary education was given in India, natives would be produced by it fit to be technical assistants.

The following resolutions were then put before the meeting by the President :—

First—“That, in the opinion of this Conference, it is essential for the proper performance of the duties demanded from the Agricultural Department in the direction of agricultural improvement that the Director of the Department should be provided with an Assistant or Assistants who are experts in the practice and theory of agriculture.”

Second.—“That it will be preferable to train natives to be qualified for the post of Assistant in the Agricultural Department in this country rather than in Europe, and that this end cannot be attained unless there be a high class education established in this country.”

Mr. Thomson suggested an amendment, as they were not prepared in the Punjab to move in the directions discussed.

The *President* pointed out that since 1881 there had rested upon Local Governments in every province the duty and obligation of undertaking the improvement and investigation of agriculture. That duty and obligation had been imposed not by the Government of India, but by the Secretary of State, and had not been withdrawn. Of course it was left to each Local Government to determine whether the time had come to move in this direction in their Province.

Mr. Thomson understood that the time for taking action is not determined by the resolution, and withdrew his proposed amendment.

The *President* then put the resolutions to the vote, and they were passed.

Proceedings of the Agricultural Conference.
Seventh Meeting, Monday, the 13th October 1890.

PRESENT :

SIR E. C. BUCK, K.T., <i>Secretary to the Government of India, Revenue and Agricultural Department.</i>	} President.
HON'BLE W C. BENNETT, <i>Secretary to the Government of the North-Western Provinces and Oudh.</i>	
H. F. CLOSTOUN, Esq., <i>Commissioner of Settlements and Agriculture, Madras</i>	} Members.
DR. T. COOKE, <i>Principal, College of Science, Poona.</i>	
M. FINUCANE, Esq., <i>Director of Land Records and Agriculture, Bengal.</i>	
T. H. MIDDLETON, Esq., <i>Professor of Agriculture, Baroda College.</i>	
HON'BLE P. NOLAN, Esq., <i>Secretary to the Government of Bengal.</i>	
E. C. OZANNE, Esq., <i>Director of Land Records and Agriculture, Bombay.</i>	
F. A. ROBERTSON, Esq., <i>Director of Land Records and Agriculture, Punjab</i>	
E. B. STEEDMAN, Esq., <i>Deputy Commissioner, Hoshiarpur, late Director of Land Records and Agriculture.</i>	
R. G. THOMSON, Esq., <i>Officiating Revenue Secretary to the Government of the Punjab.</i>	
DR. J. A. VOELCKE, <i>Consulting Chemist to the Royal Agricultural Society of England.</i>	
J. W. P. MUIR-MACKENZIE, Esq., <i>Under-Secretary to the Government of India, Revenue and Agricultural Department</i>	

AGRICULTURAL ENQUIRY.

The *President* : Before proceeding to the business of the day, invited any further discussion that might be desired of the resolutions passed at yesterday's meeting, and made himself the following remarks :—

The *President* : I ask leave to further draw renewed attention to the obligations resting on the Government of India, on Local Governments, and on Agricultural Departments in connection with agricultural improvement and education, and in so doing I desire to avoid any suggestion as to how those obligations should be fulfilled. I merely wish to draw renewed attention to their existence.

From some of the remarks which have been made during the proceedings of the Conference, it seems to have been assumed by some of the members present that it is *optional* whether any measures of material importance should or need be taken in connection with agricultural education or improvement. It has been inferred in some of the remarks that the subject is a minor and subordinate part of the administrative scheme, and that agricultural education and improvement are "luxuries," not necessities, of administration.

I venture to contend that it is not within the power of the Government of India, or of any Government in India, to assume this position, or to refuse to take material action, except on the score of impossibility. The plea of unimportance cannot be accepted. To repeat what has already been said in my opening remarks, Her Majesty's Government, in consequence of the repetition of famines culminating with the great famine of 1876-77, formally constituted a Commission to enquire into the agricultural conditions of India, and to

recommend such reforms as they might consider necessary to place the administration of India in reference to the protection of the agricultural classes in a more secure position. I will quote one among many of the formal conclusions placed on record by the Commission in reference to the formation of Agricultural Departments. They wrote in Vol. II, Section II, of their Report as follows :—

“ We now pass to the consideration of the measures which we recommend for the introduction of better methods of cultivation, and generally for the diffusion and application of a scientific knowledge of agriculture in India, and for the provision of a class of officers in the public service who shall possess such knowledge, and be in a position to apply it effectually. On the importance of this knowledge both to the governing class and the governed, it is unnecessary for us to dilate. Our report has clearly shown how greatly agriculture preponderates over all other interests and employments in which the people of India are engaged; how essential we think it that technical knowledge should be called in to enable the productive powers of the soil to be applied in the most effective manner, not merely to add to the wealth of the country, but to secure a food-supply which shall keep pace with the increase of population; and how valuable in all departments of administration would be the acquisition by the executive officials of more accurate knowledge of the statistics of agriculture, of the ordinary turn-out of the harvests, and the relative produce of the crops from year to year. As long ago as 1870 the Government of India began to take steps for establishing a more efficient system of control over the action of the Local Governments in relation to all matters connected with the statistics of agriculture and its practical improvement. From time to time repeated injunctions have been issued that increased attention should be paid to these important interests, but very little progress has been made in giving effect to these orders, and only in the North-Western Provinces have organized measures been taken in this direction by any of the Local Governments. It is our hope that the example thus offered may be followed at an early date elsewhere, and that an Agricultural Department may be established in every province on the general basis suggested in the former part of our report, and now further to be explained in detail.”

Her Majesty's Government, in dealing with this and cognate recommendations of the Famine Commissioners, imposed on the Government of India the obligation of making proposals for giving to them practical effect. They wrote as follows :—

“ These proposals aim at three objects :—

- 1st.—More complete and systematic ascertaining and rendering available of the statistics of vital agriculture and economic facts for every part of India in order that Government and its officers may always be in possession of an adequate knowledge of the actual condition of the country, its population, and its resources.
- 2ndly.—The general improvement of Indian agriculture with the view of increasing the food-supply and general resources of the people.
- 3rdly —Better and prompter organization of famine relief whenever the actual approach of famine may be indicated by the statistical information.

“ For the attainment of these objects, and especially of the *two former in ordinary times*, the Famine Commissioners have recommended the creation or extension of a very elaborate local machinery supervised and controlled provincially, and in the last resort, by a branch of your Secretariat.

“ The proposals you now make with reference to these recommendations go somewhat beyond them as regards the ultimate supervision; they touch lightly on the provincial control; but they hardly deal at all with the point on which the Commission lay much stress—the local machinery. You say (paragraph 4) that local Agricultural Departments may hereafter be constituted at the different provincial head-quarters, and that you are prepared to entertain favourably any proposals from this view, from which I conclude that you do not purpose to take the initiative—even to this extent in carrying out the suggestions of the Commission. The proposed district organization you dismiss on the grounds of its cost, and in one particular of its being open to objections of principle; and you make no reference to the suggestions for the provision of means for systematic agricultural research in India, nor to those for the promotion of agricultural knowledge in the Civil Service.

“ 5. I shall be glad to receive with as little delay as is consistent with the careful consideration which their importance requires a fuller expression of the views of your Government on these questions.”

The final proposals of the Government of India were formally communicated to Her Majesty's Government in a despatch No. 19, dated 14th March 1881, and formally accepted by Her Majesty's Government in No. 55 (Revenue), dated 16th June 1881; they were then embodied in the Resolution

No. ⁶₃₄₀₋₄₀ -G., dated 8th December 1881, issued for the information and guidance of all Local Governments. Steps were taken in the years that followed to introduce into each province the administrative reforms necessary to give practical effect to these instructions. Delay has occurred in carrying them out in connection with agricultural improvement and education for four reasons—

The *first* that time was necessary to allow each Local Government to organize Agricultural Departments.

The *second* that it was primarily requisite to provide the Departments, when organized, with duties which would be of financial utility to the State.

The *third* that it was desirable to employ the Departments initially on arranging a system under which agricultural information and statistics could be continuously provided.

The *fourth* that the Supreme and Provincial Governments have since 1881 been embarrassed by financial difficulties.

The reasons which compelled delay have now been more or less eliminated. Ample time has been given for the organization of Departments. The Finance Commission have accepted the fact that they are financially useful to the State; systems, more or less complete, have been established in each province for the continuous supply of agricultural information and statistics, and financial embarrassment is understood no longer to exist. The obligation created by the Famine Commission of 1878-79, *i.e.*, obligation to give full effect to the recommendations of the Famine Commission, so far as they were accepted by Her Majesty's Government in connection with agricultural improvement and education, can no longer be avoided; and I submit that, in the face of the acceptance by Her Majesty's Government of the great importance attributed to that obligation, it is not constitutionally within the power of the Government of India or of any Local Government to relegate it to a subordinate position, or to consider the fulfilment of it as in any degree *optional*, unless they are relieved from the duty imposed upon them by Her Majesty's Secretary of State.

Mr. Thomson asked whether it was for the Conference to discuss the obligations resting on the Government of India or on Local Governments.

The *President*: It is certainly not for the Conference to suggest what obligations should be imposed on any Government, Imperial or Provincial. But it is the main function of the Conference to suggest and advise how obligations, which are in connection with agricultural improvement actually placed on record, can be practically fulfilled. Such obligations constitute the basis of its discussions, and it is imperative to ascertain and understand what they are, so far as they are recorded.

The *Hon'ble Mr. Nolan* observed that of the difficulties enumerated by Sir Edward Buck as having hitherto retarded the development of an active agricultural policy, that one alone which was connected with finance had been felt in Bengal. Want of money had been the obstacle there, not want of time. Sir Edward Buck might be able to speak with authority as to the removal of this impediment as it affected Imperial finance; but in the Lower Provinces it had not been even reduced, and while it remained it might prove insuperable. He enquired whether, in the opinion of the President, any advantage would ensue from preparing an estimate of the cost of carrying out the proposals of the Conference? If this were ascertained, some provision might be made to meet it.

The *President* said that if the Conference could sit for a considerably longer period, it might be possible to do so; but there was hardly time now. All that could be done now was to consider the principles involved. It would be for the Local Governments, when they had funds available, to decide how far the improvements suggested might be carried out. The President added that he would like to direct attention to the despatch sent by the Government of India in March 1881 to the Secretary of State, in which the former submitted certain proposals based on

the recommendations of the Famine Commission. The reply of the Secretary of State seemed to him to imply that the Government of India had underestimated the importance of the questions involved.

The Conference then proceeded to discuss the subject of the analysis of districts.

The *President* called upon the Hon'ble Mr. Benett to explain the system under which the pargana book is maintained in the North-Western Provinces and Oudh.

The *Hon'ble Mr. Benett* described the statistical registers maintained in the North-Western Provinces and Oudh. He said there was a series of registers for each village; and as each district comprised some two or three thousand villages, the registers were necessarily too numerous for any one to wade through them for information. What they had done was to have the information abstracted into pargana books,* each pargana employing between 40 or 50 patwaris. The pargana book contained about four pages of information for each village. The book is written up by the registrar kanungo, and on one page there are all the more important items relating to the village. The Collector or Deputy Collector during his tour sends for the pargana book, and writes in it anything of interest relating to the village. He thought that the book would gradually collect in a convenient form much valuable information, and in course of time would be of the greatest use. The North-Western Provinces and Oudh Government has recommended that every 8 or 10 years some official should analyse the pargana book and make an abstract. The pargana book should, he thought, be sent in to the Collector to sign.

Mr. Clogstoun said that they had a very elaborate system of statistics in Madras. They had elaborate returns from each district and taluk, which showed areas cultivated, held, irrigated, &c. The firka book, as it was called in Madras, would give information relating to the Revenue Inspector's area, and would, he thought, be of use in enabling the authorities to localize all cases in which the revenue was falling off. The village was the unit in Madras.

The *Hon'ble Mr. Benett* said that in the Central Provinces the registers were to be kept up much in the same way as in the North-Western Provinces and Oudh. But it had been considered preferable to have for each village a separate book, which could be sent for when required for inspection, instead of a register for the whole pargana.

The *President* pointed out that in some provinces the facts relating to each village are not brought together into one sheet. To gather the history of a village it would be necessary to go through a number of forms.

Mr. Robertson: I would ask leave briefly to describe the Punjab system of village records. Each village or "mouza" has a village note book containing ten statements, which give very full information as to its agricultural condition. The "patwari" of each circle keeps these up for the villages in his circle, and the "office kanungo" keeps up a counterpart of each one of these at the head-quarters of the tahsil, so that an officer can always consult these records either at the tahsil, or by sending for the tahsil copies, and while in camp he can consult the patwari's copy. Abstracts of these note books, one for each assessment circle, one for each tahsil, and, finally, one for each district, are also kept up. Every year the tahsildar has to record his remarks on the condition of the village on Statement X in these note books in one-fourth of the villages on his tahsil, and for seven months of the year either the tahsildar or his "naib" or assistant is bound to be in camp. In addition we have several other safeguards against the neglect of approaching famine or deteriorations. The patwari has to write up every month in his diary an account of the general condition of the crops, husbandry, and cattle of his circle. He is bound immediately to report any special calamities to the kanungo and the tahsildar. Field kanungos are directed to pay special attention to these matters when they visit a patwari circle. In addition to this, a statement of prices is furnished twice a month, and we receive besides a weekly telegraphic report on the state of crops and weather from thirteen selected

* *Vide Appendix E.*

districts, in which prices have to be noted. We also receive by post, in the Director's office from every district a rain report every week, and a prospect report regarding the crops every month. The chain is therefore very complete. Patwaris constantly report on their circles to field kanungos, who in their turn report to tahsildars, tahsildars to Deputy Commissioners, and these last to the office of the Director of Land Records and Agriculture, who publishes in addition general summaries on the *kharif* and *rabi* harvests. It would not be easy under these circumstances for the deterioration of villages or the approach of scarcity to escape attention.

I have no wish to criticize the "pargana book," but I understand that where this pargana book is in existence, there are no separate village note books kept by the patwaris; and if we are to have one or the other, I think the note books preferable. Note books supplemented by the pargana book might be better still, but I doubt if the latter is absolutely necessary, and only urgent necessity would justify our imposing further tasks on our Revenue staff. The Punjab system may not be perfect, but I think it is a good one, and it goes a very long way to meet all the requirements of the Government of India on this subject.

The *President* said Mr. Robertson had shown that a great deal had been done in the Punjab, but what he (the *President*) wished to ask was whether the Punjab system fully met the requirements of the case.

The *Hon'ble Mr. Nolan* asked whether the proposal to keep village note books was intended to extend to provinces where there had been no cadastral survey?

The *President* thought that, where practicable, such books should be maintained, but it was not possible for the Conference to say in what provinces they should be kept up.

The *Hon'ble Mr. Nolan* found that the suggestion placed before the Conference by the Resolution of the Government of India, dated 25th March, extended in terms to all India, and therefore to those parts of Bengal where there were no village records, and no agency by which these could be compiled. Taken in this sense, it merged in the larger proposal of the Famine Commission Bill introduced for giving partial effect to the latter recommendation, and to be withdrawn in consequence of the reluctance of Her Majesty's Government at home to sanction even for a limited area the imposition of the rate advocated by the Famine Commission; and, in the face of this decision, it was hardly possible to advocate the extension of the system to the province generally.

The proposal also affected those parts of Bengal in which village accounts were kept up, particularly Government estates, and so far he thought if very reasonable. But he suggested that when a new register was introduced, some of those in existence might at the same time be abolished. It appeared that there were ten in use in the North-Western Provinces—that is, ten for each village; and he feared that we could not add an eleventh without discrediting a system which seemed already to have been pushed too far.

The *President* said he quite accepted the position that where there are no facts and statistics, they cannot be ledgered. We had only to deal with those provinces which can give us such statistics.

Mr. Steedman observed that the Punjab returns directly led up to what was prescribed by the Government of India.

Mr. Clogstoun pointed out that in Madras *zamindari* and *inam* villages there are accountants, and that the Local Government is considering the advisability of compelling them to keep records.

Mr. Finucane said the subject for discussion this morning he thought is the form and maintenance of district analyses. The objects arrived at in making these analyses of districts, as he understood it, are, first, the ascertainment of existing agricultural practices and resources of each district with a view, where possible, to the ultimate introduction of improvement; and, secondly, the determination with a view to the administration of famine relief of what

parts of each district or tract are protected from or liable to famine. The first of these objects may, he thought, be attained by such investigations as have been undertaken in Bengal by Mr. A. C. Sen and others. Mr. Sen's report on the Agriculture and Agricultural Systems of the Dacca District is a sample of an agricultural analyses of one district of this kind. Dr. Voelcker had told the Conference that he has perused the report, and that he has found it to be useful and interesting. Similar reports might in his (Mr. Finucane's) opinion be prepared with advantage for all districts in Lower Bengal, Behar, and Orissa. Officers engaged in the preparation of agricultural analyses of districts of the kind he referred to should, as a matter of course, take advantage of such statistics and information as are available in order to endeavour to determine what, if any, parts of each district and tract are liable to famine.

As regards the question of the form in which village registers should be utilized, it may be remarked that in Bengal there were at present no village or pargana registers; and the question for consideration as regards Bengal was not so much the utilization of information provided in village registers as that of whether such registers should be prepared; and, if so, by what agency. This point was not, he understood, at present before the Conference. The question now before it was how certain registers kept up by village agency in some provinces should be utilized. As in Bengal they had no such registers, he need not make any remarks on this point. If the question were whether statistics where no such agency exist should be compiled by any other agency, and, if so, what agency, he would have something to say if that question were before the Conference.

The *President* then put the following resolutions before the Conference :—

- 1st.—“That where practicable agricultural statistics should be compiled by the village officers or agency for every village or estate in each province.
- 2nd.—“That where such are compiled, some system should be adopted under which the leading facts and statistics indicating the agricultural condition of the village or estate for each year should be abstracted in a simple form.”
- 3rd.—“That these forms should be brought together in a special volume to be maintained for each administrative circle, *e.g.*, Revenue Inspector's circle, pargana, &c., in which district officers should from time to time enter remarks, if required, on the progress or degradation of the villages or circle.
- 4th.—“That some system should be established ensuring that the information contained in the forms shall be utilized by the district authorities.
- 5th.—“That it should be the special duty of the Agricultural Department to ascertain from time to time by inspection that the forms are properly maintained and efficiently utilized for each district.”

The following discussions then ensued :—

The *Hon'ble Mr. Nolan* said with regard to the first resolution that the question whether where a new agency had to be created for the purpose it should consist of village officers was under consideration in Bengal.

Mr. Steedman said with regard to the second resolution that he understood the proposition was that all that information available should be abstracted. He thought that the kanungos were already too much occupied, and that this would seriously add to their work.

Mr. Robertson said the necessity for both the pargana book and village note book was not apparent.

The *President* mentioned that there had been instances brought to notice where the deterioration of villages had not been brought to light until too late owing to the absence of information easily accessible through such means as the pargana book.

The *Hon'ble Mr. Benett* confirmed this statement, and added that a well posted-up pargana book would be of great value to a new Collector. If he wanted any information regarding any village, he could get it in little time by referring to the pargana book. The village papers would be too voluminous for him to look into.

Mr. Clogstoun said that in Madras a book of the kind would be most useful for the Revenue Inspector.

The *President* said that another argument not yet mentioned in favour of the pargana book was that such an abstract would be useful for periodical comparison with the Settlement Officer's report.

The *Hon'ble Mr. Benett* observed that much of the cost and labour required for the completion of recent settlements in the North-Western Provinces might have been avoided if pargana books had been maintained for the districts from the first.

Mr. Steedman did not think the resolution called for. In the Punjab the work would be increased, whereas at the present time an endeavour was being made to reduce the statistical tables now prepared.

The *President* said that returning to the main subject of discussion—district analysis—he did not think that, if the resolutions were adopted, a very searching analysis would be gradually worked out. Special reports on agricultural practices, though they would be useful if the Local Government possesses the necessary machinery to furnish them, do not constitute the analysis required by the Government of India Resolution, of December 1881. If the gradual history of a village were recorded year by year, we should have in time the most perfect analysis of a district. All that he advocated was that some measures should be taken for providing for the growth of a district analysis. If the Conference accepted this view, it would not be necessary to enter into any lengthy discussions regarding the importance and value of district analyses which had already been admitted. The pargana book was started in the North-Western Provinces in 1883 after he had left the province. But the special advantage he claimed for the pargana book was that it provided a compendious view of the general condition of the tract to which it related. When he visited the province in 1889 and inspected one of these books, he had six years' statistics to go on, and he could have written from the book an account of the tract to which they referred in one afternoon.

The *Hon'ble Mr. Benett* said that there was the danger that the attention of the Collector will be devoted entirely to those villages selected for analysis. In the North-Western Provinces it was almost impossible to say whether one village was worse than another. It was absolutely essential after an analysis had been completed that it should be gone on with. A stereotyped form of analysis was not desirable.

Mr. Clogstoun thought that the term "district analysis" was not an appropriate one.

The *President* agreed that a better term might have been selected, and that it was always possible to revise it. The *President's* resolutions were finally agreed to by the Conference. Referring to the Bombay Statistical Atlas, the *President* enquired whether the Conference would recommend a similar publication for other provinces.

Mr. Thomson feared that a Statistical Atlas such as that of Bombay would be an expensive work to get out frequently.

After further discussion on the subject, the following resolution was also passed—

"That the district analysis contemplated by the Government of India Resolution of 1881 will be effectually provided for by the settlement reports and records, supplemented by the annual abstracts of village statistics. But that it will be also useful that the Agricultural Department should collate and publish, or encourage the collation and publication from time to time of, general information and statistics showing the agricultural condition of each district either in short abstracts or in such volumes as the Statistical Atlas of Bombay, or, where statistics are not available, such reports as those of Mr. Sen's and Mr. Basu's on the Dacca and Lohardugga Districts in Bengal.

The Conference closed with a vote of thanks to the *President* proposed by *Mr. Clogstoun*, and seconded by the *Hon'ble Mr. Nolan*.

APPENDIX A (vide page 1 of Proceedings).

No. 345—55 R.

Extract from the Proceedings of the Government of India, Revenue and Agricultural Department, No. 345—55 R., dated 25th March 1890.

REVENUE.

Read Finance Commissioner's Note F. C.—30, and the following correspondence, regarding the duties and cost of Agricultural Departments :—

- Letter to the Government of Madras, No. 263—66-1 R., dated 3rd June 1887.
- Letter from the Government of Madras, No. 63, dated 19th January 1888
- Letter to the Government of Madras, No. 692—32-2 R., dated 26th September 1888.
- Letter from the Government of Madras, No. 79 A., dated 14th November 1888.
- Letter to the Government of Bombay, No. 258—67-1 R., dated 1st June 1887.
- Letter from the Government of Bombay, No. 7187, dated 27th October 1888.
- Letter to the Government of Bombay, No. 91—28-2 R., dated 4th February 1889.
- Letter from the Government of Bombay, No. 4101, dated 6th June 1889
- Letter to the Government of Bombay, No. 550 R., dated 3rd August 1889.
- Letter from the Government of Bombay, No. 8914, dated 25th November 1889.
- Letter to the Government of Bombay, No. 189 C., dated 30th January 1890.
- Letter from the Government of Bengal, No. 2419—913 L. E., dated 1st December 1886.
- Letter from the Government of Bengal, No. 2420—399 (Agri.), dated 1st December 1886.
- Despatch to the Secretary of State, No. 3 (Revenue), dated 10th May 1887
- Letter to the Government of Bengal, No. 209—68-2 R., dated 6th May 1887.
- Letter to the Government of Bengal, No. 219—68-3, dated 11th May 1887
- Despatch from the Secretary of State, No. 61 (Revenue), dated 18th August 1887.
- Letter to the Government of Bengal, No. 523, dated 27th September 1887.
- Despatch to the Secretary of State, No. 9 (Revenue), dated 18th October 1887.
- Letter to the Government of the North-Western Provinces and Oudh, No. 210—69-1 R., dated 7th May 1887.
- Letter from the Government of the North-Western Provinces and Oudh, No. 1440—L-243 A., dated 3rd November 1887.
- Letter to the Government of the Punjab, No. 315—93-1 R., dated 24th June 1887.
- Letter from the Government of the Punjab, No. 140, dated 2nd December 1887.
- Letter to the Chief Commissioner, Central Provinces, No. 192—63-1 R., dated 27th April 1887.
- Letter from the Chief Commissioner, Central Provinces, No. 491 S., dated 14th May 1887.
- Letter to the Chief Commissioner, Burma, No. 190—64-1 R., dated 26th April 1887.
- Letter from the Chief Commissioner, Burma, No. 450—72 R., dated 16th March 1888.
- Letter to the Chief Commissioner, Burma, No. 321—71-4 R., dated 4th May 1888.
- Letter from the Chief Commissioner, Burma, No. 474—116 R., dated 18th May 1888.
- Letter to the Chief Commissioner, Assam, No. 191—65-1 R., dated 26th April 1887.
- Letter to the Chief Commissioner, Assam, No. 289—65-2 R., dated 9th June 1887.
- Letter from the Chief Commissioner, Assam, No. 2359, dated 13th July 1887.
- Chief Commissioner's Circular (Assam), No. 31, dated 28th June 1887
- Letter to the Chief Commissioner, Assam, No. 441—65-4 R., dated 18th August 1887
- Letter from the Chief Commissioner, Assam, No. 3532, dated 26th October 1887
- Letter to the Chief Commissioner, Assam, No. 45—9-1 R., dated 9th January 1889
- Letter to the Chief Commissioner, Assam, No. 148—9-3 R., dated 18th February 1888.
- Letter from the Chief Commissioner, Assam, No. 463, dated 3rd February 1888.
- Letter from the Chief Commissioner, Assam, No. 1571, dated 2nd June 1888.
- Despatch to the Secretary of State, No. 3 (Revenue), dated 5th February 1889
- Despatch from the Secretary of State, No. 33 (Revenue), dated 21st March 1889.

Read again the following correspondence on the subject of rules for regulating the pay of Directors of Land Records and Agriculture :—

- Letter from the Chief Commissioner, Burma, No. 202—4 G., dated 9th April 1889.
- Letter to the Chief Commissioner, Burma, No. 615—61-4 R., dated 22nd August 1889.
- Despatch to the Secretary of State, No. 295 (Salaries and Establishments—Land Revenue), dated 17th September 1889.
- Circular to Local Governments and Administrations (excepting the Government of Madras), No. 69—51-6 R., dated 12th October 1889.
- Letter to the Government of Madras, No. 67 C. I., dated 27th December 1889.
- Despatch from the Secretary of State, No. 105 (Revenue), dated 7th November 1889
- Circular to Local Governments and Administrations (excepting the Government of Madras), No. 165—170 C.L., dated 23rd January 1890.

Read also—

- Resolution of the Government of India, No. 44 F., dated 9th June 1883, issuing instructions regarding the adoption of a Code for Famine Relief.
- Resolution of the Government of India, No. 63—77 C. (Famine), dated 19th December 1889, regarding the examination and revision of the Provincial Famine Codes.

Read again—

- Despatch to the Secretary of State, No. 197 (Financial), dated 21st July 1888.
 Despatch from the Secretary of State, No. 104 (Revenue), dated 13th December 1888.
 Despatch to the Secretary of State, No. 6 (Agriculture), dated 1st June 1889.
 Despatch from the Secretary of State, No. 108 (Revenue), dated 7th November 1889.
 Letter to the Government of Madras, No. 133 C., dated 6th January 1890.
 Letter to the Government of Bengal, No. 214 C., dated 1st February 1890.
 Letter to the Government of the North-Western Provinces and Oudh, No. 215 C., dated 1st February 1890.
 Letter to the Chief Commissioner of the Central Provinces, No. 219 C., dated 1st February 1890.
 Correspondence regarding the appointment of an Agricultural Chemist and the deputation of Dr. Voelcker to India.

RESOLUTION.—The Governor General in Council, in communicating for general information the correspondence connected with the Finance Commission's enquiries regarding expenditure on Departments of Land Records and Agriculture, desires to take the opportunity to review briefly the present position of the Departments and to draw renewed attention to the duties for which they are specially responsible.

2. In 1881 Her Majesty's Secretary of State, in pursuance of the recommendations of the Commission appointed to investigate the causes which lead to and the measures necessary for the prevention of famines in India, authorised the constitution in each Province of a special Department, the duties of which were to be classed under the three heads—

- (1) Agricultural enquiry.
- (2) Agricultural improvement.
- (3) Famine relief.

3. The responsibilities and functions of the Departments involved under the third head are dealt with in the Famine Code which has been issued in each Province, and they will be determined in more precise detail when the revision of the Codes, recently ordered, has been completed. It is not expedient to enter into any particular examination of them in this Resolution. It is sufficient for present purposes to note that the Departments of Land Records and Agriculture are concerned rather with the collection and collation of statistics and facts calculated to be useful to those who have to administer famine relief than with the direct organisation of famine relief itself; and that any work which they may be called upon to do under the name of famine relief must be the direct or indirect outcome of that general agricultural enquiry which forms the most important part of the Famine Commissioners' recommendations. It is only necessary, therefore, to consider at present what has been or remains to be done under the first two of the heads under which the duties of the Departments were originally classed.

3. The Resolution No. 6—340-50 G., of the 8th December 1881, on the formation and duties of the new departments, indicated that throughout the greater part of British India the primary basis of agricultural enquiry must be the facts and statistics recorded, in respect to each field and each village, in the forms of accounts or other returns and records which are annually prepared by the village accountants.

In accordance with this view the first object which the Departments were required to secure was the gradual improvement of these village officials in order to secure greater accuracy in the returns provided by them. The orders which have from time to time been issued by the Government of India and Provincial Governments in connection with this aim have indicated that, so far from the responsibility of the district officials for the efficiency of the village accountants and the accuracy of their returns being interfered with or weakened by the performance of the duty thus imposed on the Departments, the fulfilment of their responsibility has been facilitated and strengthened. In almost every Province the primary measure taken has been the better organization and inspection of the staff by whom the village accountants were themselves immediately supervised. In other words, the new Departments have been made specially responsible that the supervising staff in each district, in all parts of a Province, uniformly efficient, and that, under the control of the district officials, it is continuously and adequately maintaining the land records and accounts of each district up to the requisite standard. The initial aim, in fact, of the inspection system which has been introduced is that the reports of the officers of the special Department should provide information to the district officials themselves, as well as to the chief revenue authorities, in what respect or to what extent in each district the village establishments and their supervising staff may have failed to satisfy the requisite conditions. The defects having been discovered and pointed out, the responsible authorities have been able to correct them. A uniform and satisfactory standard is thus being gradually reached, which hitherto the individual and unequal efforts of district

officials had, with rare exceptions, failed in attaining, and, in the opinion of His Excellency the Governor General in Council, the chief factor in the reform has been the periodical inspection of the supervising staff in each district by an official, whose technical experience and whose knowledge of defects likely to occur and where to look for them, have brought to light various errors and irregularities which had been allowed to grow up; who has been able to gauge the general efficiency of the staff of village accountants; and who has been specially competent to discover in what respects the supervising officials have proved themselves to be inefficient or careless, to have been insufficiently acquainted with their duties, or to have misunderstood the forms of accounts and land records.

4. Turning now to the ultimate object with which the Agricultural Departments have been thus required to secure the systematic improvement of village accountants and their returns, this is, as already indicated, the establishment of a foundation of statistics and data upon which may be based a system of continuous "agricultural inquiry," the wide significance of which term is fully explained in the Resolution of 1881. But in almost every Province subsidiary results have also been gained in the process. The work of revenue administration has been facilitated, the rights and interests connected with land have been more correctly recorded; the business of the Civil Courts has been simplified; frauds or deficiencies in the collection of rent and revenue due to Government have been prevented; and the future revision of land assessments has been made less costly. In several Provinces the village accountants, who a few years ago were on the whole an uneducated and inefficient body of men, have been trained to conduct under the guidance of the supervising staff the annual field plotting and revision of the village maps which changing circumstances render necessary, and without which the constant employment of special survey establishments would be called for, while in one Province—in which ten years ago these village officials were in many districts exceptionally illiterate and backward—almost the whole of the revision of the survey of from 80,000 to 40,000 square miles has been effected with remarkable accuracy by the agency of village establishments. The Government of India, though viewing with satisfaction the general progress already manifested, does not wish to imply that perfection has been attained in any Province. The ideal which should be kept in view is that every village should possess an accountant trained in surveying and crop inspection, compiling and submitting his returns intelligently and punctually. The difficulties of procuring such an official vary in the different Provinces, but are especially great in those where the hereditary system is in full development, or where the functions of the village accountant are largely concerned with the actual collection of revenue. It is the duty of the Departments to devise methods of overcoming these difficulties, and to remedy defects, as far as possible, both by constant inspection, and by assisting the Government and the district officials with suggestions and advice regarding the improvements which may be possible either in the education and qualifications of the accountants, in their methods and standards of work and discipline, or in the form, matter and compilation of their records.

5. In 1887 a Finance Commission was appointed under the direction of Her Majesty's Secretary of State to review the expenditure entailed by the administration of the country. In dealing with the cost of the Agricultural Departments which were the outcome of the Famine Commissioners' recommendations, the new Commission desired that the value of the Departments should be tested by an inquiry into the financial, apart from the purely administrative, effect of their working; in other words, by ascertaining whether the improvement and more systematic utilization of the village accountants and their returns, so far as this was due to the Departments, had proved remunerative or the reverse. This recommendation of the Finance Commission was supported by Her Majesty's Secretary of State. The test which the Commission suggested for application was an estimate of the saving which would be effected by the diminution of periodical expenditure on surveys and settlements in consequence of the improved village records. In dealing, however, with certain ryotwari Provinces, in which the land assessment of each district is subject to annual fluctuations, it was found necessary so to extend the estimate as to allow it to include the saving which might result from the prevention of frauds and deficiencies in the annual collections. Except in the case of the Madras Presidency, in which the circumstances are in some respects exceptional, the enquiries thus instituted have been recently completed, and the correspondence on the subject is now circulated for general information.

This correspondence indicates that at the commencement of the present year the Government of India was in a position to report to Her Majesty's Secretary of State that every Local Government, other than Madras and Bombay, had been able to show that a considerable economy had been effected. More recently also it was found possible to submit, from the Bombay Presidency, final proposals which, although not equally favourable when gauged by a purely financial test, offer considerable advantages in an administrative direction. The

amount gained in three Provinces alone during the current decade is said to have been 200 lakhs of rupees, and the additional gain in six Provinces during thirty years is estimated to be from 12 to 16 lakhs a year after charging the cost of the Departments and after material reductions on the original estimate.

6. A stage has now been reached in the history of the Departments at which His Excellency in Council considers that more definite consideration should be given to the fulfilment of those other important duties which have been imposed upon them in pursuance of the recommendations of the Famine Commissioners. Hitherto little has been done beyond the systematic organization of the arrangements under which the improvement of the staff of village accountants and their supervision have been effected or are to be maintained. But for the necessity in the first place of allowing time for the development of this organization, and in the second of meeting the view taken by the Finance Commission that the position of the Departments should be first justified by direct financial results, an earlier opportunity would have been taken to call attention to the further responsibilities which rest upon the Departments, and which have been so far inadequately or unequally fulfilled. These may be briefly indicated as, firstly, the utilization of the statistics and data deduced from the village accounts and returns for the purposes required by the Famine Commissioners; and, secondly, "agricultural improvement" in the wide sense attached to that term in the despatch received from Her Majesty's Secretary of State in 1881.

7. Both subjects were to some extent dealt with in the Resolution issued in 1881. In regard to the first it was indicated that, when the machinery through which information was to be primarily collected had been brought into working order, an analysis of agricultural tracts should be undertaken with the view of determining the measures necessary to protect them against famine and to secure in them the maximum efficiency of agricultural operations.

As pointed out in the recent Resolution of the 19th December last on the revision of Famine Codes, it was intended that the examination and analysis of agricultural tracts should be based primarily upon the returns provided by village accountants, and it is now necessary to determine with more precision how this object can be satisfactorily attained. The history of recent years has confirmed the opinion expressed by the Government of India in the Resolution of 1881 and in subsequent Resolutions, that the distress of the agricultural community consequent upon the failure of crops, the undue pressure of land assessments, or other causes, can be materially alleviated by timely measures of relief which would be suggested by a more intimate acquaintance with the annual condition of precarious tracts than has hitherto existed. Many cases, for instance, have occurred, and not a few of them at very recent dates, in which, owing to the absence of continuous and systematized information, deterioration of agricultural conditions has not been followed, until too late, by the suspension and remission of land-revenue, or by the requisite reduction of assessment for which the circumstances have called; or again, in which the approach of famine has not been met, as it should have been, by adequate and timely measures of relief. It is the duty of the Departments of Land Records and Agriculture to organize and maintain a system which, if efficiently worked by the executive and responsible officials, shall make such events impossible. In the opinion of the Governor General in Council, adequate experience has now been gained in various Provinces to admit of the consideration of the broad principles upon which the statistics and data annually provided by the village establishments can be most effectively utilized for the purposes indicated in the Resolution of 1881, and to demonstrate the necessity that the special attention of every Local Government and Administration should be given to the subject.

The system adopted in each Province must vary in accordance with local conditions, and it is, perhaps, premature to determine, at this stage, the principles which would be found useful for general application. But the Government of India has no hesitation in suggesting that one practice, already adopted in some Provinces, may with advantage be generally accepted, namely, the institution for every village of a separate record, wherein should be ledgered each year those facts and statistics which prominently indicate the fluctuations of its agricultural condition and afford clear evidence either, on one hand, of its increased prosperity, or, on the other, of its deterioration. Further suggestions on this subject will be circulated at a later date.

8. In the Resolution of 1881 the remaining duty of the Departments, *viz.* that of directing the development of agricultural improvement, was made secondary to that of acquiring a knowledge of the agricultural conditions of the country. Sufficient progress, however, has now been made in the organization of a system of agricultural enquiry to admit of a more precise determination of an examination of the subordinate question on which the action of the Departments should be based. In the opinion of His Excellency in Council three principles may at once be laid down for adoption. The first is that continuous enquiry should be maintained by means of experimental farms or other similar agency, with the view of ascer-

taining the possible results which may be gained by the introduction of new, or the modification of existing, processes and practices connected with agriculture. The second, that the education of the agricultural population, and especially of the lower classes, should be so directed as to enable them to appreciate and, where expedient, to adopt those results. The third, that protection should be given to precarious tracts by measures which lie within the power and means of the State, but beyond those of the people.

The action involved by the application of each of these principles requires a considerable period of time for its full development, and must, in the opinion of the Government of India, precede any systematic or costly attempt to introduce supposed or suggested agricultural improvements. And in each case a carefully considered programme or working-plan is required before action can be properly commenced. As indicated by the Secretary of State in his Despatch No 33 of the 21st March 1889, while it will be necessary for each Local Government and Administration to carry into practical effect the policy regarding agricultural education and other administrative matters with which the Departments are concerned, it is the duty of the Imperial Government to control and direct the general policy. But, before laying down the broad principles upon which action should be based, the Government of India is anxious to place itself in the closest possible acquaintance and accord with the opinions and desires of the Local Governments.

9. His Excellency in Council considers that a convenient opportunity will occur for discussion of the general questions dealt with in the two preceding paragraphs in connection, firstly with the anticipated report of Dr. Voelcker, the Agricultural Chemist to the Royal Agricultural Society of England, whom the Secretary of State has recently deputed to India for the investigation and examination of the conditions under which action may be usefully taken in connection with agricultural experiments; and, secondly, with the report, now under the consideration of the Madras Government, of the Committee appointed by His Excellency the Governor of Madras to investigate the results of the action taken for some years past in that Presidency in the direction of agricultural improvement. The correspondence which has been circulated in reference to the appointment of an Agricultural Chemist indicates that the original proposal of the Government of India contemplated the utilization of the services of the Chemist both in respect to the institution of systematic enquiry on experimental farms and otherwise, and also in respect to the education imparted in Colleges of Agriculture and Forests, both of which subjects are cognate to the questions of which the Government of India desires the discussion. The report of the Madras Committee, on the other hand, will provide useful information as to the results of the action which has been taken in that Presidency, and the directions which experience has there proved it to be desirable to follow or avoid. His Excellency in Council accordingly desires that a Conference should be held at Simla on the 1st of October next, by which date the report both of the Agricultural Chemist and the Madras Commission will have been received, and that before the 1st of August each Local Government and Administration should nominate the officer or officers whom it may wish to attend, including, unless there is some special objection, the Director of the Department of Land Records and Agriculture.

10. His Excellency the Governor General in Council desires also that advantage should be taken of the Conference to discuss the measures which may have, previously to the date of its assembling, been suggested by Local Governments and Administrations in connection with the 7th paragraph of this Resolution for the effective utilization of village accounts and returns for the purposes required by the Famine Commissioners.

11. In the meanwhile, such further information and correspondence as may be available will be circulated by the Government of India.

To the Government of Madras.
 " " Bombay.
 " " Bengal.
 " " North-Western Provinces and Oudh.
 " " Punjab.
 " Chief Commissioner of the Central Provinces.
 " " " Burma.
 " " " Assam.

To the Secretary for Bihar to Resident at Hyderabad.
 " Chief Commissioner of Coorg.
 " " " Ajmere.

ORDER.—Ordered, that the above Resolution be forwarded to the Local Governments and Administrations noted on the margin for information and guidance.

Ordered, also, that the above Resolution be forwarded to the Administrations noted on the margin for information.

APPENDIX B (vide page 8 of Proceedings).

Dated Poona, the 8th July 1890.

Report of Committee appointed by Bombay Govt. Resolution No. 3664, dated 27th May 1890.

We have the honour to intimate that we have discussed in Committee the subjects to which our attention is directed in Government Resolution No. 3664, dated 27th May 1890, and to submit our report as follows :—

2. We would observe, *in limine*, that we consider that the ordinary administrative machinery of this Presidency, which is being strengthened by an increased and better paid inspecting subordinate establishment, will efficiently furnish all the safeguards against surprise by famine which it is the object of Rule 2 of the Provisional Famine Code to provide. Our village system, coupled with the intimate knowledge of, and close touch with, their respective charges, that our District Officers are compelled, by constant and almost continuous touring, to acquire and keep up, ensures the premonitory symptoms of a scarcity or failure of crops being brought to notice without any special staff of observation beyond that which is now being organized. Another preliminary remark, which our experience induces us to make, is that, in the districts where the chances of famine are greatest, the conditions of agriculture are such that famine cannot be said to approach with slow and gradual steps to be watched and reported on. If the rains fail, or fail partially in the early part of the monsoon, and the autumn (*kharif*) crops fail with them, the people wait for the later rains to cultivate the spring (*rabi*) crops. The rains may again hold off in a manner to cause alarm, but not until the end of September, and sometimes even later, need hope be abandoned. A few days' good rain may ensure a moderate, a few more days' perhaps a bumper, crop.

3. It is again within our experience that, in cases of scarcity or failure of crops over a limited area, the migratory and independent habits of the people make any action for their relief superfluous. Some of us have seen relief works opened and only taken advantage of by the ordinary able-bodied labourers of the neighbouring villages, while half the houses (or, in some instances, the larger majority of them) in the vicinity are locked up and deserted, the owners having gone in search of employment during the months that intervene before the renewal of their own agricultural operations.

4. But we fully recognise that it is *because* local scarcity is attended with little actual danger to the inhabitants of the affected area, while if the failure extends over several districts Government action becomes called for, that the collation of information by the Agricultural Department is exceedingly desirable, as it will put Government in a position to know whether a widespread calamity has to be met and dealt with, and at the same time save any chance of its being affected by the naturally exaggerated apprehensions of local officers when scarcity is confined to any particular district or portion of it.

5. But while thus allotting to the Director of the Agricultural Department and his Divisional Staff the task of collating and supplying information so as to place before Government a synoptical view of the condition of the whole Presidency, and while further making it incumbent on the Director to check the collection and annual compilation of statistics to be submitted to the Collector and to bring to his notice irregularities and shortcomings, we urge that District Officers must on no account be relieved of the responsibility which now falls on them. It should be their duty, as heretofore, to keep themselves at all times acquainted with the condition of the people, the prospects of the harvest of their district, and to ascertain and report any unusual mortality among cattle from scarcity of fodder or from disease. The initiative in proposing or preparing measures of relief should be theirs, while, subject to the instructions of Government and with due regard to the advice of the Head of the Agricultural Department, the Circle Inspectors should, as now, be subject to their orders and control.

6. A Committee, of which most of us are members, is submitting proposals for the proper organization of the inspecting staff. It will only be necessary, in order to carry out the wishes of the Government of India, to incorporate in the Provincial Famine Code the special rules for the guidance of the Circle Inspectors. The rules which we think should be incorporated are shown in the Appendix. Very little further modification of the Code is necessary.

7. As regards the other points to which our attention has been directed, no fresh rules seem called for. The statistical account required by Section 17 of the Code has already been prepared, and provision is being made for the "minute, but compendious, analysis of precarious tracts."

8. A full return of famine works, which it would be expedient to entertain in case of emergency, has been prepared and submitted for each district. We would recommend that revised returns be prepared and periodically renewed as may be called for. Of the works originally entered, many may have been subsequently carried out, and the available programme

should always be kept up to date. But no new provision in the Code is needed ; for the orders of Section 29, that the programme should be "maintained," cover the necessary periodical revision. Our experience has taught us that it is only in exceptional districts that minor works under Civil Agency can be undertaken in any large number. The District Boards might be instructed to prepare and keep a list of these ; but, except in the case of earth-works of the simplest nature, such as tank clearances or repairs to dams, there are no works on which unskilled labour can be profitably employed on any scale without professional supervision.

9. As regards the utilising forest-produce for human food, we need only refer to the Government Resolutions on forest settlements conceding special privileges to wild tribes and certain other classes of the inhabitants of forest tracts as to the collection of edible wild fruits and roots. In times of great scarcity or famine it should be open to the Collectors to extend such privileges to all classes. In the latest Panch Mahals Settlement Reports special provision has been made to meet the exigencies of scarcity and famine (Government Resolution No 2368, dated 20th April 1887).

10. The question of price returns, referred to in the 9th paragraph of the Government of India's Resolution, has been considered and met by special provision in our additional rules for the special attention of, and report by, the Collector (Appendix, Rule g).

We would submit, for the consideration of Government, that the fortnightly and monthly price returns published in the *Government Gazette* might with advantage be submitted from the districts to the Director, Land Records and Agriculture, and compiled by him. He would be able to add explanatory remarks as to variations, and steps might be gradually taken to ensure a higher standard of accuracy. It cannot be expected that the necessary scrutiny of returns should be made in the Secretariat, and there is no want of evidence to show that such scrutiny is very much needed.

11. We can give no opinion based on *recent experience* as to the relative advantages of a money dole, a grain dole, and the distribution of cooked food, because fortunately we have had no widespread famine since the date of the preparation of the Bombay Famine Code and that Code embodies the experience of the great famine of 1876-77.

12. Turning now to the Government of India Resolution No. 345-55-C. I, dated 25th March 1890—

We have already discussed head (8) Famine Relief. As to head (1) Agricultural Enquiry, adequate measures have been or are about to be taken for the due record of facts and statistics. The Manual of Revenue Accounts has been carefully revised and is complete, and the staff engaged in supervising the collection of village statistics and compiling taluka returns is to be re-organized,—a question dealt with in the report called for in Government Resolution No. 1616, dated 27th February 1890, and we need only remark, in this place, that the prominence which the Supreme Government gives to the re-organization, from a famine point of view, adds weight to our recommendation, that no time should be lost in reforming the present Bhag Karkun establishment.

13. The subsidiary question of the education of kulkarnis and talatis has been fully dealt with in the report of the Committee of 1888, dated June 30th, paragraph 6, and we completely approve of the decision arrived at by that Committee, the gist of which is that while in Gujarat, where the talatis are stipendiary, the ideal, that "*every village* should possess an accountant trained in surveying and crop inspection," may be pursued by the Agricultural working with the Revenue Department, it can never be realized in those parts of the Presidency where the village officers are hereditary. In such parts the aim should rather be that *each circle of villages* should be in charge of an Inspector fully competent to survey and to guide the crop inspection of the kulkarnis.

14. The second head, (2) Agricultural Improvement, is sub-divided into—

(A) Analysis of agricultural tracts specially liable to famine, and

(B) Schemes for agricultural improvement, including agricultural education.

The duty of preparing a more detailed district account than that contained in Mr. Ozanne's Statistical Atlas will devolve on him and his Assistants. The appointment of Divisional Inspectors, to act in the latter capacity, is proposed in the report above alluded to.

The Government of India desires that a separate village record should be maintained, in which facts should be ledgered which indicate the fluctuations of the agricultural condition of every village and any improvement or deterioration. Such registers will, in our opinion, be necessary for the purposes of future revisions of rates. Forms should be fixed by the Director, and these should be filled in annually by the Circle Inspectors when assembled at the taluka or the compilation of the taluka returns. The principle has already been established that "the skilled supervision which directs the collection of these facts will also digest them for general use" (Government Resolution No 2557, dated 24th March 1884, paragraph 9).

The Mamedars will be responsible for the correct compilation of the taluka returns, while the District Inspector will make it his special care to watch and check the ledgering of the statistics, year by year, required both for famine needs and for revisions of rates.

It seems well here to explain what the registers will show.

There will be at least three registers.—

1. Ledger of population and resources (compiled from Village Form 13).
2. Ledger of wells (compiled from Village Form 15).
3. Ledger of cultivation (Village Forms 16 and 16A, Irrigation).

Such statistics are now, as far as possible, shown in the survey revision reports, being collected at the time of the revision survey. In future they will be collected year by year and village by village. This will entail no provision for establishment beyond that now being made.

There are other important statistics shown in the survey settlement reports village by village. These are the records of sales and leases of land registered in the registration offices. Their practical value can be largely increased for settlement purposes if they are properly formulated and explained. They afford means of gauging the tendency of land to pass into the possession of money-lenders and those large capitalists who invest in land in some districts. We think that the Divisional Inspector should visit the registration offices and examine these records, collating and digesting them with the aid of the District and Circle Inspectors, who have it in their power to ascertain the circumstances under which the recorded transactions took place.

It is not out of place to remark that taluka ledgers, containing the information which we propose should be tabulated in the village ledgers above referred to, are now regularly maintained in the office of the Director.

15. As to agricultural education and improvement, we will discuss the former subject first.

It is within the cognizance of Government that the College of Science, Poona, has been enlarged so as to constitute the agricultural branch of that college the agricultural college of the Presidency, and that a similar step is being taken in connection with the Baroda College. Both colleges are now affiliated to the University for the Diploma in Agriculture recently instituted by the Senate. Farms are or are about to be attached, which will be to some extent experimental, but primarily demonstration, farms, on which the students in agriculture can see the staple crops of the locality grown, and can watch experiments. These farms will be respectively under the Superintendent of Farms, at Poona, and under the Professor of Agriculture at Baroda, each assisted by qualified Assistants. One of the duties of these Assistants will be to hold farm classes on the farms. At Poona theoretical instruction is imparted by a teacher of Agriculture and Botany, as well as by the Professors of Chemistry, Physics, and other kindred subjects. A veterinary hospital is attached to the college, to make the lectures in veterinary science more practical.

This provision is made, both for the theory and practice of agriculture.

The students are, for the most part, Brahmans and Paisis, but many, especially from Gujarat, belong to the purely cultivating classes. They are not always or generally youths who intend to farm themselves, but are candidates for the Diploma, seeking thereby an entrance into Government service. It is our conviction that the beginnings in agricultural education should thus be made among the educated classes. The successful candidates for the Diploma will seek employment in the Revenue Department, after the small demand for the Agricultural and Educational Departments has been satisfied. The posts in the last named department are those of high school teachers of agriculture and physics, who are, at present, men trained at Madras or Poona. They teach the first principles of agriculture common to all systems, and they give some practical instruction on the plots of land specially attached to the schools for this purpose. It is intended that the agricultural classes in the high schools should feed the agricultural colleges and in some degree this result is being secured.

We must instruct the educated classes first, so that they may assist in agricultural enquiry. When that enquiry has sufficiently advanced—and it must advance slowly when we consider the great variations due to soil, climate, and situation—it will, in our opinion, be time to take steps to teach the principles of agricultural science in primary schools. We must get abreast of the empirical knowledge of the cultivator before it will be safe or useful to allow any teacher to arrogate to himself the right to teach Indian agriculture.

There is, however, one way of reaching the real cultivators, as desired by the Supreme Government, and that is by inducing them to come as apprentices to the farms. Something has already been done in this direction at the Bhadgaon Farm, and some of the apprentices have turned out superior farmers. Nothing, however, of real importance can be done in the way of teaching apprentices till accommodation is provided for them at the farms and till the number of farms is increased.

16. This brings us to the subject of agricultural improvement. Without anticipating the result of the deliberations of the conference to be held at Simla in October, we may say that there appears need for establishing experimental farms in the Southern Maratha Country and in Gujarat, and also, later on, in the Konkan. The principles which have been laid down—*viz.* that such farms should not be of large area, that the field of experiment should be as small as is compatible with the nature of the experiment, and that, the cost of pure experiment deducted, such farms should be made to pay their working expenses—are sufficient to prevent any extravagant expenditure. The necessity for more farms arises from the necessity of testing results obtained in one locality by those obtained in others, for without this to recommend imitation would be dangerous. The expenditure will consist in the small initial outlay on the purchase of land, if Government land is not available, and on the erection of a few farm buildings. And the recurrent expenditure will be only the cost of the Superintendent (say about ₹100 to ₹150 per mensem) and his clerical staff required to keep the strictest record of the cost of cultivation and outturn. The varying outturn of the staple crops of the Presidency cannot be said to be known with accuracy, and it is thus highly desirable that the farms should afford the necessary information. While the farms are called on to pay expenses, and to show a profit, except on the purely experimental area, it is only fair that the Superintendents should be allowed relaxations of the account rules as far as possible. No farmer can make his farm pay if he is not at liberty to turn his capital over as often as he can do so with profit.

17. As to other definite proposals which we are invited by Government Resolution No. 4175, dated 14th June, to make for this Presidency, we think it highly desirable that the Director should have funds at his disposal to import cotton and other seed which has experimentally been proved superior to local seed; to purchase locally and distribute at cost price seed which experimental trials have proved to be suitable; and occasionally to buy improved machines which he has reason to think can be introduced with benefit to the country.

This was the object of the grant of ₹10,000 per annum made in Government Resolution No. 8742, dated 29th November 1883, Revenue Department, but the Director informs us that this grant has been reduced to ₹3,000 this year. The original grant does not appear to us excessive, and we recommend that it should be provided for in future.

As to cattle-breeding, both for the plough and the dairy, we think that definite steps should be taken by the Agricultural Department. A small beginning has been made at the Bhadgaon Farm with the Mysore breed—essentially a plough breed. This might be extended to other localities where Government farms are established. But attention need not be confined to breeds useful for the plough. The Director informs us that he has submitted proposals to facilitate enquiry as to the relative merits of local milch breeds, and that he wishes to take up the question of crossing with foreign animals noted for their qualities as milch kine.

A scheme has already been submitted for establishing a farm at Alegaon to breed and feed sheep for Commissariat purposes, as much need exists for the improvement of sheep as of cattle, and we think that the Alegaon Farm might very well be utilised by the Director for dairy cattle as well as for sheep and plough cattle.

Cattle and Agricultural shows and Horse shows are held in various parts of the Presidency. In some places they are combined. Most are aided by Government grants. As to Horse shows, we need say nothing; but we think that the Agricultural Department should now be enabled to take a more definite share in the encouragement of Cattle and Agricultural shows. Agricultural shows are largely attended by the cultivating classes, and tend towards improvement by exhibiting grains and other products—in many cases far superior to the products of the locality where the show is held. They bring cultivators together. They facilitate the distribution of superior seed. In the form of Cattle Fairs, they are an indigenous institution, and some of the most successful local shows are now held in connection with long-established fairs.

18. To sum up our proposals for agricultural improvement:—

- (1) The number of experimental farms should be increased.
- (2) They should be also cattle farms, to breed plough cattle for the cultivators.
- (3) They should be used for the purpose of growing pedigree seed for distribution.
- (4) As far as possible they should be adapted to receive apprentices of the cultivating classes.
- (5) The Agricultural Department should have a liberal annual grant for the purchase and distribution of seed, whether locally or from abroad.
- (6) And a similar grant for the purchase of improved machinery and implements requisite under the present conditions of husbandry.
- (7) The Alegaon Farm should be made a dairy and stock farm under the Agricultural Department.
- (8) On this farm and on others the improvement of sheep and goats should, when possible, be studied.

- (9) The farms on their non-experimental areas, should, in the first instance, grow the staple crops of the locality in the best local method, before attempting innovations. The objects should be to thoroughly understand local practices, to try modifications suggested by experience and the principles of scientific agriculture on the experimental area, to test the results of modifications, and when they prove beneficial to demonstrate them to the cultivators.
- (10) The Agricultural Department should be enabled to encourage Cattle and Agricultural shows.

The sanction of the post of Superintendent of Farms for the Presidency, which has lately been accorded, will make it possible for the Director to undertake the duties which we have sketched out, and will at the same time enable him to provide overseers to the farms at a moderate rate of pay.

G. F. M. GRANT,
Commissioner, C. D.

H. E. M. JAMES,
Commissioner, N. D.

ALFRED KEYSER,
Acting Commissioner, S. D.

C. W. GODFREY, Colonel,
Acting Survey and Settlement Commissioner.

J. D. CRUICKSHANK, Lieut.-Colonel, R. E.
Superintending Engineer, C. D.

E. C. OZANNE,
Director, Land Records and Agriculture.

APPENDIX to Bombay Committee's Report.

Proposed modifications in, and additions to, the Bombay Famine Code.

Chapter I, Section I.—For "Agricultural branch of the Revenue Department, &c." read "Office of the Director, Land Records and Agriculture," and below, for "this branch" read "Revenue and Agricultural Department of the Secretariat."

REASONS:—When this section was drafted, no decision had been arrived at as to the special recommendation of the Famine Commission for the formation of a statistical branch in the Secretariat. The work which that branch was intended to do has gradually been taken up by the Director of Agriculture, and his office is, in fact, the statistical office of the Presidency; therefore the wording of the section should be altered as proposed. (*Vide* paragraph 4 of Government Resolution No. 6511, dated 1st September 1933.)

Chapter I, B.—Civil Officers.—This chapter deals with the duties of district officers and others in famine, but in Section 17 "duties before famine" are noticed, and between this and the next section should be added the special orders and set rules which the Government of India requires, *viz* :—

(a)* Every Circle Inspector shall in his weekly diary to the Mamledar specially notice all important facts bearing on the condition of the people, cattle, and crops, the supply of drinking water, prevalence of diseases affecting man or beast, and any sudden or important rise or fall in the price of food-grains and fodder. The rainfall in different parts of the circle must be described, care being taken to show whether it is seasonable and sufficient or otherwise. The diary shall be sent with the Mamledar's remarks to the Assistant Collector.

(b) For the purpose above mentioned it will be incumbent on the Circle Inspector to be in constant communication with the village officers under him, and should there be any such break in the rain as to give cause for apprehension, he should visit weekly one or two large villages in each of the several groups into which he should sub-divide his circle for the purpose and collect the requisite information from personal observation and enquiry.

(c) It shall be the duty of village officers at once to report the existence or prospect of any distress or failure of crops, fodder or water-supply or any unusual emigration from their

* Remarks.—Rule (a) This rule is taken with slight verbal alterations from the Circle Inspectors' Rules sanctioned in Government Resolution No. 7214 dated 11th October 1936. Rules (b) to (c) and (d) are new. Rule (f) is in substance taken from the remarks below Taluka Form 37.

villages, to the Circle Inspectors, and to keep the latter informed of any change, whether for better or for worse, so long as the danger continues.

(d) On receipt of any adverse reports, the Mamledar and the District Inspector shall at once proceed to the tract represented as adversely affected, and communicate the results of their observations to the sub-divisional officer (Assistant or District Deputy Collector).

(e) It shall be the duty of district officers, as heretofore, to keep themselves informed of the condition and prospects of their charges, and primarily it will rest with them to make any proposals for relief of distress affecting men or cattle when, in their opinion, the necessity arises.

On receipt of any report of a serious failure of crops being imminent or probable in any portion of his charge, the sub-divisional officer shall proceed forthwith to the spot and report to the Collector the result of his personal observation.

(f) As provided in Form No. 37 of the Taluka Manual, the Mamledars shall submit to the Director, Land Records and Agriculture, periodical rain returns, taking special care that the particulars specified in paragraph 3 of the remarks are duly filled in, viz. whether the rainfall was sufficient, normal or otherwise; whether it was particularly beneficial or injurious to any staple crop, or whether any defect or disease in crops is attributable to any particular fall or absence of rain for any period, and whether the rain promoted or retarded any agricultural operations; and make such additional remarks as may be called for as to the nature of the season and state of the crops, specially noting any adverse circumstances or sign of distress which may be indicated in the diaries of the Circle Inspectors.

(g) When in any district prices rise considerably (say 15 or 20 per cent.) above the normal rate, which can be ascertained by a reference to the average prevailing rate of a cycle of immediately preceding years, the Collector should report the circumstance to Government, stating at the same time how the rise is affecting the condition of the people, and to what cause or causes it may, in his opinion, be attributed.

Chapter I, Section 20.—We would prefer that “will” should be altered to “may.”

Chapter I, Section 22.—We think that Assistant Collectors are too scarce and too valuable in times of famine to be thus utilised, and would prefer to alter the wording as follows:—
“A Personal Assistant may be appointed.”

Chapter IV, Section 11A.—Add to the first paragraph of this section—

“and should coincide with the circles of the Inspectors on the Mamledar’s staff. These Inspectors will be *ex officio* Relief Circle Inspectors in famine.”

In the second paragraph, after “appoint as many” add “additional.”

Chapter VI, Section 151.—The heading should be altered to—*C. Relaxation of Forest Rules.*

Insert new Section 151A before Section 151—

“When it appears to the Collector, in districts where edible fruits and roots are plentiful in forest reserves, that the privileges of collection enjoyed by wild tribes and special classes, should, owing to failure of crops, be temporarily extended to all classes, he may so extend them, reporting to the Commissioner and giving the necessary instructions to the Divisional Forest Officers.”

In order that the existing copies of the Famine Code may be utilised we would not alter the numbering of any section, and the new additions, &c., may be incorporated by means of printed slips.

Extract from the Proceedings of the Government of Bombay, Revenue Department,—No. 5778, dated Bombay Castle, 15th August 1890.

READ—

Letter from the Commissioner, C.D., No. R.—3234, dated 11th July 1890—Forwarding a report, dated 8th idem, by the Committee appointed in Government Resolution No. 3664, dated 27th May 1890, to consider and report on certain questions raised by the Government of India in connection with the revision of the Famine Code and review of the position of the Department of Land Records and Agriculture.

RESOLUTION.—Government fully concur in the remarks and proposals made by the Committee in paragraphs 2—9 of their report dated July 8th, 1890, and approve of the alterations in, and additions to, the provisions of the Bombay Famine Relief Code recommended by the Committee.

2. The suggestion contained in paragraph 10 of the report is already under the separate consideration of Government, and the Director of Land Records and Agriculture has been

desired to propose arrangements to give effect to a scheme similar to that advocated by the Committee.

3. The Government of India may be informed, with reference to paragraph 12 of their Circular Resolution No. 63—77 C., dated December 19th, last, that as happily no famine has occurred in this Presidency since 1877-78, or since the preparation of the Bombay Famine Relief Code, no suggestion based on recent experience can be furnished concerning the relative advantages of a money dole, a grain dole, and the distribution of cooked food. No modification is deemed necessary in this respect of the existing Code which provides for the employment of these three methods of relief as the special circumstances of each case may require.

4. Orders will shortly be issued on the subject of the reform of the present Bhag karkun establishment and of the organization of the Agricultural Department establishment.

5. The Governor in Council entirely agrees in the observations and recommendations made by the Committee in paragraphs 13 and 14 of the Report. In the Deccan and other districts where they exist the hereditary kulkarnis may be able to keep satisfactorily; under careful supervision, the village statistics, and to perform crop inspections; but for the present at least, and for years to come, it will not be possible to entrust to them survey work in the form either of measurement or of classification. They do not possess the necessary technical knowledge, they cannot be expected to obtain the requisite qualifications, and even if they did it would not be expedient to devolve such important duty on men of their status and circumstances. They will, if duly supervised, carry out instructions, but they can originate nothing and are incapable of performing any tasks requiring scientific knowledge and training. The correct compilation of returns and statistics must depend entirely on the efficiency of the supervising staff, and as the members of that staff, the Circle Inspectors and others, are to be carefully selected and will have to pass prescribed tests, it may reasonably be anticipated that they will be able to perform this duty satisfactorily and to see that the kulkarnis carry out with accuracy and diligence their share of the work.

6. Government have perused with interest the remarks and proposals of the Committee on the subject of agricultural improvement and education, but will defer passing any orders thereon until the results of the deliberations of the Conference shortly to be held at Simla are known. In the meantime the Director of Land Records and Agriculture should submit a detailed scheme showing precisely how he would propose to give effect to the suggestions of the Committee and what expenditure the adoption of his scheme would involve.

7. Copy of the report of the Committee and of the orders passed by this Government thereon should be communicated to the Government of India.

APPENDIX C (*vide page 10 of Proceedings*).

Note by Mr. J. B. HALLEN, General Superintendent, Horse Breeding Department, on Dry Grass or Hay—How to make it good?

GRASS in India is, as a rule, cut when perfectly dry, and has become fibrous, possessing little nutritive properties; hence probably one reason why native horse-owners find it is necessary to give sugar and ghee, and thus make up for the want of similar chemical constituents in the dry grass.

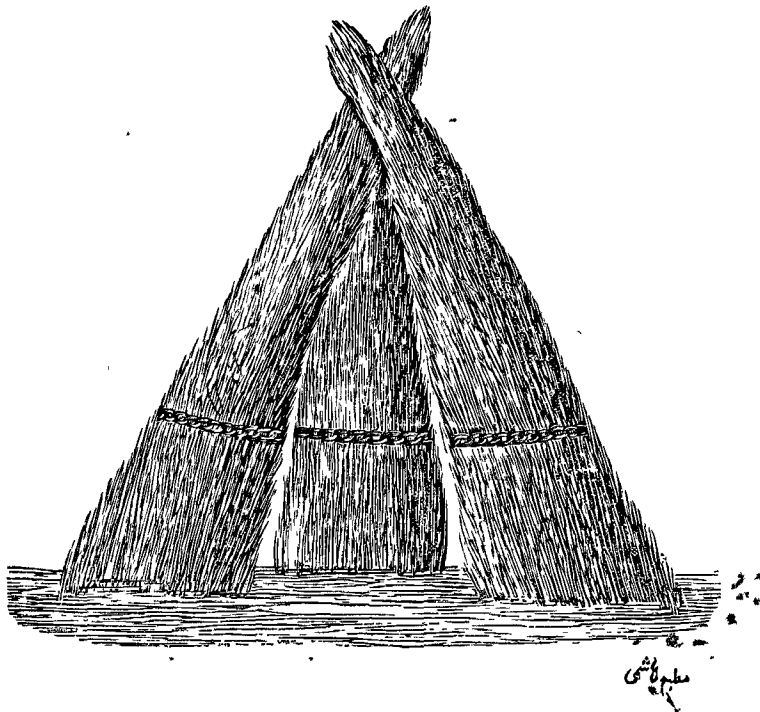
Grass for stacking should be always cut when green and in flower. The most simple way to prepare grass for stacking is as follows—

Cut when green and in flower, tie up in bundles of about 8 to 10 lb weight, and place three of such bundles on their broad ends leaning against each other as shown in the attached diagram. By this arrangement the grass will not become damaged by rain, and the central grass of each bundle will ferment and acquire more nutritious properties from containing saccharine and starch matter.

When the bundles are sufficiently dried they may be stacked. Dry grass thus prepared will be found very nutritious and sweet, and animals will eat it readily. It will be nearly as good as fair hay made in England and other countries. Proper hay-making requires much practical experience.

If the weather is hot, and sun powerful, grass will be dry enough, as a rule, in two or three days, and can be then stacked, but it should be stacked in small ricks, in case of any heating taking place, for if grass be stacked when too green or wet, it will surely heat too much, go beyond the fermenting process of making sugar matter, &c., and will become on fire.

A little heating makés the grass sugary and gives a very sweet odour, the odour of hay.



APPENDIX D (*vide page 36 of Proceedings*).

No. 1971 Agri., dated Calcutta, the 9th September 1890.

*From—*Mr. FINUCANE, Esq., *Director of Land Records and Agriculture, Bengal,*
To—The Secretary to the Government of Bengal, Revenue Department.

No. 1621—174 Agri., dated 2nd May 1890.
No 2806—247 Agri., dated 11th July 1890

WITH reference to your letters cited in the margin, I have the honour to submit the report called for on the points indicated.

2. It is pointed out in your No. 1621-74, dated 2nd May 1890, that the attempts made by the Government of Bengal to promote agricultural enquiry and improvement have in many cases taken the form of encouragement to private exertions, such as those now being made by silk-rearers to eradicate the disease of pebrine among silkworms, and the experiments of the Agricultural and Horticultural Societies. It is requested that I should review the results obtained by this method as well as by the more direct action taken on model farms, and that I should consider what further steps can be taken in the same direction. Report is also called for on the utilisation of village accounts, the form which they should take, and on the means by which they should be maintained.

3. In reviewing the work of the Agricultural Department on these points, it will be convenient to take them in somewhat different order from that suggested. The Government of India, in defining its duties of Provincial Agricultural Departments, declared that, as enquiry must precede improvement, the first and main duty of these Departments should be—not the conduct of agricultural experiments or the supervision of model farms—but the prosecution of enquiry into existing systems of agriculture and the complete and systematic ascertaining of agricultural and economic facts, so that Government may be in possession of adequate know-

ledge of the condition of the people of the country and of their resources. In more advanced countries the existing systems of agriculture, and the agricultural conditions of the various parts of them, are so well known that no enquiry is ordinarily required before undertaking experiments with a view to improvement. In India it is otherwise. The agricultural practices and conditions of different provinces, and of different districts in the same province, are so varied and so little is known of them, that it would be unwise to undertake agricultural experiments, with a view to improve the existing methods of agriculture, without first ascertaining what the practices are which it is intended to improve. It is owing to neglect of this precaution that many of the experiments made, and improvements attempted, in various parts of India have sometimes failed to produce satisfactory results. In Bengal such mistakes have, it is hoped, been avoided so far as it was possible for a Department to avoid them which was placed, at its creation, on a temporary basis, and from which immediate results were expected in order to justify the continuance of its existence.

(a) *Agricultural enquiry through surveys and records-of-right.*

4. The work of the Agricultural Department in Bengal commenced with an enquiry into existing systems, either (a) in the form of surveys and record-of-rights, or (b) in the form of analysis of districts, or (c) in the form of agricultural experiments in experimental stations. The results of the conduct of surveys and of the preparation of record-of-rights, which have chiefly occupied my attention and time during the past four years, need not, it is presumed, be reviewed here further than to say that a survey has been made and a record-of-rights has been prepared of an area covering 4,826 square miles; that these operations have extended to every Division in Bengal; that they have affected about half a million of raiyats; that they have been conducted without any of that friction and opposition which formed a concomitant of previous surveys and settlements whenever undertaken on a large scale in Bengal; that they have cost less than the rough and incomplete operations previously undertaken through non-professional agency; that they have already eventuated in a considerable increase in Government revenue, and that they have furnished valuable statistical information as to the condition of the people, the relative areas under various crops, the amount of the rents paid, and the system of agriculture followed in the areas affected.

(b) *Agricultural enquiry by analysis of districts.*

5. Under the second system of enquiry, that known as analysis of districts, it may be said that the agricultural systems of a few important districts—Dacca, Lohardugga, and Burdwan—have been studied, then agricultural conditions have been ascertained, and careful reports on the agriculture of them have been prepared. Similar enquiries are now being prosecuted in the Cuttack and Nuddea districts. The results of these enquiries may be briefly stated thus—

- (i) They have given a knowledge of the native system of the agricultural and rural economy of these districts which was not before available.
- (ii) Many things, such as green manuring, the Mauritius system of cultivating sugarcane, the value of cowdung and of artificial manures, such as oil-cakes, are shown to be known to and fully appreciated by cultivators in certain districts, such as Dacca and Burdwan, where cultivators are intelligent and the advantages of resort to these manures has been brought home to their minds; while the value of cowdung is not so thoroughly appreciated and the use of artificial manures is unknown in the more backward districts, such as Lohardugga and the districts of the Patna Division, where cultivators are ignorant and the system of land tenures is insecure.
- (iii) It has been found that Indian agriculture is not in all districts in that stagnant condition which has been sometimes supposed. Many improvements have been introduced, and the cultivation of many crops has been undertaken by the present generation of cultivators, which were unknown to their fathers. The progress made varies, however, in different districts, so that the cultivators of some districts have much to learn from those of others immediately adjoining them.

(c) *Agricultural enquiry by experiments in agricultural stations.*

6. In the natural course of events agricultural experiment with a view to improvement should begin when a sufficient knowledge has been acquired of existing system of agriculture and of the agricultural condition of a district. Such experiments were undertaken in Bengal on a small scale—

- (1st) in an experimental station, at the expense of Government, at Seepore, near Calcutta;

(2nd) in an experimental station, at Doomraon, at the expense of the Maharajah of Doomraon;

(3rd) in an experimental station, at Burdwan, at the expense of the Burdwan Raj.

A summary of the result of the experiments made at these stations is given below; it must, however, be noted that, as the experiments have been carried on for periods varying from only two to four years, it is manifest that these results cannot be regarded as conclusive, even as regards the districts in which the experiments were made, and still less as regards districts with different conditions of soil and climate.

I.—CROPS.

Potatoes.

1st.—Potato seed imported directly from England succeeded well in the plains, and such seed as well as English seed acclimated at hill stations yielded a heavier outturn and better quality than *doshi* (country) seed.

2nd.—High cultivation paid better than the ordinary method.

3rd.—A mixture of castor-oil cake and bone-meal proved to be a profitable manure for potatoes; the addition of bone-meal not only increased the yield but improved the quality.

4th.—In sandy laterite soil potatoes were much damaged by a species of red ant. The use of bone-meal as a manure either saved the crop, or very much lessened the injury done by white ants.

5th.—Cut sets were used with safety.

6th.—In the plains seed tainted with blight yielded a good crop, but the produce was inferior in keeping quality and rotted in July and August.

Sugarcane.

1st.—The red Bombay—a Mauritius cane imported by Major Sleeman—is not suited to the climate of Lower Bengal.

2nd.—Castor cake with some addition of superphosphate proved to be the best manure for sugarcane.

3rd.—In a year of drought no manure for sugarcane proved to be so good as cowdung.

4th.—As far as possible, manure should be used at the time of planting the cane sets and placed well below them.

5th.—Sugarcane is best grown in sandy laterite soils.

6th.—Saltpetre applied as a top dressing to sugarcane gave a net profit.

7th.—A modified Mauritius system of planting is probably better than the ordinary method.

Cotton.

1st.—The variety known as *khaki* did well in sandy laterite soil, and gave a heavy crop annually for four years.

Wheat.

1st.—The local Buxar variety proved to be better than the Mozuffernuggur wheat.

2nd.—Top dressing with saltpetre increased the yield and gave a large net profit.

3rd.—Green manuring with hemp gave an increased yield for the first and second years only.

Fodder crops.

Sorghum and yellow cholum were grown with advantage as fodder crops.

Jute.

Oil-cake applied as a manure to jute yielded a net profit.

II.—PLOUGHING.

Country bullocks of average strength are able to work the Seebpore or the Hindustani plough. Ploughing to a depth of five inches with a soil-inverting plough gave a larger yield, in uplands, than ploughing with the country plough.

Manures.

On light soils in the climate of Bengal no manure can properly be said to be insoluble. Crushed bones and horn shavings gave results the first year.

Practical measures to give effect to conclusions suggested by these experiments.

8. It has been already stated that it would be premature to assert that conclusions suggested by experiments continued for only a few years have been established beyond doubt, and for this reason such efforts as have been made to introduce the practices suggested by them have been made only on a small and tentative scale.

Cultivation of Buxar wheat—Efforts have been made to introduce, or rather to have a trial given to the cultivation of, Buxar wheat in districts where it was previously unknown. The grain produced in such districts has been appraised by the Committee of the Bengal Chamber of Commerce and its value was compared with local varieties, the results being reported to the growers. The general result has been that the Buxar grain is valued more highly than local varieties, but Buxar wheat shows a tendency to degenerate where the land is not manured and irrigated.

Cultivation of acclimatised English potatoes.—English and Darjeeling potato seeds were sold to cultivators in Hooghly and Burdwan and grown with such success that large demands for these varieties arose. The cultivators of parts of the Hooghly district have since taken to the cultivation of acclimatised English potatoes.

Potato cultivation was also introduced, with beneficial results, in the Western Dooars of Jalpaiguri and in the Manbhoom district.

9. *Bone-meal* was distributed among some raiyats of Government estates in Burdwan, Hooghly, and Jalpaiguri and was used by selected raiyats as a manure for sugarcane, potatoes, and paddy. The raiyats in question bear testimony to the efficacy of this manure, but allege that oil-cake at Rs. 8 a maund pays better than bone-meal at the same rate. Bones have recently been collected and broken with the common *dhenki* at a cost, inclusive of cost of collecting the bones, of Rs. 1 per maund. The raiyats of one village in Hooghly have bought 22 maunds of bone-dust at this rate and used it in the current year. Bones are now being crushed in the Jalpaiguri Jail with the *dhenki*, for sale to cultivators of Jalpaiguri, at the same rate. Bone-meal is also being made and used by some indigo planters in Behar.

Efforts to promote agricultural enquiry and improvement by encouragement to private exertions.

10. The attempts made to promote agricultural enquiry and improvement in Bengal by encouragement to private exertions may be classed under three heads:—

1st—Aid to the Bengal Silk Committee in the conduct of experiments with a view to the eradication of pebrine.

2nd—Aid to the Agr-Horticultural Society, the members of which it was thought would undertake agricultural experiments, and would, where they found the results successful, use their influence in introducing the improved methods suggested by these results in their neighbourhood.

3rd—Assistance and advice to private individuals, such as the Maharaja of Doomraon and managers of Wards' and private estates, in the introduction of new crops in the trial of new implements, and supply of good seed.

11. *Aid to the Bengal Silk Committee*.—When the Indo-Colonial Exhibition was held, in Calcutta, the Government of India, in reviewing the various products of the country, with a view to determine which of them was most likely to reward efforts for the promotion of their development, decided that silk was the product for which there was most hope. By the wish of the Government of India and of the Secretary of State, Mr. Wardle came to India "to give encouragement to the extended production of tussur silk and to see how it was that Bengal silks had fallen into disrepute within the past twenty-five years." He attributed the decline in the silk industry of Bengal to the high and differential rates of rent which, he had been informed, were charged for mulberry lands, to the failure of cocoons owing to the want of proper selection of seed by native breeders, to the defective arrangements for reeling, and to the introduction of more profitable staples, such as sugarcane and potatoes. In the course of enquiries instituted with reference to these alleged causes, it came to light, shortly after the creation of the Agricultural Department in Bengal, that perhaps too much importance had been attached to some at least of the causes above specified, and it was stated that the decline of the industry was in a great measure due to the ravages of a disease which had broken out among silkworms in recent years and threatened to ruin the industry. An enquiry was instituted by the Government of India, and it was reported by Mr. Wood-Mason that this disease was that known in Europe as *pebrine*, which had been successfully combated by M. Pasteur's system, by which moths intended for seed are microscopically examined and the eggs of such as are found to be diseased are rejected. In order to make himself practically acquainted with this system of microscopic examination, Mr. N. G. Mookerjee, who had received an Agricultural education at Cirencester at the expense of the Government of Bengal, was deputed by

the Government of Bengal to Paris to learn in M. Pasteur's laboratory the method of microscopic examination there followed. The result was that it was established beyond doubt that the disease from which silkworms were suffering in Bengal was pebrine, and it was determined that efforts to eradicate or mitigate this disease should follow the lines adopted by M. Pasteur in Europe. A committee of gentlemen interested in the industry was formed with a view to giving practical effect to these measures. Mr. Mookerjee's services were placed at their disposal and a contribution was made by the Local Government of ₹5,000 per annum for the purpose of introducing and carrying out M. Pasteur's system of microscopic examination, on the condition that at least an equal amount should be subscribed and expended for this purpose by private individuals. It is premature at present to say what the results of these attempts to eradicate pebrine, on the lines above indicated, may ultimately be. All that the committee can now assert is, that "where properly-selected and carefully-examined seed has been issued a perfect crop was the result." In addition to the examination and selection of healthy seed under Mr. Mookerjee's immediate supervision at Berhampore, a plan has recently been adopted of helping private gentlemen, residing at a distance from the Bengal silk districts, to rear seed according to European methods, and to get the crop so reared distributed as seed in the silk districts which are infected with pebrine.

Agricultural enquiry through the Agri-Horticultural Society.

12. The Agri-Horticultural Society has received since 1886 a subsidy from the Government of Bengal of ₹6,000 per annum on the condition that it takes charge of and places in its rooms in the Metcalfe Hall, so as to make them readily available to the mercantile community, such articles of economic value as Government may deliver to it for custody, and that it conducts, through its members, such experiments in economic products as may, from time to time, be suggested and considered desirable. Pending the collection of economic products for the new Economic Museum now under construction, it has not been possible to place a large collection of articles of economic value in the Society's rooms. In order to give effect to the latter part of the arrangement, a scheme was drawn up, with the approval of Government and of the Council of the Society, for the conduct, through its members, of certain experiments designed with a view to test the relative values of certain manures, of using a soil-inverting plough as compared with the country plough, of early ploughing as compared with late ploughing, and of the merits of Buxar wheat as compared with local varieties. It cannot be said that any of the members of the Society have made any sustained effort to carry out any of these experiments, or that any results of value have been obtained.

13. In the preceding paragraphs a summary has been given of the efforts made to—

- (1) investigate the existing agricultural practices of parts of Bengal ;
- (2) to make experiments in small experimental stations with a view to test the value of certain suggested improvements ;
- (3) to apply the results tentatively and on a small scale.

It could not have been expected, in so short a time, and with the agency of only two assistants, who were employed on this branch of the duties of the Agricultural Department, that any striking results would be attained, and it cannot be pretended that any great or striking results have been attained. It remains to consider what further steps should be taken in the same direction.

Further steps in the same direction.

14. It appears to me that the direct action of Government in the introduction of changes in the agricultural practices of a country like India cannot at best have any great effect for many years to come, unless and until Government is prepared to expend very much larger amounts on this branch of administration than it is at all likely to spend, or perhaps than it would be justified in expending, in the permanently-settled districts of Bengal. It has been already stated that where primary education is spreading and intelligence is awakened by communication with the outside world and reasonable security of tenure prevails, there cultivators do not wantonly waste the manual resources at their disposal, and are even resorting to artificial manures. Where, on the other hand, as in Behar and Chota Nagpore, the body of the cultivators are ignorant and the tenure of land is insecure, there cultivation is backward, and attempts to introduce improvements are, and will be, futile. For this reason I am of opinion that it is of cardinal importance, in connection with the question of improvement of the agricultural practices of the country, that primary education should be spread and that reasonable security of tenure should be guaranteed. It is not within my province to suggest the means by which funds may be made available for the extension of primary education. Whether the whole system of what is called higher education in Bengal is not too much of

a literary as distinguished from a physical and practical character, whether a large portion of the funds now devoted to higher education should not be devoted to primary education, and whether an education rate should be imposed—these are large questions which it would be out of place to discuss on the present occasion. As to the second point of cardinal importance—security of tenure and the necessity of a survey and record-of-rights in order to attain it—much has already been written by me, and it would serve no useful purpose to repeat my views here. Mr. Sen's report on Dacca shows that, with a population of 756 65 to the square mile on the entire area and a very much larger population on the cultivated area (much of the district is under jungle), the people of that district are prosperous, and the system of agriculture comparatively progressive; while in such districts as Chumparan and Lohardugga, with a population of only 487·57 and 133, respectively, to the square mile, it is known that the cultivators are lamentably poor, and the system of agriculture backward and stationary. The cause of this poverty and backwardness in the latter instances appears to me to lie more in the ignorance of the cultivators, and in the apathy entailed by insecurity of tenure than in the number of the population pressing on the resources of the soil. But while thinking that spread of education and security of tenure will ultimately have more effect on improvement of agriculture than any direct efforts of Government, by way of encouragement of improved practices shown in experimental farms to be beneficial, or by farms, agricultural shows, or the like, I am at the same time of opinion that much may also be usefully done, at a moderate cost, in the latter directions.

Establishment of an Agricultural College at Seebpore.

15. It is obvious that without some sort of agency possessed of an agricultural education and training, it is impossible for an Agricultural Department to effect any substantial agricultural improvement, and it seems equally obvious that, given such educated and trained agency, it will be impossible for Government to reach the masses of the agricultural community, in the matter of agricultural improvement, unless the sympathies are enlisted of those who are looked to by the cultivating classes as their natural leaders. Bengal at present stands alone, in being absolutely without the means of imparting agricultural education and training of any kind, either to the servants of Government who may be employed in the Agricultural Department and in the management of estates, or to the sons and agents of zemindars and cultivators who may be desirous of such training and education. It appears to me to be eminently desirable that the means of imparting such education should be provided, for there is no part of India in which there is more likelihood of such education and training being appreciated and subsequently taken advantage of. Bengalees have surpassed the inhabitants of other provinces in other walks of life, as pleaders, doctors, engineers, and there is no reason to suppose that they would not take advantage of opportunities to acquire and make use of a knowledge of agriculture and of the sciences connected with it, if such opportunities were placed in their way. Those who maintain that agricultural education is useless, that the raiyats' practice admits of no improvement, are consistent in refusing the means of an agricultural education, for if such education leads to no useful results, then the Bengalee will not be slow to find this out; but for those who believe that existing practices are susceptible of improvement with profit, it is difficult to overrate the importance of imparting to the better-to-do classes connected with land an agricultural and practical education which will divert their minds from chimerical literary and political pursuits, and give them important practical subjects on their own estates, on which they may interest themselves. Proposals have already been made for the establishment of an agricultural college or school at Seebpore at a moderate cost. I would take this opportunity of renewing and inviting attention to that proposal.

16. The proposals made for imparting education, of a high character, to Bengalees and others at Dehra Dun do not affect the necessity of having an agricultural school at Seebpore, for the education at Dehra Dun cannot be agricultural—

- (1st) because there is no agricultural land there, and
- (2nd) because the education to be given at Dehra Dun is to be of a high character, for which some preliminary training is required elsewhere.

Attached to the agricultural school at Seebpore it is necessary that there should be an experimental station, where well-devised experiments may be carried on with scientific accuracy, and a demonstration farm in which the students may take a part in the actual work of farm operations.

Elementary agricultural education.

17. In addition to the higher class of agricultural education provided in the proposed college, elementary instruction may be given in primary schools. An agricultural primer has lately been adopted as a text-book in these schools.

Experimental agricultural stations. Requisites for conduct of agricultural experiments.

18. Over and above the agricultural college and the experiments conducted in the station attached to it, experiments should be conducted, under skilled supervision, in the various parts of the country of which the soil and climate and systems of cultivation are broadly and distinctly different from those prevailing in Calcutta and its neighbourhood. The requisites for the proper conduct of these experiments are—

- 1st—The sites of the experimental stations should be so selected that they may be typical of as large areas as possible
- 2nd—The soil of the various plots on which experiments are made at each experimental station should be uniform.
- 3rd—The experiments should be devised with a definite object, after enquiry into the system of agriculture practised in the locality, and they should be made with a view to the introduction of definite and practical improvements, if the experiments show profitable results
- 4th—They should be carried on continuously for a number of years on the same plots.
- 5th—The soil should be analysed.

19. With the establishment at present available, I do not think it desirable to open any new experimental stations. The three stations already established are quite as much as can be supervised by the agency now employed; but if funds were available, and this agency were strengthened, it would, in my opinion, be desirable to establish additional experimental stations in Eastern Bengal, Orissa, and Chota Nagpore. Provision should be made for the permanent retention, in the Agricultural Department, of the officers engaged in the supervision of experiments and their numbers should be increased.

Establishment of a veterinary school.

20. The establishment of a veterinary school in Bengal has been already recommended, and the necessity for such a school has been admitted.

Utilisation of village accounts.

21. As regards the utilisation of village accounts, and the form which they should take, my views were reported at length in my letter No. 767, dated 19th November 1885. That report was written on the assumption that it had been decided that a Patwari Bill was to be passed, and that the system followed in the North-Western Provinces was to be introduced, in its entirety, in Bengal. In Government estates held under khas management in which rayats' accounts are kept by Government as landlord, the registers and forms of account given in the draft rules annexed to the letter above cited may be adopted. In permanently-settled tracts no arrangements for maintenance of village accounts can be made without legislation; but in temporarily-settled tracts, like Orissa and Chittagong, now under survey and resettlement, arrangements may, if it is thought desirable to do so, be made, at the time of settlement, for the appointment of patwaris, whose duty it would be to keep up registers in forms similar to those prescribed in the North-Western Provinces. These registers contemplate—

- (1) the keeping of rent accounts, by the patwari, between landlords and their tenants;
- (2) the keeping of records of all mutations of holdings by transfer, inheritance, or otherwise;
- (3) the collection of statistics, year by year, after field-to-field inspection of the area under every crop.

22. It is clear that accounts and registers of this character cannot be kept up without an expensive agency, whether that agency is paid directly by the landlords concerned or by the rayats or by Government. If the obligation to pay patwaris is imposed on the landlords and is really enforced, it is manifest that this fact must be taken into consideration in fixing the amount of Government revenue to be demanded of them, and therefore that the whole or a portion of the cost of such agency must ultimately fall on Government. Where, as is the case in the North-Western Provinces and elsewhere, such agency already exists, it is obviously desirable to utilise it for the purposes indicated, and one important effect of so utilising it is that the necessity for new surveys on the expiration of the term of settlement is obviated; but it may be a question for consideration at the conference whether, in parts where no such agency exists, the results to be achieved, even if successfully attained, are worth the expense which must be incurred in the creation and maintenance of such agency. According to the North-

Western Provinces rules, a patwari is appointed for an area of 1,500 acres of cultivated land, or (say) of four square miles, inclusive of waste, and he receives a salary of ₹7 per month. A temporary settlement ordinarily lasts for thirty years, so that the patwaris' salary for this period amounts without interest to ₹2,520, or ₹630 per mile, and this is exclusive of the cost of supervision of the patwaris by canoongoes and others. A resurvey and settlement on the expiration of the term of thirty years would not cost half of this amount. It follows that it would be cheaper to have a new survey and settlement every fifteen years than to maintain the records from year to year by the agency of patwaris, thus avoiding the necessity for a new survey. If, then, the creation of such agency is to be justified at all, such justification must be on grounds other than financial. These other grounds are, that the patwari keeps correct accounts as between zemindars and their raiyats, and thus protects the latter from fraud, and that he collects and furnishes accurate statistics which may be utilised for famine and other administrative purposes. The question for consideration is whether the protection afforded to the raiyat by patwaris' accounts, and the statistics of cropped areas collected by them, are worth the extra expenses involved in creating and keeping up patwaris, and also whether the information required for administrative purposes cannot be obtained in other ways. It appears to me that if accurate maps and records are prepared, if copies of them are made over to the landlords, and if the obligation is put upon the landlords, by law, of furnishing such returns of mutations of holdings and statistics of crops as are now furnished by the patwaris in the North-Western Provinces, there is no reason why landlords may not be brought to furnish sufficiently accurate returns of this kind without patwaris. In this case landlords may be left to make their own arrangements for keeping their raiyats' accounts and for furnishing statistics of crops, and all that Government need do would be to provide an agency, such as that of canoongoes or Sub-Deputy Collectors, to check from time to time the accuracy of the returns furnished by the landlords. It is impossible for zemindars in Bengal to furnish accurate returns of cropped areas, or of mutations of holdings, without maps and village records; but given such maps and records, there is no reason why they should not be brought to do so, under penalties for failure, such as are provided in the Road Cess Act. The effect of carrying out a scheme of this kind would be that Government would be relieved of the gigantic task of keeping accounts between landlords and tenants, and would be also relieved of the necessity for that constant and irritating interference which is involved in the appointment of a Government patwari in every village, while the information and statistics required for administrative purposes would at the same time be obtained, and a financial saving would be effected. If this principle were adopted, the returns which zemindars might be asked to file need not be either numerous or complicated. Those annexed to this letter would probably suffice, and zemindars might be left to make their own arrangements for compiling the necessary information for filling them up. If Government are prepared to incur the expense of creating and paying patwaris according to the North-Western Provinces system, that system would probably be more thorough and efficient; but if not, then the system now suggested may, perhaps, be worthy of consideration.

PROPOSED REGISTERS.

I.—Return of mutation of names on account of transfers by sale, inheritance, or partition of holdings.

1	2	3	4		5	6	7	8
			FIELD NUMBERS OF FIELDS					
Number of khatian according to settlement records.	Name of raiyat in settlement record	Name, father's name, caste, and residence of new raiyat.	In old holding	In new holding.	Area of holding	Rent.	Status of new raiyat whether occupancy or non-occupancy.	Remarks explanatory of nature of the transfer whether by sale, inheritance, or partition.

II.—Return of deceased and abandoned raiyats whose holdings have not been resettled.

1	2	3	4	5	6	7
Number of khatian according to settlement records	Name of deceased or abandoned raiyat.	Area of land.	Rent.	Date of relinquishment or abandonment of holding	Cause of relinquishment or abandonment of holding	REMARKS.

III.—Return of new settlements of waste lands and abandoned holdings.

1	2	3	4	5	6
Name of raiyat.	Number of fields according to the settlement records.	Total area of holding.	Rent.	Remarks explaining whether the land was waste or abandoned holding	Remarks explaining how the rent was fixed—according to the settlement rates by written contract or otherwise.

IV.—Crops cultivated. Abstract of totals of areas under each crop.

District.	TOTAL OF CEREALS AND PULSES								FIELD CROPS.										MISCELLANEOUS											
	Rice.	Wheat.	Other food-grains including pulses.						Gilgenda.	Sugarcane.	Cotton.	Jute.				Other cereals.	Indigo.	Coffee.	Tea.	Tobacco.	Cinchona.	Food-crops.						Non food-crops.	Total area of crops.	Deduct area cropped more than once.	Actual area on which crops were grown
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

NOTE.—The headings may be altered according to the crops grown in the locality.

APPENDIX E (vide page 57 of Proceedings).

Extract from the Proceedings of the Government of Madras, Revenue Department,—No. 515, dated 4th July 1890.

READ—

The Report of the Agricultural Committee, appointed by G O, dated 25th September 1888, No. 686, Revenue.

ORDER.—Towards the end of 1888, His Excellency the Governor in Council appointed a Committee, consisting of the gentlemen noted on the margin, with the subsequent addition of the Director of Public Instruction, to institute a comprehensive inquiry into the past working of the Agricultural Department and the College of Agriculture and to make suggestions for the conduct of operations in the future.

W Wilson, Esq., M A, C S, *Chairman*.
Rajah Sir T Madhava Row, K C S I.
Hon P Chentel Row, C I E
J. Gross, Esq., M A, C S.
F A Nicholson, Esq., C. S., *Secretary*.
J Adam, Esq., M A.
Raj Bahadur A. Sabapathi Mudaliar Avergal.

Committee, consisting of the gentlemen noted on the margin, with the subsequent addition of the Director of Public Instruction, to institute a comprehensive inquiry into the past working of the Agricultural Department and the College of Agriculture and to make suggestions for the conduct

of operations in the future.

The Committee held eighteen meetings, examined many witnesses orally and received numerous replies to sets of interrogatories issued by it; it considered notes of suggestions from various gentlemen connected with agriculture or interested in the improvement of agricultural methods and knowledge; and its investigations were further assisted by two valuable papers contributed by Messrs. Nicholson and Benson. The result of its labours is a most interesting report, in which all the various branches of the question of agricultural progress in India have, it is believed for the first time, been brought together and thoroughly discussed.

2. The report, however, contains no summary of the Committee's conclusions and recommendations, and owing to this defect it is desirable to recapitulate here at greater length than would perhaps otherwise have been necessary the opinions which the Committee has formed regarding the results that have hitherto been obtained and the lines on which the Administration of the Department should proceed in the future.

3. In order to indicate to the Committee the matters upon which its opinion was desired the Government suggested in the order appointing it that attention should be directed to the following

Lines of inquiry.

points:—

- (1) What benefit has accrued or is likely to accrue to the cultivating classes from the Agricultural Department as at present constituted?
- (2) What improvement it has effected or is likely to effect in seeds, implements, breeds of cattle, sheep, and horses and methods of cultivation throughout the Presidency?
- (3) What inducements does it hold out to raiyats to improve their stock and mode of agriculture?
- (4) Its operations in regard to cattle-disease, and the benefits resulting from those operations.
- (5) The operations in connection with, and the benefits derived from, the stock farm administered by the Department, with financial results.
- (6) Whether the breeding of stock can be properly or economically carried on by Government?
- (7) The duties of the officers employed under the Department.
- (8) The best means of increasing the efficiency of the Department, having special reference to the benefit of the agricultural community.
- (9) The course of study pursued at the College of Agriculture.
- (10) The class of students at the College and the conditions under which they come to it.
- (11) Whether the students engage in agriculture after leaving the College?
- (12) Whether the College ought to remain under the control of the Director of Public Instruction?
- (13) Whether the Agricultural Department ought to continue to be administered by the Board of Revenue?
- (14) Whether the Agricultural Department ought to be restricted to matters connected with agriculture?

4. As regards the past the Committee has very little that is favourable to report. Large

Operations in the past.

quantities of seeds have been distributed and some new varieties introduced, but the practical results to the raiyats have as yet been but trifling. Many varieties of ploughs have been brought to

the notice of the cultivators, but though numbers have been bought they are very little used and have not found general favour with the farmer. The introduction of the Beheea sugar-mill, however, has met with greater success, and its superiority to the old wooden mill is now generally recognised by the rayat. The efforts made by the Department towards the improvement of the breeds of cattle, sheep, and horses have been insignificant and spasmodic. The attempts to induce the rayats to breed a better class of pony, which have been made in the districts of Salem, Coimbatore, and the Nilgiris by giving the services of good sires free of charge, have been fairly successful, and the prospects of this undertaking are encouraging. A few bulls and rams have been distributed, and a cross-breed of sheep was established at the Saidapet Farm, but without any appreciable result so far as the rayats are concerned, and it is more than doubtful whether these bulls and rams were better or more suitable for the rayats than animals taken from many very good breeds which exist in the Presidency. A stock depôt was established in December 1887 with the intention that it should form a centre for the distribution of bulls and rams. The Government is of opinion that the establishment of such a stock depôt is a mistake, and that if it were considered desirable to provide bulls and rams for distribution (which it is not), that object would be obtained more economically by purchase in the open market. The Government further ascertained that the system of breeding going on upon this stock depôt was calculated to lead rather to the deterioration than to the improvement of stock. The depôt was accordingly closed after it had been in existence for about a year. The experiments conducted at the Saidapet Farm with the object of showing how the agricultural methods of the country could be improved are reported by the Committee to have been fairly successful, and the demonstration of the value of deep tillage and the possibility of growing fodder crops is adduced in support of this statement. But the advantages were not shown to the rayat and the practical results have, therefore, been inconsiderable. The Committee finds that the Department has been able to hold out very little indirect inducement to the rayats to improve their stock and mode of agriculture. The most important of the measures taken with this object in view are the agricultural exhibitions that have been held from time to time, but strong doubts have been raised as to their success and usefulness. Private enterprise has to some extent been fostered by the encouragement accorded to the efforts of the late M. R. R. Krishnaswami Mudali of Shiyali to introduce better systems of farming, by the gift of stock and implements to the Mission Farm at Karur, and by a grant-in-aid to the Madura Farmers Club. It is, however, clear that the few endeavours which the Department has made to indirectly induce improvements have been as little fruitful in practical results as its more direct efforts.

The work of the Cattle-Disease Department will be dealt with at greater length below, but it may be noted here that while the Committee considers it has done appreciable good, Inspecting Veterinary Surgeon Shaw describes the subordinate staff as insufficient and inefficient, and several witnesses state that the Stock Inspectors are useless and command no confidence.

In the province of agricultural education also the results are similarly disappointing, though indirect good has possibly been effected. The only agency that has been at work is the College of Agriculture at Saidapet, and the Committee was asked to report upon the class of students that attend it, the conditions upon which they come to it, and whether they engage in agriculture after leaving the College. The Committee finds that a very great majority, possibly 90 per cent, of the students are either landholders or members of landholding families; there are, however, few sons of large landholders and in Appendix E. there is an overwhelming mass of evidence that the sole object with which most of the students join the College is to obtain employment or promotion in the Government service. Out of 187 Saidapet graduates regarding whom information has been collected, only 39 are engaged in farming; but though the College must be held to have somewhat failed in directly influencing agriculture, the Committee considers that it has nevertheless given a fair return to the country for the money spent upon it, while the attention it has excited throughout India and the undoubted good it has done during the time it has been in existence, imperatively demand its continuance.

5. It will be seen from the foregoing summary of the Committee's investigations that the amount of real good secured by all the efforts of the past has been infinitesimal, and that the greater part of the money which has been spent on agricultural improvement and education has been wasted. With the best intentions on the part of various Governments, all endeavours to advance practical agriculture have failed, and the only result of the operations of the Department has been the awakening of an interest which possibly might have sprung up

independently. But the causes of the general want of success which has hitherto attended nearly all the measures undertaken by the Agricultural Department are very clearly shown in the Report and its appendices, especially in the Note by Mr. Nicholson, who gives the following excellent recapitulation of what has been done and of the reasons of failure:—

Causes of failure.

“The original idea of 1865 was that the raiyat wanted complete teaching; his practices and implements were all to be altered. A farm, originally model, was started to teach him his business; example gave way to experiment, experimental farms required superintendents, and superintendents required education, experiment gradually gave first place to education, education turned out book-men for whom no farms were ready, nor were they ready for farms; experiment was subsequently entirely abandoned in favour of inquiry; inquiry has largely dwindled to the collection of statistics, positive improvement barely exists; the only considerable operations are those against cattle disease, even this latter organization is described by Dr. Shaw as insufficient and inefficient and a disgrace to a civilized country. There has been no planned-out design, no foundation of inquiry, no continuity of structure; the organism of 1865, conceived in error, born by chance, bred by accident, developed in starvation, guided by change, never had any vigorous vitality. There was in fact no real department till 1882. The Saidapet Farm was in some ways a department, but it lacked the necessary machinery and organization; it was isolated and wanting in almost all means of access to and by the people; only by occasional correspondence and by casual visits from the public, and by its reports, could it have any outside influence, in the way of disseminating, through precept and practice, the information it had gained or of suggesting and isolating new ideas. The Department was, moreover, wholly under-manned, its three experts—Messrs. Robertson, Benson, and for a time, Schiffmayer—were chiefly occupied with farm and college duties, and could not work continuously and closely at the numerous investigations suggested or thrust upon them from time to time, and which required the organized staff of a department. After the change in 1882 the staff was practically confined to one officer (Mr. Benson), since Mr Schiffmayer had retired and Mr. Robertson was entirely occupied with college work. Even the graduates trained for agricultural work at the college were in the end not of much use, for they were not of the raiyat class; they had no definite and assigned future; they had no farms on which to demonstrate what they had learnt, and had there been farms, they, as for the most part theoretically trained, could not have worked them. There was no organization reaching from the Government through the Board and the Director to the districts and villages, there was not, and is not to this day, any attempt to carry out what in the opinion of the Government of India should be ‘the earliest ambition of the Agricultural Department,’ viz. “to secure the active aid of those members of the native community who are sincerely interested in agriculture. There has been no effort to organize associations in every district in touch with the central bureau and ramifying into every important village, so as to provide the means of obtaining and disseminating information, and of carrying out well-chosen experiments usefully and successfully; experiments otherwise than on the farm were casual and fitful they were seldom carried out in ultimate fact by experienced hands or interested brains; they were not properly supervised, they were conducted in an amateur half-hearted way, the experiments whether with seeds or implements were often ill-chosen and doomed to failure either from want of intrinsic suitability or from want of knowledge of indigenous practices and conditions which rendered unsuitable experiments otherwise well-chosen; they were too occasional and seldom repeated, frequent failure caused indifference and suspicion. These were all faults of ignorance either in the suggesters of the experiments or in the experimenters, they would not have occurred had there been a department of wide knowledge and full experience of native and especially local practice and conditions properly organized to devise and carry out well chosen experiments, either direct or by suitable experimenters. The great fault was, not that there was incessant change, but that there was no decided plan of operations, so that change was a necessity, that there was no organized department to carry out such a plan, and hence that there was discontinuity and feebleness of purpose.”

6. To ensure success, then, in the future it is of paramount importance that a definite policy should be carefully worked out and authoritatively laid down, and that this policy should be steadily adhered to or at least should not be condemned until it has had a fair trial. It is obvious that measures of this kind, intended as they are to modify systems crystallised by the habits of centuries in a people never quick to adopt innovations, must of necessity be slow in their operation, and His Excellency in Council cannot too strongly deprecate any hasty forming of adverse conclusions because no demonstrable results are forthcoming for record in an annual report. There can be no doubt that Indian agricultural methods are susceptible of improvement, but the efforts to this end must be long continued, and unless the officers entrusted with their conduct have the cordial support and confidence of the Government, nothing but failure can be expected.

7. The first matter for consideration, therefore, is the nature of the policy which should now be adopted, and His Excellency in Council will accordingly proceed to discuss the recommendations which the Committee has made for the future administration of the department.

These are grouped in the Report under the following six main heads:—

- Recommendations of Committee.
- (a) The improvement of all aids, and the removal of all hindrances, to the stability and efficiency of agriculture;
 - (b) inquiry and research;
 - (c) experiment and demonstration;

- (d) the introduction of positive improvements ;
- (e) a proper staff and organization ;
- (f) a developed system of education both as regards school and college tuition, and as regards the general stimulation of the agricultural public.

Each of the above heads is expanded in considerable detail, but the chief features of the policy proposed are, (1) the institution of a careful and definite system of inquiry into existing practices, (2) the inauguration of experiments under the control of trained agriculturists, and the demonstration of the results to the raiyats, and (3) a comprehensive scheme of agricultural education.

8. The importance of inquiry as an essential preliminary to any original endeavours to

Inquiry and research.

improve Indian agriculture has been strongly insisted upon by the Government of India, but the analysis of districts which was in consequence undertaken in this Presidency consisted mainly of the compilation of statistics which had no direct bearing upon agricultural methods. The Committee, therefore, suggests that the duty of collecting this information should be entrusted to a special account staff, and proposals with this object in view have already been submitted to the Supreme Government. If these are accepted, the Agricultural Inspectors will be available for other work, and it is recommended that a certain number of them should be employed on a careful and minute study of agricultural practices, their work being carefully directed and supervised by European experts. The latter would also be required to prepare detailed reports on agriculture and rural economy, and the work of inquiry will be further prosecuted by issuing sets of questions to trustworthy sources of information, the answers being collated and published in the form of monographs.

9. The Committee proposes that experiment and demonstration should be carried on at

Experiment and demonstration.

special farms, "to be established whenever and wherever suitable superintendents, thoroughly acquainted with the conditions of the country, can be obtained." It is pointed out that such farms would not be expensive, as they need not exceed 30 acres in extent, and it would not usually be necessary to acquire the land outright. The Committee is informed that five or six farms could be started at once, and that it would be possible to have one in every accessible district within two or three years. For experiments with special crops, such as cotton and tobacco, the Committee recommends distinct experimental stations, and though it is not at present in favour of a Central Farm, it considers that it may eventually be advisable to utilise one of the district farms for such further research and experiment as would ordinarily be carried out at a central institution.

The Committee further urges that Local Boards, Associations, and private individuals should be encouraged to conduct experiments and demonstrations; and it concludes this portion of its Report by recommending the wide and persistent publication of successful results.

10. The question of education is dealt with at great length in the Report, and the importance of it as a means towards agricultural

Education.

improvement is strongly insisted upon. Dealing, first, with indirect education, the Committee recommends the abolition of the present system of exhibitions and the substitution of prizes for fields or farms or specific items of farm management, a subject on which much interesting information is contained in Mr. Nicholson's Note. It is also recommended that the diffusion of practical agricultural knowledge should be further stimulated by publishing the results of successful experiments and other useful information or suggestions in a popular form, by means either of a Departmental journal or casual papers.

But it is to school and college education that the Committee attaches most importance,

School and College Education.

and more than half of the Report is devoted to this subject.

With reference to the Saidapet institution, the Committee lays down the proposition that

A Central College.

a Central College is absolutely essential for the training of the necessary agricultural experts and teachers and the provision of veterinary education. It recommends that there should be two courses in agriculture, corresponding to the two tests under the Technical Education Scheme; that a separate branch of the College should be established for providing veterinary instruction, and that *Forestry* should be added to the list of subjects which are now taught. It suggests the revision of the present course of study and recommends that the system of working the farm annexed to the College should be radically altered so as to make the practical

instruction more varied and complete and allow of more individual attention being given to the students.

Turning next to the more difficult problem of school education, it is pointed out that

Agricultural instruction in schools.

Agriculture is already an optional subject in Standards IV, V, VI, and VII, and in the Primary, Special Primary, Middle School, and Upper Secondary Examinations; but, owing to the want of teachers, it is taught in very few schools, and even in these the instruction given must be far from satisfactory. The Committee does not recommend that the subject should be made compulsory, but suggests that the efforts of the Government should be directed to encouraging the study of it and providing facilities for the training of teachers. In order to secure this object the Committee considers that special scholarships must be instituted and full advantage taken of the Grant-in-Aid Code, which provides for special assistance being given to persons sent for training as technical teachers; and that *Agriculture* must be taught as an optional or compulsory subject in all District Normal Schools. The Committee acknowledges that the provision of qualified teachers can only be made very gradually, but it is of opinion that if the policy sketched above is pursued steadily for a few years, marked progress will be made in the spread of agricultural instruction; and in support of this view the Committee refers to the rapid extension of the teaching of *Hygiene*, since that subject has been regularly taught in elementary Normal Schools.

11. His Excellency the Governor in Council agrees with the Committee in giving education a prominent place amongst the desiderata for

Views of the Government.

a generally improved agricultural system, and this is being supplied as fast as circumstances will permit; but the long established usages of the cultivating classes, partly founded on ignorance, partly on poverty, and partly on custom to which they adhere with the tenacity of religious conviction, can only be changed or removed when destrable by special teaching and demonstration, and by instructors who can plainly show the people that new methods are real improvements adapted to Indian agriculture, apart from systems sanctioned by Western theories and Western practices. Special instruction in agriculture, however, is almost non-existent owing to the want of men competent to give it. The Committee proposes the system which has been described above, but although a scheme of this kind may become possible in the remote future, it is not practicable now, and must be replaced by something which, though less ambitious, is more in accordance with existing means and yet not inadequate to existing requirements. The scheme which, in the opinion of His Excellency the Governor in Council, fulfils these conditions will now be briefly sketched.

12. At or near the head-quarter station of five representative districts there should be

Combined schools and farms.

established a combined agricultural school and farm. The school should afford general instruction up to the Upper Secondary grade and special agricultural teaching up to the standard of the present junior department of the College of Agriculture. The farm should be worked principally in the interests of the school, but should also be available for experiment and demonstration. It should be under the management of the head master of the school, who, as well as the second master, should be a graduate of the Sandapet College and capable of personally working farm implements and handling cattle. These farm schools will be educational institutions, managed by the Director of Public Instruction, but the Director of Agriculture and his Assistant must be freely consulted as to their working, and the farms, so far as they are institutions for inquiry, experiment, and demonstration, will be under the exclusive control of the Agricultural Officers. The necessary funds will be provided in the budgets of the two departments, the charges common to both being distributed in such proportion as may seem suitable. It will in time become possible to connect these schools with the District Normal institutions, and by this means a class of teachers specially trained in agriculture will become available for supplying agricultural instruction in ordinary Primary and Middle schools.

The Board of Revenue should carefully consider the question of the location of the schools and submit a statement of its views on the matter to the Government. The institutions must be within easy distance of a railway station so as to allow of frequent inspection by the Assistant Director, and for this reason, if it is decided to locate one in the Kistna district, it will be better to have it at Guntnur or Bezvada instead of at the Collector's head-quarters. In determining what five districts should be selected, special regard must be paid to the importance of obtaining conditions of soil, climate, and agricultural practices that are representative of a considerable area, and each farm should, so far as is possible, represent a different set of conditions.

13. The Committee has reported strongly in favour of the continuance of the College of Agriculture, and the Government fully accepts the conclusion that some such institution is an essential feature in any system of agricultural education. But with the establishment of schools in the interior providing the same instruction as the junior department, the retention of that branch, which is said to be an impediment to the higher work of the College, is no longer necessary, and it will accordingly be closed. The Government is further of opinion that the instruction afforded should be confined to agricultural and veterinary science, and that the necessary knowledge in other subjects should be secured by raising the standard of the entrance examination. The First-in-Arts Examination of an Indian University would probably be a sufficiently high test, but on this subject and on the questions of the length of the course, the nature of the curriculum, &c., it is not possible to pass orders at present, for, as is pointed out in the Report, these are matters for the consideration of a committee of experts. The Director of Public Instruction should appoint such a committee at an early date, and after consultation with the Director of Agriculture, he should submit proposals for the orders of the Government. It seems very desirable that the instruction given should be much more practical than it is at present, and limited to subjects directly connected with agriculture. In order to secure this object the farm attached to the College should be extended, and the Director of Agriculture must have an important share in the management of the institution.

The Government is not in favour of any attempt being made to teach *Forestry* at the College. The subject is only remotely connected with agriculture, and the means for affording instruction in it at Saidapet could never be satisfactory.

14. Having now provided for schools and a college, the next matter is to connect them by means of a system of scholarships. The Directors of Public Instruction and Agriculture should accordingly consult and submit proposals for this purpose. The present scholarship scheme is not a very satisfactory one, and it must be considerably modified to suit the altered conditions. Probably the best plan will be a system of district stipends tenable at the five farm schools, and a number of college scholarships to be awarded by competition among the students of these schools, but it is unnecessary to come to any decision on this point until the proposals of the two Directors are before the Government.

15. The operations in regard to cattle disease are dealt with in paragraphs 16 and 17 of the Report, and in paragraphs 41, 42, and 43 the difficulties which have been met with are graphically described. The Committee says that—

“in dealing with diseases which, owing to the customs of cattle management and the conditions of the country, spread with immense rapidity and find a victim in every stall, we deem it hopeless for many years to attempt directly preventive and curative work over the whole area of the country, and we are absolutely convinced that the present method of placing solitary Inspectors, themselves insufficiently educated and trained, in charge of a whole district, with but little supervision, and no possible chance of obtaining local influence over so vast an area, is radically wrong. We look forward to a time when there will be a highly-trained Stock Inspector with a staff of Salubry subordinates in every taluk, when the sense of the country will be actively on the side of the preventive and curative staff, and when better stock management will remove the predisposing causes of epidemics. This is not yet within measurable distance, but we consider that the Department should at once bend its efforts to obtain as quickly as possible a considerably strengthened staff of Stock Inspectors.”

In the judgment of His Excellency in Council, such a policy as this is utterly impracticable. It would require a whole army of Stock Inspectors and Salubris, and even then little could be done, in the present state of opinion, unless the members of this huge staff were given wide and stringent powers of compulsion; and when regard is had to the classes from which these men would be drawn, the comparatively low pay they would receive, and the great opportunities for oppression that they would possess, there can be little doubt that the authority entrusted to them would be so gravely abused that the remedy would be infinitely worse than the disease. The present Act in fact has been tolerated only because it has never been put fully into operation, and to endeavour to give real effect to it would, in the opinion of His Excellency in Council, be an unwise and mischievous measure.

Moreover, the Government doubts whether the effects of disease are so serious as is generally represented, and the report contains some remarkable opinions to this effect. Mr. Benson considers that the losses from cattle disease are not really great on the whole, and Mr. Robertson maintains that they result from the impoverished condition into which the stock too frequently get, and not from the severity of the diseases that prevail. The number of cattle

that die of disease is undoubtedly large, but it is admitted that the rate of mortality is far from a high one, and the cases in which the ploughing cattle or the more valuable animals are completely swept away, or even seriously affected, are comparatively few. As Mr. Benson has pointed out, cattle must die of something; in this country they are not, to any appreciable extent, slaughtered for food, and if epidemics were entirely stamped out, the result, under present conditions, would be that cattle would multiply far beyond the means of subsistence, so that, besides further deteriorating in quality, they would perish from starvation in no less number than they do now.

It appears to His Excellency the Governor in Council also that sufficient weight has not been given by the Committee to the attitude of stock-owners towards the operations of the department. The dealing with cattle-disease is a most difficult operation even in a highly civilised country, requiring a very large number of highly skilled persons and the co-operation of thoroughly organized local authorities, as well as the hearty support of the farming class. But the evidence which is contained in the Board's report of the 23rd March 1889, and in all similar reports, conclusively establishes the fact that such conditions exist nowhere, and are not likely to be found until after the lapse of a very considerable period of time. The raiyats not only will not co-operate, but they offer passive or active obstruction to all efforts to assist them. In the latest report of the Inspector of Cattle Diseases, which the Government has seen, that officer writes as follows:—

Attitude of the raiyats.

“The raiyats generally look upon us with dislike; they do not desire our help; they are caused a certain amount of trouble by the erection of a pound and the impounding of their cattle, and they do not like the trouble and do not think the removal of the sick from the healthy any use. At Agugundala a great resistance was made to the sick cattle being removed to the pound and some cases have been brought to the notice of the Magistrate.”

It is this state of feeling on the part of the farming classes that has been the chief cause of failure in the past. The staff has no doubt been insufficient and proper supervision has been impossible; but even with this imperfect organization appreciable good would have been done if it had not been for the opposition, religious scruples, apathy, and ignorance of the raiyats. It is admitted on all hands that to continue on the present lines is utterly useless, and there is a general consensus of opinion that no improvement can be effected unless a very expensive staff is entertained and invested with wide and summary powers. But for the reasons set forth above His Excellency the Governor in Council considers that the grant of such authority would be fraught with grave danger to the people, and that the expenditure of so large a sum as would be required cannot be justified. It may also be remembered that all attempts to deal with rinderpest in England, without the power of slaughter, are considered useless, and such slaughter in India is not to be thought of, even though provided for in Act II of 1866. His Excellency in Council is constrained, therefore, to accept the conclusion that the money hitherto expended upon attempts to cope with cattle-disease has been practically wasted, and that until the spread of education has effected a change in the attitude of the raiyats, it would be wiser to suspend the attempts to directly combat the evil. Operations in this direction must, therefore, be discontinued, and this branch of the Agricultural Department will accordingly be abolished for the present. The Act will not be repealed, but the notifications applying it indefinitely to certain localities will be cancelled, and in future its provisions will be put into force only on the occasion of large cattle fairs, which are especially dangerous as foci of disease.

16. The changes in policy which have been described above will necessitate considerable modifications of the existing staff of the Department. The present Assistant Director of Agriculture will be chiefly employed in organizing and supervising the new Farm-schools, and will have little time for conducting inquiries into the methods of agriculture followed in the various parts of the Presidency. It has already been stated that such inquiries seem to the Government to be essential, and His Excellency in Council has therefore resolved to apply to the Secretary of State for a second European expert, who will be primarily employed in investigations of this nature and will also be available to take Mr. Benson's place when required to do so. Two of the Agricultural Inspectors can be attached to this officer, and employment can no doubt be found for the others in connection with the new Farm-schools.

The abolition of the post of Inspector of Cattle-Diseases will set free a veterinary officer, but his services will be required as Vice-Principal of the College of Agriculture and for the supervision of veterinary matters connected with the farms. There should be a small veteri-

nary hospital attached to each of the five district farms, and for the charge of these the best of the Stock Inspectors should be selected, the services of the others being dispensed with. The usual notice should be given to them at once, but they will be retained in their present posts until the sanction necessary for the abolition of the appointment of Inspector of Cattle-Diseases has been obtained. The Deputy Inspector will remain in charge of pony-breeding operations, which should be persevered with. There remains only the Sub-Assistant Director of Agriculture, and the Director will report how he proposes to employ him. The Board and the Director of Public Instruction should draw up an estimate showing clearly the total cost both of the agricultural establishment proper and of the college and new schools. The Government desires that this estimate may be submitted with as little delay as possible.

17. The foregoing scheme provides only for a beginning being made in the task of improving the agricultural methods of the country and is neither so elaborate nor so costly as that put forward by the Committee. What the cost of that scheme would be is nowhere stated, and it is difficult to frame even an approximate estimate of it. The amount would, however, undoubtedly be very large and on this account alone it would be impossible to accept the proposals in their entirety, for the necessary funds cannot be found, and even if the money were available, it would be most unwise to disregard the lesson taught by past failures and rashly embark on any extensive and costly policy until experience had shown that action was being taken on proper lines. The measures which the Government has ordered to be carried out will involve only a slight increase in the total expenditure on agriculture, as the saving produced by the abolition of the cattle-disease establishments will be almost sufficient to meet the extra charges due to the changes in other branches of the department. The Government scheme, however, is capable of almost indefinite expansion, and if it is found, after a sufficient trial, that the work of reform is proceeding in the right direction and that the degree of success obtained is sufficient to justify further expenditure, it will be easy to extend the field of operations without making any change in the general character of the policy.

18. There remain a number of recommendations which His Excellency in Council has not yet dealt with, and the more important of these will now be noticed.

19. The Committee has recommended that "Irrigation" (including the control of minor Irrigation works), "Forests" and the operations under the Land Improvement Act and the Agriculturists' Loans Act should be dealt with by the Commissioner of Revenue Settlement instead of by the Land Revenue Commissioners. The Government is opposed to the transfer in the case of "Forest," but it sees no objection to the suggestion so far as the other subjects are concerned. The Board will be requested to report upon the matter.

20. The recommendation that legislation should be undertaken for the purpose of defining authoritatively the status of the riyat need not be noticed at length, for it is made under a misapprehension of the real facts. The ruling in *Fakir Mahomed vs. Tirumalachariar*, upon which much stress is laid by one of the witnesses before the Committee, has not been followed by the High Court (See Indian Law Reports (Madras) V, 163, and VI, 303), and as a matter of fact the Government never has treated riyats as tenants-at-will, nor has the Government any intention of revising the classification of soils. This principle has been repeatedly laid down and is very clearly stated in the Settlement Manual. The statement to the contrary in the Manual of Administration is incorrect and the re-classification of the Chidambaram taluk is not a violation of the assurances of Government, as this taluk has never been settled on the system now followed throughout the rest of the Presidency.

21. The Committee reports that there is a general disbelief in the success of exhibitions and shows conducted on the lines which have hitherto been followed, and in the following passage it recommends that they be abandoned :—

"The evidence before us, which gives both official and non-official experience, is almost unanimous in rejecting exhibitions of the present class, as a means of educating riyats who do not possess the competitive and commercial spirit, and of whom not one in a thousand hears of the show. There is also much evidence that the prizes are, in the majority of cases, taken not by the producers, but by mere purchasers of samples; the prizes themselves are, moreover, too insignificant, the chance of winning one is far too small, and the connection with improvements in cultivation is too indistinct to afford the smallest inducement towards improvement. In the matter of stock, the inducement afforded even by local shows, as in Nellore, is doubtful, most excellent cattle have been bred there from time immemorial, and we cannot say that the breeds have been improved by the local shows. We are, therefore, strongly of opinion that the present system of exhibitions has

had and will have no result, owing to its inability to excite the interest of the raiyat, to stimulate his hopes and desires, or to arouse competition, and we recommend therefore that it should cease."

His Excellency the Governor in Council concurs generally in the view taken by the Committee, and exhibitions of the nature hitherto attempted will be discontinued, the money being diverted to more useful modes of aiding the cause of agriculture. The Government considers, however, that shows for cattle and ponies will prove useful, and these should continue to be held, but the expenditure on them must not be great.

22. The Committee is of opinion that a knowledge of agriculture would be of great advantage to a Revenue Inspector, and it recommends the gradual introduction of a rule restricting such posts to persons who have obtained the preliminary group certificate in agriculture. A somewhat similar proposal was made by Mr. Grigg in 1884, but was negatived by the Government, and His Excellency in Council sees no reason to modify that decision now. He does not attach the same importance to a knowledge of agriculture in a Revenue Inspector as the Committee does, and unless a considerable addition is made to the salaries it would be impossible to get men with this special knowledge.

23. His Excellency in Council believes he has now noticed all the matters of importance which are dealt with in the report, and it only remains for him to express his cordial thanks to the members of the Committee for the valuable assistance which their inquiries and suggestions have afforded him in the settlement of a difficult and complex question. The acknowledgments of the Government are also due to the gentlemen who favoured the Committee with their views upon the matters submitted to them; and, lastly, His Excellency in Council desires to specially mention the excellent work done by Mr. Nicholson, whose great interest in, and extensive knowledge of, the subject must have been of incalculable advantage to his colleagues.

Conclusion.

APPENDIX F (vide page 44 of Proceedings).

Note by MR. J. B. FULLER, Commissioner of Settlements and Agriculture, Central Provinces, on Agricultural Improvements.

There could, of course, hardly be a greater mistake than to suppose that the principal means of bettering the agriculture of India lies in the introduction of European processes or implements, or that an Experimental Farm forms an indispensable nucleus for the spread of improvements. This idea has been repeatedly negatived by the Government of India. But I venture to think that Provincial Agricultural Departments and their critics show a tendency the one to give special prominence to what I may call *exotic* methods of improvement, and the other to gauge results by the progress made in the introduction of these methods. Annual reports treat in full detail of European ploughs, pumps, the use of bone manure, ensilage, &c., but contain comparatively little bearing on the improvement of agriculture on purely indigenous lines. There are two reasons to explain this. In the first place, we have far more knowledge of European than of Indian agriculture at our command: the *dicta* of European experts give us an easy code of instructions; whereas laborious investigation is required before we can trace out the causes which have stimulated development in some parts of India and have retarded it in others. In the second place, any attempt to deal with agricultural interests comprehensively inevitably leads Agricultural Departments into trespassing on the domains of the higher Revenue authorities, who feel themselves responsible for present conditions, and are apt to resent any suggestions for changing them. Agricultural Departments, I venture to submit, have a tendency to spend too much time over trifles, because it is only in trifles that their authority prevails.

2. Measures for the improvement of agriculture may be classified according as their object is—

- (1) the more complete utilisation of existing resources;
- (2) the extension to one part of the country of processes known and practised in another part;
- (3) the introduction of processes which are foreign to the country.

3. I venture to make the following brief notes regarding the measures which suggest themselves under each of these classes:—

The utilisation of resources which are already known to the people.

- (a) The most prominent of the measures which have been taken under this head is the *extension of irrigation* by means of works (such as the Ganges canal) constructed

by the direct agency of Government. Comprehensive schemes have been worked out for canal irrigation in these Provinces, but have not been prosecuted owing to the existence of grave doubts as to the real utility of irrigation under local circumstances for crops other than rice, sugar-cane, and vegetables. This is a question which still requires most careful investigation. There is, I think, a field for the construction of Government tanks in the uplands of the Mandla and Balaghat districts, where the land is the property of the State, and is well fitted for rice cultivation were irrigation available, but is at present for the most part waste. The expediency of constructing tanks in this locality will shortly be considered when its raiyatwari settlement is taken in hand.

In connection with this subject, reference may be made to a scheme for taking power by law to remove obstacles to private tank-making which originate in the jealousy of individuals. There can be no question that the construction by private individuals of large tanks, such as are of common occurrence in the Bhandara and Chanda districts, has almost entirely ceased under British rule, and one reason for this is to be found in the development under our laws of individual at the expense of communal rights. It is almost impossible for a man to construct a tank without submerging or otherwise damaging land belonging to others; and, under the law as it stands at present, the objections of these latter cannot be overruled. In the original draft of the Provincial Revenue Act as framed by Mr. W. B. Jones in 1881, provision was made for the interference of Government in these cases for the compulsory expropriation of the necessary land on payment of compensation by the person whose tank would submerge it. These provisions were struck out of the Bill in its passage through Committee, but it is a question whether the case is not one in which action could fittingly be legalised by an amendment of the Land Acquisition Act.

- (b) There seems to be a *prima facie* case for the interference of Government to promote the establishment of *village fuel reserves*, and thus obviate the necessity of using manure as fuel. A very large proportion of villages contain waste land of little or no agricultural use which has been stripped of every kind of herbage by indiscriminate grazing, but which, if properly conserved, could produce brushwood and small trees which would be of great value to the villagers both for fencing purposes and fuel. Where the land belongs to Government and is settled with riyats direct, the appropriation of waste land for such reserves offers no difficulty, and in the Sambalpur district, in which proprietary rights have not been alienated, arrangements have been made at the settlement just concluded for reserving a considerable number of tracts which are to be managed, under the Deputy Commissioner's control, by a Committee of villagers purely for village purposes, and not with any view to revenue considerations. But in districts where the land is held by private proprietors, interference is impossible without legal warranty. In this matter also the development of individual rights has been injurious to the community. The waste land is the property of the proprietor of the village, but he is bound to allow the tenants free use. The interference of Government offers the only means of maintaining the rights of the tenants, while conserving the waste for the benefit of the community. It may be possible to provide for the formation of village fuel reserves under the rules for the management of private forests which are now being framed under Section 124 of the local Land Revenue Act.
- (c) Of measures which do not depend on the direct interference of Government, the most important is perhaps *education*. This, to be effective from the present point of view, must reach the actual cultivators of the soil, that is to say, it must, over the greater part of India, be given in vernacular and in the village schools. Agricultural colleges or classes in which teaching is given in English may be of service from the educational point of view, and as a means of supplying the Government with a better trained class of servants than the present system of Arts teaching affords. But for very many years their practical influence on agriculture must be of the slightest, as only a very small proportion of the students can be expected to take to agriculture as a profession. As in other colleges and classes, where instruction is given in English, their students learn in order to secure Government employment, and not to acquire knowledge which is to be turned to practical account.

An Agricultural Class has, within the last two years, been established at Nagpore, in which a two years' course of instruction is given in theoretical and practical agriculture. It promises to flourish. But its students aim at Government service, and have no intention of taking to agriculture. As servants of Government their attainments may have some influence for good. But the practical effect will be very slight.

The question is whether, in the present imperfect state of our information, we can safely aspire to teach agriculture to the raiyat. I do not think that we can venture beyond principles. But I am disposed to think that instruction in the principles of agriculture, though it will not of itself help a man to plough or sow, will not be altogether barren. There is a chance that it may lead the people to think more for themselves and to be less bound by custom and less apathetic in the matter of their cultivation. It is easy to go too far in criticising the methods followed by the raiyat. But it is undeniable that agricultural improvement is hindered by prejudices, and the effective teaching of agricultural principles may go some way to weaken the prejudice against change.

The mere addition of a text book of agriculture to the subjects taught in village schools will be of little service. Arrangements must be made to train the teachers, if the lessons are to be anything more than mechanical cram. A primer of agriculture has, under the Technical Scheme inaugurated by the Chief Commissioner, been introduced into village schools in these Provinces. But this measure will be very imperfect, unless it is supplemented by a normal class in agriculture. Proposals have been drawn up by the Inspector General of Education for the establishment of such a class for village school-masters in connection with the Agricultural Class at Nagpur.

- (d) A great deal can be done by executive *encouragement* on the part of Government, even, although this encouragement may not be supported by any pecuniary advantage. It is too often taken for granted that the question of improvement is merely one of profit and loss, and this is especially the case in discussions touching the exemption of improvements from assessment. But the fact is that men spend money on improving their lands quite as much from feelings of sentiment as from a nicely calculated hope for profit, and it is admitted that the existing rental of land in highly developed countries returns a very small percentage on the capital value of all the improvements which have been made in it. In a vast number of cases, a man spends money on his land as he spends money on his family, because it is his own and he takes a pride in it; and Government can do a good deal in various ways to foster this feeling. One of the most signal instances of land improvement in India with which I am acquainted is afforded by the Bijragogarh pargana of the Jabalpur district. Before the mutiny, this tract was a Native State. Its soil is particularly poor and unpromising, but one of its last rulers made it his policy to encourage the embanking of fields by granting a superior status to all raiyats who spent money in this way. The result is very striking, the pargana having been in his time embanked almost from one end to the other. A similar policy led to the construction of the magnificent irrigation tanks in the Bhandara and Chanda districts. By the indiscriminate conferral of proprietary and cultivating rights, Government has divested itself of the power of stimulating improvement in this fashion. But in temporarily-settled Provinces the recurring revisions of the land revenue demand still offer it an opportunity for somewhat similar encouragement. In these Provinces it has not been accepted as a principle that improvements are to be exempted from assessment in perpetuity, and, save in the case of specially costly works, the Government has gone no further than to exempt from assessment at the next following settlement. Experience is showing that this concession is amply sufficient. Since it has been made known to the people, the embankment of land in the northern districts has received very remarkable extensions. More fields have probably been embanked during the past two years than in the whole course of the 20 years preceding, and this, too, although the current settlement is on the eve of expiry, and survey operations have been in full swing. My enquiries indicate that this is due not so much to any definite feeling of security against assessment as a general idea that the Government wishes people to embank, and will deal liberally with them if they do so. The enhancement of land revenue against which they are protected is trifling. But

and thousands of vernacular notices have been distributed. It may be remarked in passing that the expenditure of so much money in embankments just before the revision of the Government revenue demand indicates that the periodic resettlement of the land revenue is, when proper precautions are taken, not the discouragement to land improvement which it is often supposed to be.

- (c) Another means of stimulating improvement, especially the improvement of seed and cattle, is afforded by *agricultural shows*. No such shows have as yet been organized on a proper basis in the Provinces. Prizes are awarded for produce and cattle at some of the larger fairs, but I fear that they are merely so much money wasted. The distribution of prizes is, of course, useless unless the prizes reach the right people. And I apprehend that, under present circumstances, this is rarely the case. Were qualified judging Committees insisted upon and the grant of prizes made widely known through the country-side, I think that some good might result, especially if the prizes were such as would be valued by the better classes of raiyats, such as certificates and puggias of honour.
- (f) Strong views are held against the *assignment of land revenue* to private persons, but there can be no doubt whatever that by the grant of small assignments a most potent stimulus might be given to certain classes of improvement of a quasi-public character, such as the digging of wells, the construction of tanks or tree-planting. Revenue was commonly released for these purposes under Native rule, and the inducement is one which is appreciated by native landholders at far above its money value. Thousands of rupees have been spent and wasted on road-side arboriculture, for which small grants of revenue might have been most profitably substituted. Endeavours have been made to enlist the help of the people in road-side tree-planting by making over to them the fruit of the trees. But this has not proved very successful. I am not able to write with certainty on the point, but I think that, if Government was prepared to remit the revenue of a few fields in a village on condition of the proprietor's planting and maintaining trees on roads running through it, we should find many men quite willing to undertake the work. So also, in the case of the construction of wells or tanks for drinking purposes.
- (g) The direct assistance now given the people by *loans* of Government money under Acts XII of 1883 and XIX of 1884, is thoroughly appreciated by them, and promises, if judiciously extended, to become a most important factor in agricultural improvement. Within the last four years the amounts loaned out have risen from Rs.1,168 to Rs.43,150 a year. They are recovered without difficulty, and are accepted by the people as a very tangible indication of the interest taken by Government in their welfare. The Acts would be of still more value did they admit of the loaning of money on *good security* to pay off debts carrying high interest previously incurred for agricultural purposes. However largely the system of Government loans may be extended, it will still, of course, supply but a very small proportion of the capital required for the agriculture of the country. But its effect will reach far beyond the men who are immediately benefited. The very exorbitant rates at which interest is now charged for small loans are based on custom and not on market value, and the loaning out by Government in a district of a much smaller sum than that required to carry on its agriculture will go far towards breaking down this custom and reducing interest charges within reasonable limits.
- (4) There are no doubt cases to be found in which agriculture is hampered by *over-assessment of Government land revenue*. The introduction of any measures which would tend to lessen the popular belief in the rigidity of the Government demand is, I think, to be much deprecated except for really urgent reasons. Our revenue is paid in with so much regularity and so little trouble, mainly because its payment is regarded as absolutely inevitable. Arrears would rapidly accumulate, were an idea to get about that remissions could be obtained without much difficulty. At the same time, I have come across cases (not in these Provinces), where the land revenue demand was really excessive and reduction was urgently called for; and, under these circumstances, agriculture must necessarily become degraded, unless prompt and sufficient relief be given.

- (i) Lastly, there is the question of lessening *agricultural indebtedness*. Separate representations have been lately made on this subject by the Administration of these Provinces, and I need do no more here than note that the circumstances under which a considerable proportion of the land is now cultivated are such as to absolutely bar improvement. The rayat is virtually the bond-slave of the exporter—his rent is practically the whole of his crop, minus a subsistence allowance, and he has no inducement whatever to improve the outturn. I need not point out how harmful these conditions may be in, for instance, preventing a proper rotation. Wheat is required by the creditor and wheat must be sown year after year, although the land may urgently need a change. It may be remarked here that the common practice of borrowing seed-grain is of course incompatible with any improvement by seed selection, unless the lender can be induced to select before advancing.

4. I now come to the second class of measures which aim at *extending to one part of the country processes known and practised in other parts*. The differences between the methods of agriculture followed in various parts of India are of course in greatest measure essential, and result from differences in local conditions. But, unless we are prepared to admit that agriculture has progressed with equal strides throughout the whole country, it follows that some parts can in all probability copy with advantage from others. The precise matters in which imitation is possible require, of course, great knowledge and experience for determination. It is extremely easy to make mistakes, and, owing to an imperfect acquaintance with local circumstances, to wrongly conclude that a process which is successful in one tract can be extended to another. Much success in this direction cannot be hoped for, unless Agricultural Departments are officered by men who are not only trained in agricultural science, but also have an intimate acquaintance with Indian agriculture. These qualifications cannot be expected in the Heads of Departments, who are, and must continue to be, selected principally for administrative reasons. Very little success can be expected, unless a permanent technical assistant is attached to each Department. Natives of India who have passed through an English Agricultural College, and have subsequently (or better still having previously) made a study of the agriculture of their own country, would be the best qualified persons for this post.

Something can be done in a less ambitious way by enlisting in Agricultural Departments the services of good Native cultivators and using their agency to the knowledge of improvements. An instance in point is furnished by the Nagpore Sewage Farm, which was started by the importation from Cawnpore (at the suggestion of Sir E. C. Buck) of a number of Kachi cultivators and settling them on Government land. They have succeeded admirably, and their example is being followed by a number of local cultivators who were previously ignorant of the value of sewage and prejudiced against its use. During the last two seasons, a trained sugar-maker from the North-Western Provinces has been employed in demonstrating to the people in several districts that sugar-boiling can be effected economically by the use of the megass which is now discarded in these Provinces, wood being used in its place. The reports which have reached me of his work seem to show that his example has had some effect.

The distribution of good seed, whether raised on Government Farms or purchased locally, is a measure falling in this class, which may prove extremely useful, if it is guided by sound agricultural knowledge. Without such knowledge interference will result in more harm than good.

So long as the Heads of Agricultural Departments are unassisted by specialists, they can hardly venture to attempt much. It may be urged that a single specialist of high qualifications with the Government of India would suffice for the guidance of local Departments. With his assistance more could no doubt be done than at present. But, looking to the diversity of Indian agricultural systems, it seems doubtful whether he could ever acquire sufficient local knowledge to render his advice of practical value everywhere.

5. Thirdly, *of the introduction into India of foreign seeds or processes*.—Measures falling under this head, though promising, less than many of those already mentioned, cannot be disregarded in the face of such instances of successful acclimatisation as those furnished by maize and the potato, and of the improvement effected by the introduction of the Bihis sugar mill. Speaking generally, improvements of this class cannot be attempted until they have been carefully proved in this country, and they furnish the principal *raison d'être* for experimental farms. For the guidance of experiments on these farms the advice of a scientific expert is greatly required. At present experiments are made very much at random, and frequently without particular reference to the precise question which has to be investigated. I cannot say that much of practical utility has resulted from the Nagpur Experimental Farm during the

seven years which have elapsed since its establishment. The results which have been obtained (as might, indeed, have been expected) go in great measure to prove the soundness of existing practices. For instance, it has been shown that the manuring of wheat land *without irrigation* is of doubtful utility, and this explains the indifference to manure of the people in wheat districts, which has often been quoted in proof of their ignorance or stupidity. On the other hand, the importance of manure to kharif crops has been demonstrated. Experiments in manuring wheat *in conjunction with irrigation* promise important results. Successful experiments have been made with a number of novelties, such as ensilage, but the only practical result which the Farm can claim in this direction is the acclimatisation and introduction of a new variety of cotton which has found some favour with cultivators in the Wardha districts.

The Farm has been of use in adding to our knowledge of the produce of the land, and now fulfils a most useful educational purpose as a practical training ground for the students of the Agricultural Class.

6. The combating of cattle disease by the use of precautions and remedies, which have proved successful in Europe, may be briefly referred to here. The view held by the Administration of these Provinces is that very little can be done to lessen disease in the absence of legislation to enforce the isolation of infected cattle. But we have lately entertained two trained Native Veterinary Inspectors who are sent to tracts in which cattle-disease has broken out to do what they can by example and precept to induce the people to follow rational methods of treatment. They will be placed under the orders of the Civil Veterinary Officer who is under the orders of Government shortly to be attached to these Provinces and the Berars.

APPENDIX G (*vide page 55 of Proceedings*).

Dated Poona, September 1890.

From—The Agricultural Association, Poona,

To—The Director of Agriculture and Land Records, Bombay.

WE, the undersigned members of an Agricultural Association in Poona, beg you will be kind enough to lay before the Agricultural Conference, which is to be held in October 1890, our views with respect to the general improvement of agriculture and the agriculturists in the Deccan.

The Deccan agriculturist loves his land beyond everything else, but as a class he is hardly able to derive the means of sustenance from it. His holdings are generally small; constant cropping without manuring has exhausted the land, and all the labour he bestows upon it secures for him but a very small margin of profit over the expenses, very often none at all, and sometimes it ends in loss. It is no wonder then that he is notoriously indebted, and notwithstanding the measures which Government have adopted for his relief, he finds himself surrounded by all sorts of difficulties and distress.

To improve his circumstances, we think it necessary that he should be placed in a position to improve the yielding power of his land, and his own intelligence and thoughtfulness, and that

Government should afford him facilities to do so. He must be made (1) to manure his exhausted land, (2) to use improved methods of culture, (3) to increase the area under wet cultivation, (4) to introduce the cultivation of more productive and profitable crops, (5) to improve his educational status and intelligence, and to acquire habits of prudence and economy, and it should be the duty of Government to assist him in his endeavours in all these respects and to give him full assurance that the fruit of those endeavours will be entirely his.

The Deccan agriculturist lives upon his capital. He scarcely makes any return to his land in the shape of manures. The dung of his cattle, if he has any, or if his women and children collect it from streets, he generally turns it into fuel for his own use or for sale. He sometimes gets shepherds to fold their sheep on his dry crop land, and it is only for wet or garden crops that he tries to collect some manure of cattle dung, ashes, oil-cake or rotten fish. In the neighbourhood of large and Municipal towns, where there is always some wet crop and garden cultivation, he uses night soil and street sweepings, and we beg to suggest that such manure may be conserved for him under some system of village sanitation. It is well known that Indian villages are notoriously dirty, and Government can order some arrangement by which the large quantity of dirt and rubbish can be collected together by village servants, hereditary or hired, for the purpose of manure, to be sold to the villagers just as town sweepings are sold: we believe the proceeds will considerably meet the cost of keeping the villages clean. Government may authorise some small rewards to the cultivator who buys the larger portion of this manure and uses it on his land.

The cultivator seldom produces green manure, and he knows of no artificial manure. Phosphatic manure is stated to be a very important plant-food, and the exportation of large quantities of bone to Europe for the purpose of manure clearly proves the statement. It is used on dry crop as well as on irrigated land, but the Indian cultivator almost knows nothing about it, and hence he allows it to be sent to enrich other lands instead of using it on his own. The article has now become a costly commodity, and India no doubt derives profit from the export, but it would be better if the people were taught how to derive greater profit by using the article to prevent or delay the exhaustion of their land. We beg Government will undertake to show to the agriculturist demonstratively on their model farms that it would be more profitable to him to use it than to sell it at the enhanced price.

It has been remarked that the implements of husbandry in India are of the rudest kind and have not undergone any improvement since their first introduction. It has also been observed that they are suited to the soil of India and need no change; but we see European gentlemen have prepared new ploughs in different parts of this country which they say are better fitted for the soil, and when we take into consideration the great and steady application of mechanical and chemical sciences to the improvement of agriculture in Europe, we are forced to the conclusion that our agricultural implements and methods of working need improvement. We beg that Government will undertake to test on its model farms the efficacy of implements prepared on scientific principles, either in England or India, whether they be ploughs, harrows, cultivators, drills, hoes or thrashing machines, and if found to be superior to the native implements, make known their advantages to the people. They might also advertise for improvements in the existing tools or invention of new ones well suited to the Indian soil and reward those which may be found to be the best.

Government have spent large sums of money on the construction of larger canals and irrigation works, and certainly they have become very useful in increasing the areas under wet crops and lessening the effects of droughts. Government afford assistance in the shape of Tagai to cultivators who wish to repair or dig new wells. There are, however, numerous smaller rivers and streams which are capable of irrigating large portions of land during some months of the year, if not the whole of it, and the damming and improvement of which will be as useful as the construction of larger canals and more useful than the construction of wells. We beg Government will pay greater attention to such works than they have hitherto done. The cost of them will be comparatively small, but on account of their scattered and higher positions, their use, we think, will be more widely spread than of the larger works and the extended irrigation will lead to greater attention being paid to the culture and manuring of land.

We would urge on the attention of Government the desirability of introducing into India Introduction and improvement of food and other of such food and forage plants as are found to give plants. elsewhere greater or superior yield or afford the means of sustenance to man and cattle or add to the commercial products of the country. We are sensible of the benefits accruing to the country by the cultivation of improved varieties of such plants as potato, maize, sugar-cane, cotton, tobacco, and the introduction of tea, coffee, arrowroot, cabbage, white pea, beans, and lucern, and we hope that Government will try themselves and give facilities to others to introduce and acclimatise other plants conducive to the welfare of the people. Rice and wheat are the staple cereal productions of India, and any varieties of them can, we think, be successfully introduced into the country. Carolina rice has been spoken of as superior to any and commands the highest price in England. In the same way Palestine wheat is stated to be the most prolific in production, and we beg that a more careful and extended trial may be given to the cultivation of both of these important food-plants.

We are of opinion that Government should maintain in an efficient state one experimental and model farm in each province of the Presidency, and a subordinate farm in each collectorate. In these farms experiments in ploughing, manuring, introducing new sorts of crops and plants water-lifts, &c, should be carefully conducted and the results of them noted and published in the vernacular of the provinces for the information of the people. The farms should be not as they are at present in which the cultivator has scarcely to learn anything, but model farms in the true sense of the word, in which the different operations, processes, raising, reaping, and thrashing of crops, and rearing of useful plants, should afford to the visitor ocular proofs of the superiority of the methods and the results, and should induce him strongly to try them on his own lands. Every facility and encouragement should be afforded to the agriculturists to visit these farms, and the improved methods of culture should be explained to them. Annual

reports of these farms giving results of experiments should be published in vernacular and distributed for the information of the people, and copies may be given as prizes to the children of agriculturists in schools.

We think the Provincial farm should be under the management of a European well trained in the theory and practice of agriculture and horticulture and having Indian experience. He should have one or two native assistants under him educated in Indian agricultural schools and preferably belonging to the agricultural classes. The zilla farms should be under the management of natives who shall have served as assistants for some time under the superintendents of provincial farms, and certified to be qualified to have independent charge of zilla farms. We feel sure that by study, practice, and experience, natives will in time be able to take charge of Provincial farms.

As a sequence of agricultural farms, we recommend the holding of shows and exhibitions of agricultural products, generally at the places where the farms are maintained. Suitable rewards may be awarded to those whose exhibits have, in the opinion of the examiners, cost special care and attention in their production. The farm-manager will, of course, send exhibits, but he should not compete for prizes, which should entirely be left for private exhibitors. We know that such shows have stirred up healthy competition among neighbouring producers and induced dealers to order out exhibits from distant parts. The exhibits need not be confined to the zilla or the province, but should include products of other provinces, and if possible of other countries so as to place before the cultivator the best samples for production by himself. Agricultural implements should also form part of the exhibits and should be tried before the visitors.

Government should assist the cultivator in procuring for him the seed or other things which he may wish to buy for use on his own land. In fact he should be encouraged to do so and informed that the constant use of the same seed deteriorates the produce, and that it is necessary to change seed to improve it. When he sees the produce and the seed placed side by side at the Show and when he also sees that the former is of a better kind than his own, he will naturally be inclined to buy some seed and try the experiment, and Government should assist him, not only in procuring the seed, but furnishing him with information necessary for the success of the trial. The same may be said of other articles shown at the exhibition.

To the means enumerated in the foregoing paragraphs it is necessary to add general education to improve the condition of the agriculturists. He is lamentably backward in this respect. Ninety-five out of a hundred cultivators cannot read or write, and very few can count up beyond twenty. Village schools should be more thickly spread than they are at present, and, besides the knowledge of the 3 R's, elementary instruction in agriculture, showing the advantages of ploughing, harrowing, hoeing and manuring, the rotation of crops and the selection of seed should be given from books specially prepared on the subject. It is necessary that the village teachers should have received instruction in the principles of agriculture, and the subject should be taught to the pupils of Training Colleges, and demonstrated by the working on the zilla farms, to which they should be taken once a week. If practicable, farms may be attached to Training Colleges, where the teacher will be able to illustrate his lectures more frequently and get his pupils to do practical work. We are of opinion that the teaching of agriculture in Training Colleges, the pupils of which are intended for village schools and some of whom are sons of agriculturists, will be more useful to the people than the teaching of it in High Schools or Colleges, to pupils of higher classes whose connection with the agriculturists can seldom be very great or intimate.

Agricultural education to higher classes is also necessary, for no great improvement can be expected in this Department if steps are not taken to teach improved processes of agriculture to those few who can, in after-life, turn their knowledge to account. All processes of improved agriculture imply expenditure of money, habits of foresight and thrift, and general development of intellectual power. These are conspicuous by their absence in the majority of actual cultivators of the soil. The English farmers, and not the agricultural labourers, have effected all the improvements accomplished in that country during the last 50 years, and the growth of such a class is only possible where education and competence are combined. The teaching of agriculture therefore must touch and vivify, so to speak, the upper classes, and when these master the processes, the good influence will slowly penetrate in the lower strata of society. Agricultural education must in short follow the course taken by all other branches of education—literary and professional.

We now come to a subject which is of vital importance to the agriculturist in his present Tagai advances. impoverished and helpless state, and we wish to draw the special attention of Government to it.

As the State in India claims the rights and advantages of its double position as Landlord and Sovereign, it must in theory at least accept the obligation of helping the poorer portion of its tenants (and they constitute in this Presidency more than 90 per cent. of the agricultural classes) to effect improvement in their lands. The Viceroy, Earl of Mayo, as far back as 1870, justified the creation of a separate Department of Agriculture on the ground "that the duties which in England are performed by a good landlord, and the work done by the great agricultural societies in Europe and America, fall in India, in a great measure, upon the Government, which is too often the only Indian landlord who can command the requisite knowledge and capital for the improvement of the land." The Government has accepted this obligation in the abstract, and every year a sum of a few lakhs of rupees is set apart in the budget of each Presidency for granting subsidies in aid of local improvement works to deserving and needy raiyats. The obligation is, however, so very scantily recognised in actual practice that the amount spent during the last three years in this Presidency has ranged from Rs. 80,000 to 90,000 upon a total land revenue collection exceeding three crores. In the Madras Presidency the sums spent show even smaller proportions. It is true the Government spends vast sums in the development of large irrigation and railway works, but such expenditure does not, by itself, remove the necessity of adopting a more liberal policy in respect of helping the poorer raiyats to improve the lands held by them. The Tagai rules have been in this Presidency lately revised by Government so as to enlarge the powers and discretion of District Revenue Officers, and remove the restrictions with which the exercise of such power was till very recently hemmed in, and relax the strictness with which punctual repayment was enforced. It is our firm conviction, however, that no mere change in rules will mend matters to any large extent, and that a change of system is necessary if due effect is to be given to the benevolent intentions of Government. (1) In the first instance Government must encourage its officers to deal liberally in the matter of these advances. The success of District administration must to a large extent be measured by the number of small improvement works undertaken by the raiyats with Government help. (2) Such a change in spirit will be materially helped if the work of granting these loans for land improvements is handed over to the Department of Agriculture. It will thus be brought into direct connection with a large and increasing sphere of usefulness and its hold upon the more enterprising raiyats will be strengthened in a way which cannot fail to be of immense benefit. The agency entrusted with the collection of land revenue is necessarily not the fittest agency for stimulating useful expenditure, and the change here suggested will restore the Director of Agriculture to the position occupied under native rule by the old Deshmooks and Deshpandes, who discharged many of the functions of inquiry, report, and stimulation of the improvement of land, &c., which belong to the new department. (3) Thirdly, we would suggest that the Director of Agriculture should be helped in this and other work by associations of local agriculturists. The Talooka Local Boards are a convenient agency through which the Director of Agriculture can make enquiries, and these can help him by their knowledge and experience to turn to the best account this benevolent liberality of Government. (4) We would lastly suggest that in many of the districts liable to droughts and famine, Government might well permit the raiyats to go on paying 6 per cent. interest on sums advanced to them, and levy this interest charge as an addition to the assessment as long as the principal remains unpaid. In this way the interests of Government revenue will be properly protected, and the desire for improvement stimulated to an extent not hitherto realised. If the four-fold improvement in system suggested above is carried out, we feel sure that the present stagnant condition of Indian agriculture will undergo a most healthy change for the better. It might indeed be said, and in fact has been said, that Government assistance is not needed by the raiyats and that the Tagai advances are inconsiderable by reason of the unwillingness of the raiyats to borrow money from Government. It is also urged that Government has no right to enter into competition with private capitalists. This latter fear is more imaginary than real; for the lakh or two spent by Government in this way is as a drop in the ocean of many hundred times that amount annually borrowed by raiyats from private Sowers.

The need of help to the raiyats is evidenced by the fact that in four districts in this Presidency, the annual loans equal the amount of Government revenue paid from year to year. The small Government advance will set the standard of fairness, and moderate the ardour of rapid gain felt by many of the middle-men sowers.

The raiyats, ignorant as they are, are not so great imbeciles as not to know the value of a difference of four from six per cent in the rate of interest. The apparent unwillingness is due to other causes, the chief of which is the desire of village and taluka officers not to be bothered

with additional work and responsibility. The four-fold improvement suggested above will, we feel sure, remove all difficulties, and give satisfaction to Government and the people alike.

At present there is a great and general complaint on the part of the agriculturists that all

Pastures

grazing lands on which they used to feed their cattle have been absorbed into Forest limits, and for want of food they have been obliged to reduce the number of their cattle and are unable to keep them in working condition. We are fully alive that under the altered condition of the country, it is not possible to rely exclusively on the wild free grass system of unrestricted grazing in village commons, and that the rayats must learn to raise green fodder for their cattle in their own fields. At the same time it should not be forgotten that the transition from the old condition of free pasture in common lands to the new system cannot be accomplished in the way the Forest Department has sought to force it under compulsion rigidly enforced. Since the enactment of Act V of 1879 the Forest Department has been allowed by Government to exercise control over *Gairans* or village commons, Kurans proper, as also over waste lands and hilly and mountainous areas. A very large portion of Forest revenue is represented by the proceeds of these Kuran sales, and the sale of the right of grazing in hitherto free commons. The Government has conveniently ignored the obligation laid upon it by the Forest Act to provide areas for the free pasture of village cattle. Still more recently an unheard-of distinction has been made between agriculturist and non-agriculturist residents of a village, and between their agricultural and non-agricultural live-stock, and a jealous and exacting system of free and paid passes has been introduced to the great annoyance of the rayats. We submit that the Forest Department should be limited in its activity to the areas capable of being turned into reserved and protected forests, while the transfer of control to that Department in respect of Kuran lands and village commons should be disallowed. The Agricultural Department, as most interested in village cattle, should have the charge of the village commons, and *Gairan* lands, and also of the Kurans. No loss of legitimate revenue need be feared by such a transfer, if Government fix the limit of its realisations with strict regard to the preservation and development of the live-stock of the country. She-cows and she-buffaloes, sheep and goats are of as much agricultural value to the rayats for their manure, and their dairy produce, as the bullocks employed in drawing the plough or the water-lift. No distinction should therefore be made between the so-called agricultural and non-agricultural live stock possessed by the rayats.

At the root of all improvement in agriculture lies the question of a fixity of tenure and of the Government demand. The Secretary of State has, as far back as 1862 and 1865, approved the extension of the permanent settlement to all settled districts where four-fifths of the area was already under occupation, and no great expenditure on Railway and Irrigation works was contemplated. Now that revision settlements have been completed over a large portion of the Presidency, the time has surely come to give effect to these declarations of policy. Even if these old promises cannot be redeemed, there is nothing to prevent Government from declaring once for all that no enhancements will take place except in consideration of a permanent rise in prices under conditions laid down by Lord Ripon in 1884, and accepted by the Local Government in its legislation of 1886, and that this enhancement will be equally distributed all over the taluka, so that there will be no unsettlement of values and no disturbance of vested interests, which are the fatal results of the present system of settlements.

In conclusion, we beg to refer to a subject which, though not immediately connected with agriculture, has a bearing with one of the important products of agriculture in the Deccan. We mean the manufacture of sugar, which, we think, is likely to be considered at the Conference.

Manufacture of Sugar

Common country sugar is not manufactured in this part of the country except at Kolhapur, as the manufacture does not become profitable if the residual molasses is not utilised for some other purpose. In the Kolhapur State molasses is utilised in the manufacture of country liquor, but under the Government Abkari rules country liquor is not allowed to be distilled from any other substance except Mowra. A well-known and an enterprising Parsee gentleman of Poona, Mr. Aduji Dorabji Ghaswala, about eight years ago, erected a sugar refinery combined with a liquor distillery at Moondwa near Poona. He produced different kinds of sugar in this factory and sold in the Poona market. The colour of the sugar was as white as that of the best kind of imported sugar, and in the Poona Exhibition of Native Arts in 1883 a silver medal and a certificate of merit were awarded to this gentleman. We regret to find that the only sugar refinery in the Deccan practically remains closed owing to the refusal of Government of the concession to manufacture rum and sell it claimed by the proprietor on the strength

of a promise granted him by Government. When the Factory was established in 1883-84, the Government of Sir James Fergusson promised to allow Mr. Adurji Ghaswala the permission to retail the liquor produce in his factory from the refuse or molasses left after crystallising sugar. When application was made to give effect to that promise, the Abkari Department refused to grant the permission asked for, or to tax his molasses rum as country liquor. The Governments of Madras and the North-Western Provinces have made concessions to European owners of sugar factories established in their Provinces, and we hope that the Government of H. E. Lord Harris will see reasons to grant them to Mr. Adurji as there is really no chance of the industry thriving here if Mr. Adurji's pioneer enterprise is not properly supported.

APPENDIX H (*vide page 76 of the Proceedings*).

Extracts from a note by T. W. HOLDERNESS, Esq., C. S., Director of Land Records and Agriculture, North-Western Provinces and Oudh, dated 5th October 1890, placed before the Agricultural Conference by the Honourable Mr. Benett.

* * * * *

The leading idea of the Pargana Book, as we have it, is that it should serve as a permanent note-book for the District Officer. It gives him a few leading statistics, and he is expected to correct and enlarge them by what he sees and hears. If you alter the form in which they are given and expand them, they would still labour under the defect of all statistics, unless you add the personal observation of highly trained observers.

* * * * *

The present form of Pargana Register is not perfect. If I were asked to draw out a form without regard to what already exists, I might propose alterations. But the present form, it should be remembered, was settled by the most competent Revenue Officers of the Province, after prolonged discussion, and should not be altered without a careful consideration of the record of that discussion. The Kanungo staff has become accustomed to it, and I know from experience the trouble that is occasioned by constant changes in our village and tahsil statistics.

PROCEEDINGS
OF THE
AGRICULTURAL CONFERENCE
HELD IN THE
DEPARTMENT OF REVENUE AND AGRICULTURE

SIMLA

ON THE

2nd, 3rd, 4th, 5th, 6th, and 7th October 1893,

WITH APPENDICES.



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Resolutions passed at the Agricultural Conference,

SECOND MEETING.

The Botanical Department.

Resolution I.—That while acknowledging the advantage gained in bringing the whole of India under the investigation of the Botanical officers in the country, [the Conference are of opinion that under the system in force insufficient importance has been attached to agricultural botany, and recommend that more special attention should be directed in future to plants connected with agriculture.]

Agricultural Entomology.

Resolution II.—That the investigation of animal and insect pests injurious to agriculture is necessary. The work done in this direction by the officer on the Indian Museum staff in connection with agricultural entomology is appreciated. The investigation would, however, be more effectually carried out if the investigating officer were given the opportunity of personal communication with the officials and others in provinces who could co-operate with him.

District Analyses.

Resolution III.—That [where practicable, agricultural statistics should be compiled by the village officers or agency for every village or estate in each province.]

Resolution IV.—That where such are compiled, [some system should be adopted under which the leading facts and statistics indicating the agricultural condition of the village or estate for each year should be abstracted in a simple form.]

Resolution V.—That [these forms should be brought together in a special volume to be maintained for each administrative circle, e.g., Revenue Inspector's Circle, pargana, etc., in which District Officers should from time to time enter remarks, if required, on progress or degradation of the village or circle.]

Resolution VI.—That some system should be established ensuring that the information contained in the forms shall be utilized by the District authorities.

Resolution VII.—That [it should be the special duty of the Agricultural Department to ascertain from time to time by inspection that the forms are properly maintained and efficiently utilized for each district.]

Resolution VIII.—That [the district analysis contemplated by the Government of India Resolution of 1881 will be effectually provided for by the settlement reports and records, supplemented by the annual abstracts of village statistics. But that it will be also useful that the Agricultural Departments should collate and publish] or encourage the collation and publication, from time to time, of [general information and statistics showing the agricultural condition of each district, either in short abstracts or in such volumes as the Statistical Atlas of Bombay] or where statistics are not available, such reports as those of Mr. Sen's and Mr. Basu's on the Dacca and Lohardugga districts in Bengal.

Resolution IX.—That it is very desirable that the Director of Agriculture should take advantage of the knowledge gained by his periodical inspections to bring to the notice of the Revenue authority any cases of local deteriorations which seem to require special action or enquiry.]

Resolution X.—That [when the information obtained through the village or circle books is sufficient to establish serious deterioration or depression in any villages or tracts, the information should be communicated to the Director through such channel as the Local Government may direct, with the view of his suggesting remedies for the consideration of District Officers or such Revenue authorities as the Local Government may direct.]

THIRD MEETING.

Agricultural Assistants and Experts.

Resolution I.—That, in the opinion of the Conference, it is essential in the interests of agricultural improvement that there should be in each province a highly trained technical assistant to the Director of Agriculture, and that unless or until natives sufficiently well trained and qualified are available, he should be a European expert.

Resolution II.—That there should be a subordinate staff of native experts employed for the purposes indicated in Dr. Voelcker's conclusions and for superintending farms and agricultural experiments.

Resolution III.—That native experts should be trained in this country, not in England.

Resolution IV.—That the training should be not inferior to that given at Cirencester.

Resolution V.—That the range of pay for subordinate native experts should be not less than that of the appointments open to revenue officials who may ordinarily expect to rise to the higher grades of Tahsildars or Mamlatdars.

Resolution VI.—That the native experts should as rarely as possible be transferred to other departments.

FOURTH MEETING.

Construction of dams and bunds.

Resolution I.—That the Government of India be invited to circulate separately the papers submitted to the Conference on this subject.

Resolution II.—That the subject be taken under special consideration by the departments in those Provinces where the local conditions might require it.

Arboriculture.

Resolution III.—That the Government of India be invited to draw the further attention of the Local Governments to the subject of roadside arboriculture.

Formula for the division of mixed crops.

Resolution IV.—That the system proposed in the Government of India Circular No. 50-80, dated 16th August 1893, should be recommended, that no mixtures should be shown as such in the return sent to the Central Provincial office; that in district returns they should be divided into their constituent parts either initially by the village officers or subsequently by the district staff in such methods as may be arranged on the advice of the Director of Agriculture.

Form of Agricultural Department Reports.

Resolution V.—That the Conference approve generally of the principles laid down in the Government of India Circular Nos. 54 A, dated 28th April 1884, and 52 G, dated 14th September 1887.

Resolution VI.—That the Government of India be invited to make suggestions on this subject, and that at any future conference at which Dr. Voelcker's recommendations might be gone into in greater detail, the headings of the reports should be definitely revised.

Price Statements.

Resolution VII.—That so far as Military requirements are concerned, it seemed desirable that the Military Department should itself take steps, by committees or otherwise, to ascertain correct prices of articles in the price of which they are interested.

Resolution VIII.—That the system under which certificates of prices are furnished by the District Officers to the Military authorities for other purposes than determining compensation for dearness of provisions and fodder should be abolished.

Resolution IX.—That the fortnightly price returns are required by District Officers mainly for assessment purposes; that for these purposes they are sufficiently accurate, that the appointment of inspectors even at the cost of the Military Department to see after the correctness of some or all of these returns is unnecessary, and that the existing agency for the preparation and inspection of these returns is sufficient if properly worked.

FIFTH MEETING.

Education.

Resolution I.—That in considering the question of agricultural education and progress, the Conference desire to express the opinion that it is most desirable to extend primary education among the agricultural classes.

Resolution II.—That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend exclusively on separate special institutions.

Resolution III.—That it is most desirable that the Universities should recognize the Science of Agriculture as an optional subject in the course for a degree.

Resolution IV.—That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with the view of creating more interest in agricultural improvement amongst the cultivating classes.

Resolution V.—That in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and "readers."

Resolution VI.—That it is highly desirable that the claims of men trained in scientific agriculture to appointments in the Revenue and cognate Departments should be as freely recognized as those of men trained in Law, Arts, and Engineering.

Resolution VII.—That where appointments in the Revenue or cognate Departments are made on the result of the competitive examinations, scientific agriculture should be included as an optional or necessary subject in the examination course.

Resolution VIII.—That in any province in which it may be determined to introduce a scheme for higher agricultural education, no arrangements will be satisfactory which do not provide (1) for a thoroughly practical training of the students in the field and laboratory as distinct from theory or practice as taught in the lecture room, and (2) for examination tests of a special and searching character in the above branches of work.

Resolution IX.—That, in the opinion of the Conference, education in the lower schools should be of such a practical character as to fit the pupils for technical pursuits including agriculture, as well as for literary and commercial pursuits.

Resolution X.—That the text-books used in schools should be written in the simplest language ordinarily understood by the people, and should be descriptive of subjects with which they are familiar; also that the use of pictorial lesson charts, illustrating familiar objects, should be encouraged.

Resolution XI.—That the system of training in normal schools should be adapted to qualify school teachers to give instruction of the character indicated in Resolution VIII.

Resolution XII.—That in each Province a Committee, in which agricultural officers should be included, should be convened at an early date for the consideration of the questions raised in the preceding resolutions.

SIXTH MEETING.

See the Proceedings.

Proceedings of the Agricultural Conference.

The following attended the Conference :—

India	{	Sir E. Buck, Kt., C.S.I., Secretary to the Government of India, Department of Revenue and Agriculture.
		Dr. J. W. Leather, Agricultural Chemist to the Government of India.
Madras	{	Mr. H. F. Clogston, C.S.I., 3rd Member, Board of Revenue, Commissioner of Revenue Settlements and Director of the Department of Land Records and Agriculture, Madras.
		Mr. F. A. Nicholson, Collector, South Arcot.
Bombay	{	Mr. E. C. Ozanne, Survey Commissioner and Director of the Department of Land Records and Agriculture, Bombay.
Bengal	{	Mr. W. C. Macpherson, Offg. Director of the Department of Land Records and Agriculture, Bengal.
N.-W. P., & Oudh	{	Mr. O. Miller, Director of the Department of Land Records and Agriculture, North-Western Provinces and Oudh.
		Mr. E. B. Francis, Director of the Department of Land Records and Agriculture, Punjab.
Punjab	{	Mr. J. Wilson, Deputy Commissioner, Shahpur.
		Mr. J. M. Doue, Secretary to the Punjab Government, Revenue Department.
Central Provinces	{	Mr. J. B. Fuller, C.I.E., Commissioner of Settlements and Agriculture, Central Provinces.
		Mr. H. Z. Darrah, Director of the Department of Land Records and Agriculture, Assam.
Assam	{	Mr. E. A. Gait, on special duty.
		Mr. E. D. MacLagan, Under-Secretary to the Government of India, Department of Revenue and Agriculture, Secretary to the Conference.
India	}	

Invited to certain meetings.

Veterinary Lieutenant-Colonel J. H. B. Hallen, C.I.E., Inspector General, Civil Veterinary Department.

Mr. R. Ribbentrop, C.I.E., Inspector General of Forests.

Mr. E. Thurston, Offg. Reporter on Economic Products to the Government of India.

Veterinary Captain J. Mills, Principal, Bombay Veterinary College.

Prof. T. H. Middleton, Professor of Agriculture, Agricultural College, Baroda.

Captain F. C. Chapman, Proprietor, Banti Estate, Bharwari, Oudh.

First Meeting, Monday, 2nd October 1893.

OPENING ADDRESS.

1. The Conference met on Monday, the 2nd October, at 3 P.M. A proof copy of the President's proposed address was presented to each member with a request that as the address was to be published as an intimation to the public of the general plan to be adopted in connection with agricultural improvement, he would offer criticisms of any portion of the draft. The address was further considered at the second meeting of the Conference.

(i) AGRICULTURAL LEDGER SERIES.

2. The President explained the system of the Ledger Series. The system of ledgering from official records was successfully elaborated by Dr. Watt in the compilation of the Dictionary of Economic Products. The further measure of publishing information in a series of leaflets or bulletins, each devoted to one subject, was introduced by the Madras Agricultural Department. The two systems have been now combined in the Imperial Secretariat. All information which comes to hand in connection with Economic Products or Agriculture and which is worth recording is ledgered in the office either of the Reporter on Economic Products or of the Agricultural Chemist, and any notes or papers of sufficient interest for general publication are published in full or in abstract in

Agricultural Ledger Series—contd. a series of bulletins designated the "Agricultural Ledger Series." Provincial Departments of Agriculture have been invited in Circular No. 31, dated 19th August 1892, to communicate for inclusion in the series any information of general and not of purely local interest. The Bulletin when not reproducing the communicated paper in full contains reference to the source from which it was derived or to papers which can be referred to or obtained, if required. This system does not interfere with any Local Government maintaining a similar local series.

3. The Conference was invited to express its views as to the publication above described, and the President observed that unless the Provinces desired to co-operate, the plan could not be successfully carried out. The members were unanimously of opinion that the system was an extremely good one, and general co-operation was promised. The President expressed satisfaction at this decision, and invited the members to arrange for the communication of matter for the Ledger Series whenever they thought that the results of local enquiry were worthy of dissemination to other provinces.

4. The following matters of detail came also under discussion:—

Mr. Fuller urged that Bulletins consisting of abstracts of reports submitted by local Directors of Agriculture and Land Records should be sent in proof to the contributing officer, before publication, in order to ensure that the information had been fully and correctly recorded. This suggestion met with approval.

He further pointed out the advisability of giving a serial number to the main heads by the addition of the words "No. — of ——" before the words "Main head." This was agreed to, its object being to check the completeness of the Series.

Mr. Macpherson proposed that an index should be prepared annually and annually revised and brought up to date. The index should show alphabetically the subjects and sub-heads of the Ledger Series with reference to the main head, so that all information on any particular subject might be readily ascertained. The suggestion was approved.

A note by Mr. Macpherson on the subject of the Ledger Series will be found in Appendix No. III.

Second Meeting, Tuesday, 3rd October 1893.

(ii) THE PRESIDENT'S ADDRESS.

The President's Address. 5. The President's address* was read and placed finally on the table. The Proceedings opened by a discussion on the address.

6. Mr. Clogstoun stated that it was not quite clear from the President's address whether he was opposed to the institution of experimental farms as a means of prosecuting agricultural enquiry. So far as Madras was concerned he would desire to see the proposed experimental farms, the establishment of which had been for a long time deferred in deference to the wishes of the Government of India, at once started. Careful experiments of the nature suggested by Dr. Voelcker would be made on these farms by scientific experts, and any improvements found from time to time suitable for introduction might be at once introduced. There was no great need in Madras for further enquiry in view of the elaboration of agricultural statistics, or to determine the tracts in which agriculture was below a fair standard of efficiency. The main cause of failure in the harvests of the Presidency was the failure in the periodical rains, and the tracts most liable to this failure were all well known. Great efforts were being made to give these tracts some protection against drought by making liberal advances for the construction of wells.

7. Mr. Fuller recommended that enquiry should be 'special' rather than 'general.' He thought that more practical utility would result from detailed investigations into particular conditions or processes than from a general

* Appendix No. II.

enquiry into the agricultural circumstances of a tract. He alluded to the more or less successful results which had followed Mr. Mollison's experiments with potato culture to combat a serious disease in potatoes in Poona, and thought that the example should be followed.

The President's Address—contd.

8. *Mr. Wilson* hoped that the public would be fully informed as to what had been or was being done in the way of agricultural improvement, whether as regards canals and communications and general measures of that kind, or as regards more positive and detailed action, such as the distribution of seed, etc.

9. Notes showing the progress which has taken place in agricultural improvement in the Punjab and Bengal will be found at pages 35-39.

(iii) SCIENTIFIC DEPARTMENTS.

10. The subject of enquiry by Scientific Departments was then discussed. The Conference accepted the principles that scientific investigation must be conducted under Government direction, in view of the fact that the education of the people had not reached a stage at which they would take it up independently, and they also agreed that such investigation must be, in most cases, of a national rather than of a provincial character. *The President* laid upon the table a diagram showing the various departments of investigation whose work was directly or indirectly connected with the scheme of agricultural enquiry and improvement, and proposed that the work done or to be done by each should be brought under brief discussion.

Scientific Departments.

11. (1) *The Survey Department.*—*The President* stated that the Imperial Department had in all Provinces outside the Madras and Bombay Presidencies, which had their own Survey Departments, been brought into connection with the general scheme of agricultural enquiry by co-operating with the Provincial authorities in training village establishments, and in carrying out cadastral surveys to be maintained hereafter by the trained village officials. Field maps maintained by local agency must always be the basis of all systematic agricultural enquiry, and the work that had been done by the Survey Department in recent years in the required direction had been most valuable. Their chief fields of labour had been certain districts in the North Western Provinces, the whole of the Central Provinces, Burma and Assam. They had now entered on a new field in Bihar. The change which had, with the loyal co-operation of the officers of the Department, been effected was the utilization of village establishments, a new departure made since the Famine Commissioners' report was written, with the object of securing the continuous maintenance of village maps and records, without which, as already remarked, no system of agricultural enquiry could be properly kept up.

It was generally agreed that the Survey Departments in all Provinces had done most useful work in laying the foundation for agricultural investigation and enquiry.

12. (2) *The Geological Department.*—*The President* explained that at one time the researches of the Department were confined almost entirely to scientific survey. Scientific survey was no doubt of great importance even to agriculture, as providing a basis for the proper comprehension of the soils of the country. A change, however, had been made in recent years by the restriction of one section of the Geological Department to more practical investigation, mainly in connection with coal, petroleum and iron. These researches are only indirectly connected with agriculture, but will tend, so far as they are successful, to bring about the introduction of manufactories upon which the improvement of agricultural implements and the extension of agricultural works depends. Already the iron-works at Barakar and Roorkee have been of service in connection with Canal works.

On the other hand, the responsibility rests upon the Agricultural Departments to carry out the Famine Commission's recommendation to foster other industries than agriculture, and nothing will tend more to this end than the development of coal and of the mineral resources of the country. It would be desirable that the Agricultural Department in each Province should

8-1001, 16
Departments—contd

be in communication with the Geological Department and should co-operate with that Department in guiding the researches of the geological experts.

Mr. Nicholson observed that in some countries in Europe the Agricultural Department dealt with industries not connected indirectly as well as directly with agriculture. For instance, at Wurtemberg there was a Bureau of Industries under the Agricultural Department which dealt with rural industries, such as the cottage linen industry, etc. The same thing was done in Italy.

The Conference were of opinion that the Geological Department had now begun to do good work in a practical direction; that its investigations should receive the attention of Agricultural Departments, who should co-operate in the development of geological investigations directly or indirectly useful to agriculture.

13. (3) *The Botanical Department.*—The President stated that more scientific investigation had been done in the Botanical than in any other field. This was due partly to its being a favourite subject at the beginning of the century, especially in the case of medical men, who in earlier days were the only scientific experts in the country. A recent improvement had been made in the system of Botanical research which was a few years ago confined to three Provinces by dividing the whole of India amongst the existing Botanical officials, four in number, so as to bring all India under a Botanical Survey.

Mr. Fuller represented that systematic Botany was being extensively worked out in the hill regions, but that very little was done in the cultivated plains. Dr. Leather suggested that more should be done on the physiological side. After discussion Mr. Fuller submitted the following Resolution, which was carried unanimously:—

“That while acknowledging the advantage gained in bringing the whole of India under the investigation of the Botanical officers in the country, the Conference are of opinion that under the system in force insufficient importance has been attached to agricultural botany, and recommend that more special attention should be directed in future to plants connected with agriculture.”

14. (4) *Economic Products Department.*—The President explained that existing information about economic products had been collated in Dr. Watt's Dictionary—a work of ten years,—and that the Reporter on Economic Products was now engaged in developing further investigation. In reply to Mr. Nicholson, who asked whether any arrangement was or could be made for sending to England products which were worth attention, he explained that a system was now organized in co-operation with the authorities of the Imperial Institute under which products of the class alluded to would be annually sent to England for investigation. Mr. Thurston stated the services of Dr. Theodore Cooke, late Principal of the Poona College of Science, had been specially engaged at the Institute for this purpose. The President added that although the Institute had not been initiated or specially promoted by the Government of India, yet it was thought that as it had to a large extent been supported by Indian contributions, it should be utilized as far as possible for the benefit of India, and that it could be best made use of by being employed for the scientific examination of products likely to be useful to commerce.

15. (5) *Civil Veterinary Department.*—The President explained that the Department itself was new, and that the starting of veterinary establishments in each Province must, apart from the steps taken to introduce a more rational treatment of disease and to check the ravages of cattle epidemics, lead to the collection of much information useful to agriculture. Systematic and scientific enquiry is already being taken up under a special branch of the Department, and includes not only investigation as to the various breeds of cattle and the like, but also bacteriological research and a thorough investigation into the diseases of cattle and the means of coping with their diseases. As the subject was fully dealt with in recent Resolutions of the Government of India, he need not pursue it further. Mr. Nicholson observed that the money spent on these investigations ought to prove a useful investment. The Conference generally agreed that satisfactory measures had been taken to secure research in this field.

16. (6) *Entomological research*.—The President explained what had been done by Mr. Cotes of the Indian Museum with the permission of the Trustees in this direction, and intimated that if money could be found for the purpose, the Trustees would be doing a useful work in permitting the official responsible for entomological research to travel. Scientific
Departments—contd.

Mr. Darrah stated that the Assam planters were already showing their appreciation of Mr. Cotes' work by following his instructions for protecting their crops against insect pests; forwarding specimens of insect pests and offering a prize for an essay on the subject. The Chief Commissioner had increased the value of the prize by 50 per cent. and Mr. Cotes had been asked to adjudicate.

Both *Mr. Francis* and *Mr. Ozanne* spoke in favour of the series of Lesson Sheets issued by Mr. Cotes, and had advised their introduction into schools. They hoped, as did other members of the Conference, that they would be continued.

Mr. Fuller urged strongly that the officers entrusted with the duty of entomological research should be allowed to travel. It would be much more satisfactory that they should see insect pests on the crops, and personally examine the conditions under which damage was done by them on the spot, than that they should merely receive specimens at the Central Museum. After further discussion the Conference passed the following Resolution:—

That the investigation of animal and insect pests injurious to agriculturists is necessary. The work done in this direction by the officer on the Indian Museum staff in connection with agricultural entomology is appreciated. The investigation would, however, be more effectually carried out if the investigating officer were given the opportunity of personal communication with the officials and others in Provinces who could co-operate with him.

(iv) DISTRICT ANALYSIS.

17. *The President* referred to the discussions and resolutions at the last *District Analysis* Conference, and stated that, although the subject had been then fully dealt with, a great deal remained to be done in the way of systematic investigation. "District analysis" meant the ascertainment of the conditions and circumstances in each agricultural tract, and the consequent ascertainment of defects in the system of environments of agriculture in each with the view to the prevention, cure, or removal of such defects.

18. It was satisfactory to know that in almost every Province, village or circle books were now kept in which the continuous record of agricultural vicissitudes in each village would be maintained. This plan would lead ultimately to a very accurate determination of the conditions and requirements of each agricultural tract. What was now wanted was that Directors of Agricultural Departments should keep the Local Governments informed whether the record was continuously maintained as it should be, and *Mr. Fuller* added that Directors should also be responsible for drawing attention to any circumstances coming to their notice which indicated the existence of agricultural depression and hardship requiring immediate remedy.

19. After much discussion the Conference agreed that the six Resolutions passed at the seventh Meeting of the last Conference should be adopted, and that two, numbered VII and VIII below, should be added. The Resolutions passed were accordingly as follows:—

I.—"That where practicable, agricultural statistics should be compiled by the village officers or agency for every village or estate in each province.

II.—"That where such are compiled, some system should be adopted under which the leading facts and statistics indicating the agricultural condition of the village or estate for each year should be abstracted in a simple form.

III.—"That these forms should be brought together in a special volume to be maintained for each administrative circle, e.g., Revenue Inspector's circle, pargana, etc., in which District Officers should from time to time enter remarks, if required, on progress or degradation of the village or circle.

IV.—"That some system should be established ensuring that the information contained in the forms shall be utilised by the District authorities.

V.—"That it should be the special duty of the Agricultural Department to ascertain from time to time by inspection that the forms are properly maintained and efficiently utilised for each district.

District Analysis—
contd.

VII.—“That the district analysis contemplated by the Government of India Resolution of 1881 will be effectually provided for by the settlement reports and records, supplemented by the annual abstracts of village statistics. But that it will be also useful that the Agricultural Departments should collate and publish, or encourage the collation and publication from time to time, of general information and statistics showing the agricultural condition of each district, either in short abstracts or in such volumes as the Statistical Atlas of Bombay, or where statistics are not available, such reports as those of Mr. Sen's and Mr. Basu's on the Dacca and Lohardugga Districts in Bengal.

VIII.—“That it is very desirable that the Director of Agriculture should take advantage of the knowledge gained by his periodical inspections to bring to the notice of the Revenue, authority any cases of local deteriorations which seem to require special action or enquiry.

IX.—“That when the information obtained through the village or circle books is sufficient to establish serious deterioration or depression in any villages or tracts, the information should be communicated to the Director through such channel as the Local Government may direct, with the view of his suggesting remedies for the consideration of District Officers or such Revenue authorities as the Local Government may direct.”

A note by Messrs. Darrah and Gait with reference to resolutions II and III will be found below in Appendix III at page 39.

(v) AGRICULTURAL GAZETTEER.

Agricultural
Gazetteer

20. Some discussion followed as to the manner best suited for bringing together existing information regarding agricultural methods and conditions. It was originally suggested that an Imperial Officer, the Agricultural Chemist, should be employed in collecting information from original records and reports, but objections were made to the effect that this would cause considerable waste of valuable time, and that these records and reports could not always be trusted, and required correction by persons possessing local knowledge. It was, therefore, determined that the work should be taken up by the Provincial authorities, e.g., the Directors and Assistant Directors, and that the Imperial Officer should compile the results. It was further settled that it would be convenient instead of instituting a general enquiry all at once, that different subjects should by degrees be taken up and dealt with separately, and that in determining the order in which such subjects should be taken up, priority should be given to matters in which early improvement may be expected.

Mr. Macpherson communicated a note on this subject by Mr. Basu, which will be found in Appendix III (page 40).

Reference is invited to paragraphs 4 and 5 of Mr. Ozanne's Note No. 12 on page 43 with which the Conference generally agreed.

Third Meeting, Wednesday, 4th October 1893.

(vi) AGRICULTURAL ASSISTANTS AND EXPERTS.

Agricultural
Assistants and
Experts

21. In connection with the institution of organized enquiry into existing methods and conditions of agriculture, the following “conclusions” recorded by Dr. Voelcker in paragraph 412 of his report were read:—

“Before any real improvement can be effected in agriculture, the institution of organized enquiry into existing methods and conditions is absolutely necessary. Thus far, little more has been done than to collect statistics and information as to the liability of districts to famine. The expressed opinions of the Famine Commissioners and of the Government of India have clearly indicated that more than this was intended, and that enquiry into agricultural practices was recognized as a preliminary to agricultural improvement. The time has now arrived when practical agricultural enquiry should be initiated. The principal directions in which enquiry should proceed are, firstly, the obtaining of definite information as to the requirements of each district in the matter of supply of water, manure, wood, and grazing; secondly, the study of agricultural practices, with a view to the transference of the better methods to districts where they are not known.

“The agency which Agricultural Departments possess at present is inadequate to carry out such a system of enquiry, and a technical knowledge of agriculture is a necessity.

“The Directors of Departments of Land Records and Agriculture are principally occupied with administrative duties, and have neither the time nor the technical acquaintance with agriculture which would enable them to devote themselves to the subject of agricultural improvement. Further, the constant changes in the tenure of the office of Director prevent the continuity of any experimental enquiry.

"While, for administrative reasons, it is desirable to retain the Director of an Agricultural Department in his present position, the want of technical knowledge of agriculture must be supplied, this can best be done by associating with the Director one or more expert Assistants who will make agriculture the business of their lives and whose duty it will be to investigate, under the Director's orders, the agricultural conditions of the different districts of a Province. The men selected as agricultural experts should be, by preference, Natives who have been trained in India."

Agricultural Assistants and Experts—contd

22. The question raised by Dr. Voelcker as to the subordinate agency to be employed in the enquiry was brought forward. It was generally agreed that that some trained expert or experts must form part of the agricultural staff in every Province, both for the purpose indicated in the "conclusions" above-quoted and for the supervision of experimental farms.

The expert staff now existing in each Province is the following:—

Bengal	one officer on	₹ 300 p. m. and 2 on	₹ 250.
Madras	one officer on	" 750—50—1,000, one on	" 200—10—250 and four on
			" 50—20—150.
Bombay	one officer on	" 500—50—700	
North-Western Provinces	one officer on	" 400—500.	
Central Provinces	one officer		
Punjab			
Assam			
Burma			
			} None

(Notes prepared by some of the members of the Conference on the agricultural staff, existing and required, in their respective provinces will be found in Appendix No. III, pages 41 to 43.)

23. The character of the staff to be employed and the nature of the training to be adopted were then fully discussed. The following conclusions were arrived at.

24. It was generally agreed that, at any rate in the larger Provinces, which could afford it and in which agricultural enquiry and experiment were especially needed, there should be, unless and until native experts are available, at least one European expert highly trained in practical and scientific agriculture; that native experts should, as suggested by Dr. Voelcker, be trained in this country, not in England; and that the training should not be inferior to that at Cirencester. So far as the native experts to be employed are concerned, the number required in each Province will not be large. For the present the number in any Province would not exceed four or five, although in some Provinces it was hoped to work up eventually to the provision of one such official for each district.

25. The question of the pay to be accorded to native experts was discussed. It was the unanimous opinion of the Conference that trained students, once admitted to the agricultural staff, should as rarely as possible be transferred to other departments in view of the fact that each year's experience added to their value as agricultural experts. That the pay to which they can eventually rise should not therefore be less than that of the higher grades of such revenue officials as Tahsildars and Mamlatdars,—*e.g.*, about ₹250. That the minimum or initial pay must be left to Local Governments to decide, provided that the principle be observed that the general scale of pay should be as attractive as that offered to revenue officials who have the opportunity of rising to the offices above indicated.

26. It was admitted that education of the Cirencester standard, which would involve a course of three or four years, could not without undue cost to the State be supplied in every Province, and that the policy should be adopted of establishing a Central Agricultural College where a diploma of the Cirencester standard could be obtained on the principle followed in connection with education in Forestry and Veterinary Science. The Forest School at Dehra now includes pupils from every Province except Bombay, and it is contemplated that the Bombay Veterinary College is to be the only College at which Veterinary diplomas of the highest class are to be given.

27. The two Provinces in which agricultural education of a high standard has been introduced are Madras and Bombay. The Inspector General of Forests suggested that if a Central Agricultural College is established at Poona, the

Bombay Government should be invited to agree that the national Forest Institution at Dehra should be utilized by the Bombay Presidency. The suggestion as regards the utilization of the Poona College for Agricultural Education was agreed to generally, and the Bombay delegate, *Mr. Ozanne*, saw no reason why the proposal as regards Dehra should not be laid before the Bombay Government.

28. As regards the maintenance of other agricultural training schools of a high class in Madras or any other Province, it was considered that the question seemed to turn on that of the possibility of utilizing the trained students in administrative appointments. There was no other opening worth considering for trained agricultural students. In the Madras Presidency, *Mr. Clogstoun* stated, no special advantages in the competition for subordinate revenue appointments were held out to passed students of the local Agricultural College, and indeed under rules recently passed by the Madras Government which restricted to graduates the right to appear for the Revenue Higher Test examination,—an examination which must be passed by all applicants for the post of Deputy Collector, and which will, it is believed, be practically the test for tahsildars,—all hope of entering the higher branches of the Revenue service is cut off from students of the Agricultural College. The hardship of the rule, however, as regards students of the College has been admitted, and the Madras Government has decided to invite the Senate of the University to consider the propriety of instituting a general science degree or a special degree in agriculture in view to this last degree, or the general science degree plus a diploma in agriculture, being allowed to qualify for entrance to the Revenue Test Higher grade.

Agricultural students could be prepared for the science degree or the degree in agriculture while studying at the Agricultural College, and there is every reason to hope that a considerable number of paying students would elect to enter the Agricultural College and to read for these degrees in preference to studying for the degree in Arts.

29. It was agreed that the question be further discussed when the subject of agricultural education was brought forward. In the meantime the following Resolutions were passed :—

(1) *That in the opinion of the Conference it is essential in the interests of agricultural improvement that there should be in each province a highly trained technical assistant to the Director of Agriculture, and that unless or until natives sufficiently well trained and qualified are available, he should be a European expert.*

(2) *That there should be a subordinate staff of native experts employed for the purposes indicated in Dr. Voelcker's conclusions and for superintending farms and agricultural experiments.*

(3) *That native experts should be trained in this country, not in England.*

(4) *That the training should be not inferior to that given at Cirencester.*

(5) *That the range of pay for subordinate native experts should be not less than that of the appointments open to revenue officials who may ordinarily expect to rise to the higher grades of Tahsildars or Mamlatdars.*

(6) *That the native experts should as rarely as possible be transferred to other departments.*

Fourth Meeting, Thursday, the 5th October 1893.

30. *The President* introduced to the meeting *Captain Chapman*, the owner of an estate at Banti in Oudh, who had been nearly 50 years in the country and had much interested himself in agricultural matters. Any questions which he might bring forward deserved the consideration of the Conference in view of the fact that *Captain Chapman* had personally received *Dr. Voelcker* and *Dr. Leather* on his estate and had given them much valuable information based on the practical experiments which he had for some years been engaged in carrying out. *Captain Chapman's* estate was in fact an experimental farm conducted without cost to the State, and afforded a useful example which might well be followed by other educated and intelligent landowners.

(vii) CONSTRUCTION OF DAMS AND BUNDS.

31. The first subject on the table for discussion was that of the construction of dams and bunds for (a) the prevention of erosion, and (b) the fertilization of land by deposit of silt. Captain Chapman had devoted much attention to this subject and the matter had been taken up in a Circular No. 23, dated 21st June 1893, in which information was asked for regarding action taken during recent years and the practices prevailing among agricultural classes. *Construction of Dams and Bunds.*

The evidence in the replies to the Circular indicated that in many provinces the practice of fertilizing agricultural land with silt was not uncommon, especially in Madras, the Central Provinces, Bengal, and parts of the Punjab and Bombay. On the other hand, the fertilizing silt in many rivers was not utilized, notably in the case of rivers issuing from the Himalayas.

As regards the prevention of erosion by drainage and the reclamation of land at the heads of ravines, evidence was brought forward that in the Shahpur district of the Punjab and on Captain Chapman's Estate in Oudh experiments in this direction had been carried out and had proved remunerative. In the first case worthless land so reclaimed was found to be worth £100 an acre or more; in the second the cost was £100 an acre and the rent of the reclaimed land £10 an acre. In view of the extensive and serious deterioration of agricultural land due in some provinces to drainage erosion, the Conference considered the subject of importance. *Captain Chapman* suggested that the reclamation of ravine land would be a useful famine work, and *Mr. Muller* stated that it was included in the list of famine works in the North-Western Provinces. *The President* also stated that it had been recommended by the Government of India, but that the system could not be adopted in time of famine unless it had been previously worked out in a practical manner by experiment. This conclusion was accepted.

Mr. Bibbentrop drew attention to the necessity for diminishing the damage done by ravines and sandy torrents in the Sub-Himalayan tracts by proper afforestation of the head waters and subsequently furnished a note on the subject. (*Vide* Appendix III, page 46.)

32. Resolved:

(1) That the Government of India be invited to circulate separately the papers submitted to the Conference on the subject.

(2) That the subject be taken under special consideration by the Departments in those Provinces where the local conditions might require it.

(viii) REMUNERATIVE ARBORICULTURE.

33. The question of remunerative arboriculture was then discussed at the instance of *Captain Chapman*, who represented that very often the wrong class of trees was planted along the roads, and that many trees producing either fruit and timber could be planted which would yield an assured income of 8 annas a tree. *Mr. Wilson* noticed that a considerable income was derived by the District Board of his own district from a careful system of arboriculture, and *the President* drew attention to the advantage of planting fodder trees and of throwing open the grazing on such trees in times of famine. He stated that the subject was one which had received considerable attention in recent years. *Remunerative Arboriculture.*

34. Resolved:

That the Government of India be invited to draw the further attention of the Local Governments to the subject of roadside arboriculture.

(ix) MIXED CROPS.

35. The next subject for discussion was the manner in which mixed crops should be returned in the Agricultural Statistics. The method proposed in the Government of India's Circular Nos. 50—80, dated 16th August 1893, was the following:— *Mixed Crops.*

"Important 'mixtures' such as 'wheat and barley' will be entered in the village registers as 'mixtures,' no attempt being made by the village officers themselves to separate the areas of the component crops. The subdivision of areas will be made in the central offices on for-

Mixed Crops—
contd.

mulæ supplied to them. An appropriate formula for each crop will be prepared for every district or homogeneous portion of a district by the Director of the Agricultural Department in consultation with the District Officers.

“ Unimportant mixtures, such as ‘peas and pulse,’ or mixtures for which no formula is likely to be appropriate on account of the absence of uniformity in the proportion of the component crops or for any other reason, will not be recorded in the village registers as ‘mixtures,’ but as single crops, the village officer deciding the proportionate areas in each case as best he can on his own estimates.

“ For example, if a formula has been prepared showing the proportion of area which wheat and barley may be assumed respectively to cover when grown together, the heading ‘Wheat and barley’ would be one of the headings prescribed for the village returns, and all fields containing both crops would be shown under that heading. If in the case of peas and pulse no such formula has been prepared, there would be no heading for ‘peas and pulse,’ and the village officer would, on inspection of the fields, enter separately the portions of the areas under the mixed crop which he might estimate to be under ‘peas’ and ‘pulse’ respectively.

“ The formulæ suggested above will have to be based upon rough and general data. In tracts in which it is the custom to grow the component crops in distinct rows at normal distances, the determination of the formula will be easy. In other cases it will probably be based on information obtained by enquiry as to the usual proportion of seed sown and by enquiry or experiment as to the usual proportion of produce obtained.”

Messrs. Ozanne and Francis pointed out the great difficulty of getting correct formulæ for the division of mixed crops for areas so large as districts; the former urging that the attempt to improve crop statistics by general formulæ would not give such good results as the present system of leaving the estimation to the patwaris.

36. Resolved:

That the system proposed in the Government of India Circular Nos 50—80, dated 16th August 1893, should be recommended; that no mixtures should be shown as such in the returns sent to the Central Provincial office, that in district returns they should be divided into their constituent parts either initially by the village officers or subsequently by the district staff in such methods as may be arranged on the advice of the Director of Agriculture.

(X) AGRICULTURAL DEPARTMENT REPORTS.

37. The next question brought forward was the form in which the reports of the Departments of Land Records and Agriculture should be prepared. Circulars of the Government of India, No. 54 A, dated 28th April 1884, and No. 52 G. of 14th September 1887 were read.

The President stated that the principle laid down in the latter of the Circulars was the following:—

“ The report consists of two main divisions—Land Records and Agriculture—and is designed to show the executive work of the Department, not to comprise discussions on administrative measures, or to contain any description or summary of the economic or agricultural circumstances of the season. The Local Government may, however, require information of this kind to be submitted by the Department to the chief revenue authorities of the Province for utilization in preparing the Land Revenue Administration Report, and may prefer that for that purpose it should be included in the Land Record Section of the Departmental Report, rather than be submitted by independent communication. There will be no objection to this course. But there seems to be no reason why statistical statements concerning crops, irrigation, tenures, etc., should find a place in the report of the Department as well as in the Annual Land Revenue Administration Report, to which latter they should, in the opinion of His Excellency in Council, be confined. The Agricultural Section of the Departmental Report should be restricted to an account of the executive operations of the Departmental officers, and to a brief description of, or reference to, any results of special interest which may have been obtained during the preceding 12 months, whether in farms, gardens, Government estates or otherwise, but should avoid lengthy discussions on agricultural subjects and need not contain any detailed examination of the working of gardens, farms, or other agricultural institutions, which should be dealt with in the departments by orders on the Annual Reports.”

The object of the above orders was to ensure that the Director should in each Province write (1) a part of, or an appendix to, the Provincial Revenue Report, and (2) a separate report on his own Department, which should be confined to an account of the work done by the Department during the year.

It was ascertained that this was the procedure followed in the Central Provinces, North-West Provinces and Punjab: in Bengal the Director only wrote his own departmental report, and did not contribute to the Revenue re-

Agricultural
Department
Reports

port : in Assam the Director wrote the whole Revenue Report : in Madras the Director, being on the Board, did not write a separate report : in Bombay the procedure was at present under discussion. *Mr. Macpherson* was anxious that the Director in Bengal should be allowed to prepare a separate report, which should include not only his own departmental history, but also a review of the agricultural statistics of the year. The Conference considered that the matter was one which should be dealt with independently of their proceedings.

38. Resolved :

That the Conference approve generally of the principles laid down, in the Government of India Circulars Nos. 54A., dated 28th April 1884, and 52G., 14th September 1887.

39. The question was then discussed whether the headings of the reports should not be altered so as to conform generally with those of *Dr. Voelcker's* report.

Resolved :

*That the Government of India be invited to make suggestions on this subject, and that at any future Conference at which *Dr. Voelcker's* recommendations might be gone into in greater detail, the headings of the reports should be definitely revised.*

(xi) PRICE STATEMENTS.

40. The next matter discussed was the system recently introduced in Bombay for the inspection and improvement of the Price Statements required by the Military Department for Commissariat purposes or as the basis for compensation for Native Troops for dearness of provisions and fodder.

41. After the members of the Conference had described the system in force in each Province of ascertaining and publishing prices, it was resolved :—

(1) That so far as Military requirements were concerned, it seemed desirable that the Military Department should itself take steps by Committees or otherwise, to ascertain correct prices of articles in the price of which they are interested.

(2) That the system under which certificates of prices are furnished by the District Officers to the Military authorities for other purposes than determining compensation for dearness of provisions and fodder should be abolished.

(3) That the fortnightly price returns are required by District officers mainly for assessment purposes ; that for these purposes they are sufficiently accurate ; that the appointment of inspectors even at the cost of the Military Department to see after the correctness of some or all of these returns is unnecessary, and that the existing agency for the preparation and inspection of these returns is sufficient, if properly worked.

42. *Mr. Macpherson* and *Mr. Ozanne* dissented, being of opinion that inspection by special officers would be useful for purposes of general administration. The latter was further of opinion that, inasmuch as the Military Department is bound by the Regulations to accept the prices current reported by the Civil Departments, it is the duty of the Civil Departments to take measures to secure their correctness, and that the measures taken in Bombay have not only succeeded in fulfilling that duty with great advantage to Government, but at the same time have secured a marked improvement in the accuracy of the Imperial Fortnightly Prices-current with which the Administration is closely concerned. In Bombay prices for the purposes of settlement are provided for by the taluka price registers, but the check exercised by the Price Inspectors indirectly operates as a check on the taluka price returns. Therefore the system under discussion not only meets the wants of the Military Department, but materially improves the standard of correctness in prices collected for administrative and settlement purposes.

43. Memorials from certain associations in the Central Provinces regarding the insufficiency of cattle in India were laid before the Conference, but no resolution was passed on the subject. Suggestions were also offered by *Captain Chapman* on the same subject the following day. It was considered sufficient for the present that a Veterinary department had recently been established which would in due course deal with this subject.

Fifth Meeting, Friday, the 6th October 1893.

(xii) EDUCATION IN CONNECTION WITH AGRICULTURE.

44. The following papers on this subject were read :—

(1) the conclusions and recommendations made by Dr. Voelcker in paragraphs 527 and 528 of his report, *viz.* :—

Conclusions.

"527. The spread of education will be an important element in the improvement of agriculture. It will do much to remove the prejudices attaching to 'caste' and custom, which prevent progress in agricultural methods, and it will give rise to a more intelligent farming class.

"In a country where, as in India, agriculture is the chief employment, agricultural education especially should be encouraged. Until lately the tendency of education has been in a purely literary direction, and has turned attention away from the land rather than towards it; the fault can now be best remedied by substituting agricultural education for a part of the present educational programme. The work must proceed simultaneously from above downwards, and from below upwards. Elementary instruction should be given in primary schools by means of 'Readers' and 'Object Lessons' which introduce familiar agricultural subjects. In middle schools the elements of physical science, the use of agricultural primers, accompanied by *Illustration Plots* on which the ordinary farm crops are grown, should form part of the instruction. In high schools more attention should be given to physical science and to agriculture, and *Illustration Farms* or fields should be attached to the schools. Agricultural classes should be established where colleges or institutions that especially teach agriculture do not exist, and these should have *Demonstration Farms* attached, and land on which the pupils can themselves work.

"Special attention should be directed to the Agricultural education given in colleges, in order that the teachers supplied to high schools and to agricultural classes may be well-trained men, and that the Land Revenue, Agricultural, and cognate departments may be supplied with subordinate officials who have studied agriculture, both theoretically and practically.

"I do not consider it advisable to establish special agricultural colleges, but I think that it would be better to utilise existing colleges of science and to form agricultural branches at them. Universities should encourage the study of agriculture by making agriculture an optional subject in the course for a degree, and the claims of men who have passed in agriculture should be fully recognised for appointments in the Revenue and cognate departments.

There is great need of agricultural text-books suited to the circumstances of the different parts of India, and these should be in the vernacular, as well as in English.

Recommendations.

"528 That general education be extended among the agricultural classes.

"That agricultural education form a part of the general educational system, and be introduced as a prominent subject in the schools of the country.

"That text-books on agriculture, adapted to the different parts of the country, be prepared as early as possible.

"That encouragement be given [to the higher study of agriculture by recognising more fully the claims of men who have passed in scientific agriculture for appointments in the Land Revenue and cognate departments."

(2) the Resolutions passed at the Fifth Meeting of the Agricultural Conference of 1890, *viz.* :—

Resolution I.—That in considering the question of agricultural education and progress, the Conference desire to express the opinion that it is most desirable to extend primary education among the agricultural classes.

Resolution II.—That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend *exclusively* on separate special institutions.

Resolution III.—That it is most desirable that the Universities should recognize the Science of Agriculture as an optional subject in the course for a degree.

Resolution IV.—That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with the view of creating more interest in agricultural improvement amongst the cultivating classes.

Resolution V.—That, in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and "Readers."

Resolution VI.—That it is highly desirable that the claims of men trained in scientific agriculture to appointments in the Revenue and cognate departments should be as freely recognized as those of men trained in Law, Arts, and Engineering.

Resolution VII—That where appointments in the Revenue or cognate departments are made on the result of competitive examinations, Scientific Agriculture should be included as an optional or necessary subject in the examination course. *Education in connection with Agriculture—contd.*

Resolution VIII.—That in any province in which it may be determined to introduce a scheme for higher agricultural education, no arrangements will be satisfactory which do not provide (1) for a thoroughly practical training of the students in the field and laboratory as distinct from theory or practice as taught in the lecture-room, and (2) for examination tests of a special and searching character in the above branches of work.

(3) a note by the President on Agricultural education (see Appendix III, page 46)—

It was explained that this note was prepared in order to place before the Home Department of the Government of India the general views of the Revenue and Agricultural Department on the subject for such use as the Home Department might be able to make of it in the quinquennial review of education to be shortly published: and the Conference was asked to formulate suggestions which might be communicated with a similar object. The note advocated a system of early training which should neither be purely literary nor purely technical, but should teach from surrounding objects and by means of maps, books, etc., which treat of surrounding objects. It pointed out, moreover, the benefit to agriculturists and others of an acquaintance with land-records and land-maps remarked on proper training of teachers: and suggested the deferment of ambitious schemes of higher education until the agricultural classes were better able to adopt the discoveries of a high class of science. The note at the same time recommended the appointment in each province of a Committee (with which the Agricultural Department should be associated) to consider the reforms which should be effected in the system of rural education.

45. By way of supplement to the above-mentioned note, the *President* brought forward the necessity for the encouragement by the Universities of education useful to agricultural interests, and *Mr. Nicholson* drew attention to the proposal recently made by *Mr. Grigg*, Director of Public Instruction, Madras, that degrees in science and in agriculture should be established and should be opened to students who have passed the F.A. Examination. An account was given of the technical examinations in force in Madras, which was followed by a discussion regarding the necessity for holding out to successful graduates an opportunity of obtaining employment under Government.

46. *Mr. Macpherson* then drew attention to the unnecessarily difficult language of agricultural primers: and *Mr. Fuller* to the same defect in Indian Readers generally.* *Mr. Wilson* pointed out that in the Punjab the strangeness of the language was aggravated by the strangeness of the character in which it was written.

47. *Mr. Francis* emphasized the necessity for a high-class education in order to provide teachers, and the *President* explained that such education was not inconsistent with his note above-mentioned. The question whether teachers would be able to teach from gardens was then raised by *Mr. Middleton*, who also discussed the question of agricultural education generally, and read a paper on the subject (see Appendix III, page 46).

48. A copy of an address made by *Mr. G. V. Joshi* on agricultural education before the Poona Industrial Conference of 1893 was put in by *Mr. Ozanne*, without expression of his concurrence, and a copy of a note on the same subject by *Mr. Tute*, Collector of Dinajpur, Bengal, was put in by *Mr. Macpherson*. These are reproduced in Appendix III, pages 50 to 61.

49. It was not considered necessary that *Dr. Voelcker's* "Conclusions" should be adopted finally by the Conference, in view of the circumstance that they would be disowned by the Provincial Committees suggested in the *President's* note and in the *Resolution No. 12* quoted below. *Dr. Voelcker's* "Recommendations" were held to be included in the resolutions passed at the fifth meeting of the Conference of 1890. These resolutions were, after some discussion, accepted as they stood, and four additional resolutions passed. The resolutions of the Conference were therefore:—

(1) That in considering the question of agricultural education and progress, the Conference desire to express the opinion that it is most desirable to extend primary education among the agricultural classes.

(2) That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend exclusively on separate special institutions.

* See his note at page 61 in Appendix III.

Education in
connection with
Agriculture—contd.

(3) That it is most desirable that the Universities should recognize the Science of Agriculture as an optional subject in the course for a degree.

(4) That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with the view of creating more interest in agricultural improvement amongst the cultivating classes.

(5) That in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and "Readers."

(6) That it is highly desirable that the claims of men trained in scientific agriculture to appointments in the Revenue and cognate departments should be as freely recognised as those of men trained in Law, Arts, and Engineering.

(7) That where appointments in the Revenue or cognate departments are made on the result of the competitive examinations, Scientific Agriculture should be included as an optional or necessary subject in the examination course.

(8) That in any province in which it may be determined to introduce a scheme for higher agricultural education, no arrangements will be satisfactory which do not provide (1) for a thoroughly practical training of the students in the field and laboratory as distinct from theory or practice as taught in the lecture-room, and (2) for examination tests of a special and searching character in the above branches of work.

(9) That, in the opinion of the Conference, education in the lower schools should be of such a practical character as to fit the pupils for technical pursuits, including agriculture, as well as for literary and commercial pursuits.

(10) That the text-books used in schools should be written in the simplest language ordinarily understood by the people, and should be descriptive of subjects with which they are familiar, also, that the use of pictorial lesson charts, illustrating familiar objects, should be encouraged.

(11) That the system of training in normal schools should be adapted to qualify school teachers to give instruction of the character indicated in Resolution 8.

(12) That in each province a Committee, in which agricultural officers should be included, should be convened at an early date for the consideration of the questions raised in the preceding resolutions.

(xiii) RULES FOR THE ORGANIZATION OF THE SUBORDINATE CIVIL VETERINARY ESTABLISHMENTS.

Subordinate Civil
Veterinary
Establishments.

50. The rules proposed by a Conference of Veterinary Officers were read, and the Conference agreed that the rules might be submitted in their present form before the Local Governments for consideration. It was agreed that the first class Diploma should not be given unless the curriculum is extended to cover a 4-year course, that in rule 7 the words 'Veterinary graduate' be changed to 'Senior Veterinary Assistant:' and that the rules of pay proposed should be allowed to stand over for consideration by Local Governments, with the addition of a proviso to paragraph 7 as follows:—"Provided that nothing shall prevent a Senior Veterinary Assistant from being appointed to the post of Veterinary Assistant."

(xiv) SUGGESTION TO TAX UNCASTRATED HORSES.

Taxing uncastrated
horses

51. This was a suggestion made by the Inspector General, Civil Veterinary Department, in his letter No. 241, dated 24th July 1893, to the Government of India. The Conference were of opinion that the proposal had better not be put forward at present. The castration of horses and ponies was a measure not unlikely to give rise to difficulties and discontent, and to the danger of unduly diminishing the number of animals in the country. It would be advisable in the first instance to extend considerably the number of good stallions before taking up the question of reducing the number of inferior stallions. It would therefore be desirable to postpone the question until Veterinary Departments had settled down to their work and had done a good deal more in the direction of providing a better class of sires.

Sixth Meeting, Saturday, 7th October 1893.

(xv) DR. VOELCKER'S RECOMMENDATIONS.

Dr. Voelcker's
Recommendations.

52. The recommendations of Dr. Voelcker recorded at the end of each chapter of his report were read and discussed *seriatim*.

53. The opinion of the Conference as to the action which should be taken in respect to each recommendation is briefly noted below. Dr. Voelcker's
Recommendations—
contd.

The recommendations were divided into five classes:—

- I.—Those which have been or are being taken up independently of the proceedings of this Conference.
- II.—Those which are taken up in the proceedings of the Conference.
- III.—Those which are already taken up by the Conference, but require special attention to be paid to them.
- IV.—Matters not taken up but requiring attention.
- V.—Matters on which future action may be postponed.

54. The opinion of the Conference is in many cases sufficiently indicated by the class in which the recommendation is placed.

- 1. *The spread of general and agricultural education.*—Class II. Chapter II,
para 22,
- 2. *The establishment of an organised system of Agricultural Enquiry.*—
Class II. " "
- 3. *The active prosecution of positive measures already ascertained to be beneficial, and their further encouragement by the State.*—Class II. "
- 4. *The desirability of extending General and Agricultural Education.*—
Class II. Chapter III,
para 31,

These, *i.e.*, recommendations 1 to 4, are sufficiently dealt with in the proceedings of the Conference.

5. *The extension of canals and other means of irrigation to the drier tracts.*—Sufficiently dealt with by the Public Works Department.—Class I. Chapter IV,
para 43,

6. *The establishment, wherever possible, of "Fuel and Fodder Reserves."*—
Class I.—Sufficiently dealt with by Government of India Resolution No. 16A.,
dated 1st March 1883. "

7. *The increase of plantations along canal banks and railway lines.*—
Class V.—May be postponed. "

8. *The spread of arboriculture.*—It was considered that, although roadside arboriculture was sufficiently attended to, more attention should be given to village arboriculture,—*e.g.*, the extension of tree-planting in fields and available plots of land through the agency of landowners and ryots. This was considered important by nearly every member of the Conference. It was suggested that the Irrigation Department should facilitate tree-planting of this kind by allowing lower rates.—Class III. "

9. *The instituting of enquiry by Agricultural Departments as to where the above measures are needed, and how they may best be carried out.*—This comes under the head of District Analysis, but needs early attention and investigation.—Class III.

10. *The increase, by means of irrigation, of the water-supply to dry tracts.*—
—Class I. Chapter V,
para 80

11. *The increase of the manure-supply to the soil.*—Class II.—This must await the investigations of the Agricultural Chemist. "

12. *The instituting of enquiry to ascertain where such measures are needed and can be carried out.*—Class III. "

13. *The continuation of experimental research aided by Chemical Science.*—Class II. "

14. *The extension of canals and other means of irrigation to districts which are in need of them.*—Class I. Chapter VI,
para 115.

15. *The encouragement of minor works of irrigation by rendering the system of taccavi advances more popular.*—Class IV.

16. *The giving to Agricultural Departments of a share in the administration of taccavi advances.*—Class IV.

The encouragement of minor irrigation works by making advances more popular was considered most desirable. It was represented that a stronger guarantee was required that the money required for advances would be forthcoming when necessary, and it was also suggested that private money would be

forthcoming if a guarantee of security could be obtained. Mr. Nicholson advocated the loan of funds for distribution to local credit associations—of which there were already 135 in the Madras Presidency—on the condition that the loans should be supplemented by, say, 50 per cent. contributed by the associations.

On the second question Mr. Ozanne drew special attention to the following extract from paragraph 113 of Dr. Voelcker's report:—

"In the last place, I am strongly of opinion that some share in the administration of *taccavi* advances should be put in the hands of the Provincial Agricultural Departments. It would clearly be unwise to make any step which would bring about collision between the existing Revenue Authorities and the Agricultural Departments, and, therefore, the control and disbursement of *taccavi* advances could hardly be entrusted to the Provincial Directors of Agriculture. But at the same time the Director of Agriculture is the person who should best know the agricultural needs of his province, and he should be enjoined to give his special attention to the extended working of the *taccavi* system. Further, he should be empowered to advise the Revenue Authorities generally, and to report on specific cases, either of special need or of non-observance, in the application of the funds which have been granted."

Mr. Fuller recommended that a special staff should be employed and paid from the *Taccavi* fund to keep the accounts and so do away with the main obstacle now in the way of free grants of loans. Mr. Ozanne stated that the system was already pursued in some districts of Bombay. Mr. Nicholson understood that this subject had been taken up by the Madras Government, and other members of the Conference considered that it should be pressed. A suggestion by the Assam and Central Provinces delegates that a commission should be given to native officials distributing advances did not commend itself to other members.

Mr. Fuller strongly advocated the closer connection of the Agricultural Department with the system of advances, and recommended that the subject should find a special place in the annual report of the Department. The Conference agreed with this view on the understanding that the distribution of advances by district officers was not interfered with, and considered that the responsibility should be placed on the Director of bringing to the notice of Commissioners and District Officers, under such rules as the Local Governments might issue, the tracts in which agricultural advances might be usefully distributed, and the objects for which they were required.

Chapter VI,
para. 116.

17. *The prosecution of agricultural enquiry in order to ascertain the requirements of each district in respect of irrigation.*—Class IV.

Chapter VII,
para. 155.

18. *The establishment of "fuel and fodder reserves" for the primary purpose of supplying wood to take the place of cow-dung as fuel.*—Class IV.

19. *The inauguration of a system of agricultural enquiry, to ascertain the manurial facilities and requirements of each part of the country.*—Class III.—This is covered by the scheme of district analysis, but requires the special attention of Agricultural Departments in consultation with the Agricultural Chemist.

20. *The spread of agricultural education, to assist in teaching the value of better practices, and to break down prejudices.*—Class II.

21. *The employment of experimental farms, for the purpose of showing how manurial resources can be best used and conserved, and for demonstrating the value of, and extending, the better practices of other parts.*—Class II.

22. *The employment of an Agricultural Chemist to assist in utilizing existing manurial resources to best purpose, in discovering fresh ones, and in the solution of agricultural problems.*—Class II.

Chapter VIII,
para. 198.

23. *The creation of fresh "Reserves" of wood, fuel, etc. ("Fuel and Fodder reserves") primarily for agricultural purposes.*—Class I.—This comes under Class I and is partly dealt with in recommendation No. 6, but the Conference considered that more attention should be paid to the utilization of forests for agricultural purposes.

24. *The increase of plantations along canal banks, railway lines, etc.*—Class V.—This has been dealt with under recommendation No. 7 and may be postponed.

25. *The further encouragement of Arboriculture.*—Class III.

This has been dealt with in recommendation No. 8. It comes under the head of District Analysis. The Conference considered that the Directors should be made specially responsible for carrying out the enquiry recommended by Dr. Voelcker.

Dr Voelcker's
Recommendations
—contd—
Chap VIII,
para. 198

26. *The establishment of agricultural enquiry to ascertain the requirements of each cultivating district in the matter of wood-supply.*—Class III.

27. *The setting aside yearly of a portion of the Forest Revenue, to be applied to the extension of "fuel and fodder reserves" to meet agricultural needs*—Class V.

28. *The creation of more "fuel and fodder reserves" in order to supply grass for agricultural purposes, and also grazing where it can be permitted under proper restrictions*—Class I.—Mr. Wilson suggested that more might be done in the direction of establishing close seasons for grazing. Mr. Fuller noticed that the limitation of the number of cattle having access to grazing areas was important.

Chapter IX,
para. 238

29. *The extension of grass farms, and their management by a special Forage Branch of the Commissariat*—Class I.

30. *The carrying out of investigations at Government Experimental Farms on the best methods of making silage.*—Class V.

31. *The extension, wherever practicable, of the systems of growing fodder-crops, and of hedging or otherwise enclosing fields, more specially in parts where no pasturage exists or where it is very scarce.*—Class V.

Chapter X,
para. 244

32. *The employment of an Agricultural Chemist for India to investigate, among other matters, the comparative values of different Indian Fodders*—Class III. The subject was one to which the attention of the Agricultural Chemist should be brought.

"

33. *The continuance and extension of cattle-breeding farms and the distribution from them to villages, through Government agency, of stud bulls suitable for improving the agricultural cattle of the country.*—Class V.

Chapter XI,
para. 275

34. *The making Experimental Farms and Court of Wards' Estates centres for the location of stud bulls.*—Class V.

"

35. *The establishment of Dairy Farms for the supply of Milk to Troops and Government Institutions.*—Class I.—It was understood that the Military Department had taken sufficient action in connection with promotion of dairies for the supply of milk to troops, but the Conference considered that it would be very desirable that an expert should be continued to be employed under Agricultural Departments for the promotion of Dairy Farms, and suggested that Local Governments should be invited to share in the expenditure and to cooperate in utilizing the services of an expert for purposes of inspection and instruction.

"

Mr. Ozanne, quoting from Mr. Mollison, did not agree with Dr Voelcker's remark that there is a limited space for improvement in dairies, and promised to write further on this subject when the papers were circulated. His note will be found in Appendix III, page 62

36. *The appointment of an Agricultural Chemist to investigate matters connected with Dairy Farming.*—Class III.

"

37. *The prosecution of enquiry into cattle diseases and into the means of preventing cattle epidemics*—Class I.

"

38. *The exhaustive trial of new implements at Government Experimental Farms.*—Class I.

Chapter XII,
para. 298

39. *The association in trials of implements of men specially skilled in the respective sciences concerned in the enquiry.*—Class V.

40. *The distribution of approved implements from Government Farms and the utilization of Agricultural Shows for demonstrating the working of such implements.*—Class V.

41. *The continuation of experimental enquiry at Government Farms in regard to selection and change of seed, growth of new varieties of crops and of*

Chapter XIII,
para. 322

Dr. Voelcker's
Recommendations
—contd.

crops altogether new, methods of cultivation, etc.—Class II.—Mr. Francis urged that the enquiries referred to should not be confined to Government Farms, but be worked out also on cultivators' fields and private lands. The Conference agreed.

Chapter XIII,
para. 322

42. *The establishment of seed farms under Provincial Agricultural Departments for providing good seed for the various districts; and the giving of facilities and encouragement for the purchase of seed from these farms by the cultivators.*—Class IV.—The Conference considered that very careful experiment was needed in order to prove what is really good seed for each locality; the subject was one in which early and careful enquiry was required. No attempt is usually made by cultivators to retain good seed. Mr. Nicholson stated that experience in Madras indicated a difficulty, *viz.*, that good seed deteriorated very rapidly on account of defective agricultural practice. Mr. Francis suggested that the system proposed by Dr. Voelcker should be expanded, and that good seed should be obtained by purchase from other parts of the country, and that large landowners should be induced to make experiments for the purpose for determining what was the best seed for the locality.

43. *The pursuit of the study of diseases and injuries of crops.*—Classes I and V.—The investigation of insect pests is being carried on under the direction of Mr. Cotes of the Indian Museum. The Conference agreed that it would be very desirable that Mr. Cotes should be placed in personal communication with Directors and inspect the crops injured by insect pests on the ground. The investigation of other diseases of crops must await further opportunities.

44. *The organization of a system of agricultural enquiry for the purpose of obtaining a thorough knowledge of present agricultural methods and for the transference of better methods to districts where inferior ones prevail.*—Class II.—Mr. Wilson strongly recommended the Court of Wards' Estates for the purpose of Agricultural Enquiry as they now are. He did not refer to trying experiments at the expense of Courts of Wards, but only to the conduct of enquiries on the Estates in view of the fact that statistical results can be obtained on them of a more satisfactory character than on other lands. He had already utilized a Court of Wards' Estate for this purpose with, he believed, success, and promised a note on the subject which will be found in Appendix III, pages 63-64. Mr. Francis said that we should have to wait for our Agricultural experts as investigating agents before we could expect to carry out this plan systematically. Otherwise the Conference agreed.

Chapter XIV,
para. 391.

45 (a) *The setting on foot of enquiry by Agricultural Departments in order to ascertain the best methods of cultivation and manufacture of crops, such as sugarcane, indigo, tea, coffee, tobacco, etc., and (b) the endeavour by demonstrating these methods to extend the cultivation and increase the outturn.*—(a) Class II and (b) Class V.

"

46. *The employment of Chemical Science in the investigation of problems affecting these industries, and more particularly that of an Agricultural Chemist in connection with the sugar industry.*—Class V.

"

47. *The making it a penal offence to adulterate wheat, or to export or trade in adulterated wheat.*—Class V.

Chapter XVI,
para. 413

48. *That a definite system of organized enquiry into agricultural conditions and practices be instituted forthwith.*—Class II.

"

49. *That a Permanent Agency be established for this purpose, and consist of the association with the Director of the Department of Land Records and Agriculture of an Assistant or Assistants who are trained experts in Agriculture.*—Class II.

"

50. *That such experts be, by preference, Natives of India, and be trained in the country itself.*—Class II.

"

51. *That high-class Agricultural Education be provided in India so as to train the men who are to become Agricultural experts.*—Class II.

Chapter
XVII,
para. 438.

52. *That an Agricultural Chemist be appointed for India, to act as adviser to Government in chemico-agricultural matters, to carry out investigation and to direct Experimental Enquiry.*—Class I.

53. *That an Assistant Chemist be appointed to act under the above officer and to teach Agricultural Chemistry.*—Class I. Dr. Voelcker's
Recommendations
—contd

54. *That to the Agricultural Department should be attached other scientific officers, such as a Botanist, an Entomologist, and an Agricultural Engineer for the purposes of Agricultural Enquiry.*—Class III. Chapter
XVII,
para 438

55. *That agricultural enquiry be continued by means of Experimental Farms.*—Class II. Chapter
XVIII,
para 497.

56. *That distribution of selected seed and location of stud bulls be undertaken by Experimental Farms, as also the breeding of farm stock, where circumstances are favourable.*—Class II.

57. *That Demonstration Farms be instituted in connection with Experimental Farms in order to set out the results of successful enquiry.*—Class V.

58. *That General Education be extended among the Agricultural classes.*—Class II. Chapter XIX,
para. 536.

59. *That Agricultural Education form a part of the general educational system, and be introduced as a prominent subject in the schools of the country.*—Class II.

60. *That text-books on Agriculture, adapted to the different parts of the country, be prepared as early as possible.*—Class II.

61. *That encouragement be given to the higher study of Agriculture by recognising more fully the claims of men who have passed in scientific agriculture, for appointments in the Land Revenue and cognate Departments.*—Class II.

Mr. Wilson promised a note (*vide* Appendix III, page 64) on the desirability of prescribing Agriculture as a subject in patwaris' examinations.

62. *That more weight be given to Natural Science in the open competitions for the Civil Service, and at the final examination of probationers.*—Class I.—The Conference considered that it would be unadvisable to make any suggestions in support of this recommendation. They were not sure that the subject had not been sufficiently considered by the Civil Service Commissioners. Chapter XX,
para 546

63. *That a certain proportion of junior Civilians, on arrival in India, be drafted into Departments of Land Records and Agriculture.*—Class IV.—This proposal had been to some extent met by the action taken in various Provinces, but required in the opinion of the Conference to be more definitely taken up. Mr. Fuller advised that every junior Civilian should be required to go through a course of instruction either under a Settlement officer or under the Director of Land Records. The Conference were of opinion that the question should be brought to the notice of Local Governments and Administrations; and the members promised to submit notes on the existing practice in their respective Provinces with recommendations for the future. Their notes will be found in Appendix III, pages 65 to 69.

64. *That Agricultural Directors be chosen from those men who have distinguished themselves in Natural Science, and subsequently by their interest in Agriculture.*—Class IV.—It was the opinion of the Conference that, in selecting a Director of the Department, consideration was generally given to the qualifications suggested by Dr. Voelcker. They considered, however, that the recommendation made by Dr. Voelcker might be usefully brought to the notice of Local Governments.

65. *That Agricultural Directors be given some administrative powers, and that a share in the management of Loans for Agricultural Improvement be entrusted to Agricultural Departments.*—Class II.—Dealt with under recommendation 16.

66. *That a considerably increased amount of money be placed at the disposal of Agricultural Departments for expenditure upon Agricultural Improvement.*—The Conference were not prepared to make any definite suggestion under this recommendation in view of the present financial difficulties. They were, however, of opinion that the importance to the public exchequer of promoting agricultural improvement was too little regarded by our administrations. The revenues of the empire must in the future, even more than in the past, depend upon the land-revenue, which in its turn depended greatly upon the "efficiency

*Dr Voelcker's
Recommendations
—contd.*

of agricultural operations." This view was strongly urged when the Departments of Agriculture were created, in the Imperial Resolution of December 1881, and they considered that it should again be impressed upon Local Governments and Administrations, who should be advised, they thought, to bear it in mind when dealing with those recommendations of Dr Voelcker which were supported by the Conference. In most cases it was not necessary, for the purposes suggested, to place money in the hands of the Agricultural Directors. It would be sufficient that the advice of the Directors should receive careful and attentive consideration. Under the policy recommended at the present Conference, money would be chiefly required for purposes of Education, and for the conduct of agricultural enquiry and experiment; and much could be done in these directions without any excessive demands upon the budget. In connection with Education especially, expenditure would be reduced to a minimum if the policy be carried out of admitting more freely to official appointments, students who had successfully passed an academical course in physical sciences and agriculture.

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APPENDIX I.

Resolution No. 34, dated 22nd June 1893, convening the Conference.

The Government of India have now received copies of the report prepared by Dr. Voelker, who was deputed in 1889-90 to investigate the conditions of agriculture in India, and the opportunity is taken in circulating them to Local Governments and Administrations to explain the position which the report occupies in the development of the scheme undertaken in 1880-81 for agricultural enquiry and improvement. *Resolution convening the Conference.*

2. One of the chief recommendations made in the report of the Famine Commission in 1880 was the formation of Agricultural Departments, of which the ultimate aim was to be the improvement of Indian agriculture. In 1881, the Imperial Department of Revenue and Agriculture was created for the purpose of directing the policy to be followed in carrying out the Famine Commission's recommendations; and in December of that year a Resolution was issued No 6-340 350-G, dated the 8th December 1881. The Resolution commenced by explaining that before any attempt could be made to improve the agriculture of the country, it was necessary to enquire into, and collect information regarding, the agricultural conditions in each province.

3. The first step to be taken in this direction was to organize the land-record establishments, and during the twelve years which have since elapsed, these establishments have in most provinces been brought into fair working order, so that they can now be utilized for the collection of facts and statistics.

4. Another measure was to constitute a system of scientific enquiry by means of experts in those branches of investigation which were beyond the scope of the ordinary establishments. With this object there have been successively established the office of Reporter on Economic Products and the Civil Veterinary and Bacteriological Departments. The Departments of Meteorology and Geology already existed, but the attention of both has been called more distinctly than before to the work of practical investigation. At the same time the Trustees of the Indian Museum have consented to carry out through their staff enquiries connected with Economic Entomology and Zoology; while the Botanical Survey, previously restricted to three Provinces, has been extended over the whole of India.

5. None of these departments or institutions, however, were connected with agriculture proper, and from 1882 to 1888 representations were made to the Secretary of State that the scheme of enquiry could not be completed without an agricultural expert, who should organize and develop a system of agricultural investigation in those directions in which scientific control was wanted. In 1889 Dr. Voelker was sent out to India by the Secretary of State—"to advise on the best course to be adopted in order to apply the teachings of Agricultural Chemistry and in order to effect improvements in Indian agriculture." Dr. Voelker's preliminary recommendations led to the appointment, in October last, of an Agricultural Chemist, who, with the aid of a laboratory Assistant, appointed at the same time to teach in the Forest School at Dehra, will take the position of the expert asked for by the Government of India.

His duties will be necessarily concerned with a larger field than that implied by the term "Agricultural Chemistry," and it is one of the objects of the present Resolution to indicate to some extent what the duties and functions of the Agricultural Chemist will be.

6. In the detailed report now submitted Dr. Voelker makes numerous recommendations in the direction of agricultural improvement and reform, many of which cover the same ground as those of the Famine Commission. His suggestions come indeed mainly within the scope of the programme set out in the Resolution of 1881, to the principles of which the Government of India still adhere as forming the basis of the scheme of agricultural enquiry and improvement; and, although his suggestions point, as did the Resolution of 1881, to the ultimate establishment of positive measures for improvement, they do so with the same proviso that "before any real improvements can be effected in agriculture the institution of organized enquiry into existing methods is absolutely necessary." The Government of India desire, therefore, that for the present the main duty of the Agricultural Chemist should be to take his place in the scheme of enquiry rather than to institute what may prove to be premature efforts in the direction of agricultural improvement.

7. It will in the first place be necessary for the Provincial Departments of Agriculture to carry out more effectively than has hitherto been done, the instructions for establishing the system which in the Resolution of 1881 was briefly designated as "district analysis." This subject was discussed at the Agricultural Conference held in 1890 at Simla, but has not as yet been fully understood. The object of the scheme was to define with some precision, through the aid of the statistics collected by the land-records agency, the tracts in each district which are subject to failure, or, to use the words of the Resolution, in which the "agricultural operations of the country are liable for any reason to fall below the standard of full efficiency." When some progress has been made in a careful analysis of agricultural tracts, the expert will be usefully associated with the Agricultural Departments in investigating the causes of failure

See also Circular No. 55 E of the 8th May 1885.

Resolution concerning
the Conference—
contd.

and in suggesting the remedies to be applied. As soon as this stage has been reached, the greater number of those recommendations of the Famine Commission and Dr. Voelcker which deal with positive measures of remedy and improvement, will have to be taken under serious consideration; and, although it may be the case that in some directions enquiry has proceeded sufficiently far to justify immediate action, especially in tracts where agricultural depression is extreme, yet there is no doubt that in the main a considerable period must still be occupied in the preliminary work of investigation.

8. Another branch of enquiry is concerned with the existing methods and practices of agriculture throughout India. This will be entrusted primarily to the Agricultural Chemist. It will involve the collection and collation of facts and statistics contained in gazetteers, settlement reports, and other such sources of information, and will require both personal investigation in the field and continual communication with the officers of the Agricultural Departments.

9. The necessity of ascertaining by continuous and scientifically-directed trial on experimental farms what are the possibilities of improving existing methods was indicated in the Resolution of 1881, and measures have been taken in almost every province to establish farms for this purpose. The inspection of farms; the general direction of the system on which experiments are to be conducted; and the preservation of continuity in experiment will be further and important duties of the new officer.

10. The scheme of agricultural enquiry will also entail a systematic analysis of soils, water, manure, etc., in the laboratory, and these will be conducted by the Agricultural Chemist and the Assistant.

11. It will at the same time be essential that with the co-operation of the Educational Departments measures should be taken which will render the agricultural population capable of assimilating new ideas and of understanding any suggestions made to them, as time goes on, for the improvement of their agricultural methods; and which will qualify them to take that active part in the scheme of agricultural reform without which no effective results can be expected. The necessity of adapting the educational system to the requirements of the agricultural population was not dealt with in the Resolution of 1881. The Government of India, however, in the 25th paragraph of the Resolution on Education, issued by the Home Department in June 1888, recommended that this subject, among others, should in each province be brought under the consideration of a Committee. The question of agricultural education was also discussed in a valuable note submitted by Mr. F. A. Nicholson to the officers who reported in May 1889 on the Agricultural Department of the Madras Presidency. In that note Mr. Nicholson urged that in developing the efficiency of an Agricultural Department it would be necessary to consider "what means will render its operations more efficient by promoting the intelligence and receptivity of the ryot, by developing the agents rather than the mere methods of production, and by provoking them to take the initiative instead of waiting for an impulse *ab extra*."

12. The Government of India, while placing their views before Local Governments and Administrations, do not desire to communicate in any more precise form their instructions regarding Dr. Voelcker's report until they have had the opportunity of referring the questions raised to an Agricultural Conference, at which Local Governments and Administrations should be fitly represented. They have accordingly determined that a Conference shall be held at Simla on the 2nd of October next, for the purpose of considering the definite measures which should be suggested for adoption and of determining the part to be taken in them by the Agricultural Chemist. It is anticipated that the proceedings of the Conference will be brought to a conclusion within a week from the date on which they commence.

13. The special subjects to be brought under consideration at the Conference will be those mentioned in paragraphs 4 to 11 above, namely:—

- (i) the completion of the scheme of investigation by scientific experts (paragraph 4),
- (ii) the further development of "district analysis" (paragraph 7),
- (iii) the compilation of a gazetteer of existing agricultural methods (paragraph 8),
- (iv) the conduct of experimental farms (paragraph 9),
- (v) the system to be adopted in arranging for the analysis of soils, water, manure, etc. (paragraph 10),
- (vi) agricultural education (paragraph 11).

The opportunity will also be taken to consider, in consultation with the officers of the Civil Veterinary Department at head-quarters, the subjects of the prevention and cure of cattle-disease, and the further promotion of horse-breeding.

14. If any Local Government desires that other subjects dealt with in Dr. Voelcker's report should be specially discussed by the Agricultural Conference, the Government of India will be glad to make arrangements accordingly; but they are of opinion that the particular consideration of subjects other than those mentioned in the last paragraph may, generally speaking, be usefully deferred until further advance has been made in the direction of agricultural enquiry.

These instructions are not in any way intended to preclude the consideration by Agricultural Departments of matters connected with the improvement of agriculture in cases where urgent or early measures are called for, or to deprecate any action by Local Governments and Administrations which it may be deemed by them inexpedient to postpone. As at present

advised, the Government of India are disposed to believe that in cases of this kind the recommendations included in Dr. Voelcker's report will be found to be in general accord with the approved policy of the Provincial and Imperial Governments, and may properly be quoted in support of such measures as it may be thought necessary to adopt in the interests of agriculture without further delay. But they do not propose that the Conference now summoned should itself attempt to deal with those portions of Dr. Voelcker's report which are concerned with the final rather than the initial stages of the scheme.

*Resolution convening
the Conference—
contd.*

15. Local Governments are invited to depute to the Conference the Directors of the Agricultural Departments and any other officers whom it may be thought advisable to send, and to provide them with any instructions which it may be considered necessary to give in connection with their own views on the subjects to be discussed. In conclusion the Government of India desire that, they may be provided, before the 1st of September next, with the names of the officers delegated, as well as with a statement of subjects other than those named in paragraph 13 which it may be desired to have brought under discussion.

APPENDIX II.

The President's Opening Address.

The main object with which this Conference has been summoned is to frame, for the consideration of Local Governments, a general scheme for giving effect to Dr. Voelcker's recommendations. Dr. Voelcker's report, however, must be held to be subsidiary to the report and recommendations of the Famine Commissioners, and any measures proposed in pursuance of his suggestions must be brought into accordance with the policy adopted for carrying out their views and advice.

*President's Opening
Address.*

2. The Famine Commission itself was constituted at the instance of Parliament by the Secretary of State, who thus stated the general object which he had in view:—"It is evident," he wrote, "that the protection of the people of India from the effects of the uncertainty of the seasons will constitute in the future no inconsiderable portion of the work of the Government. It is therefore a duty to collect with the utmost care all information which may assist future administrators in the task of limiting the range or mitigating the intensity of these calamities."

As noted in the Famine Commissioners' report, the Government of India amplified the instructions conveyed in the Secretary of State's despatch; they urged the collection of information "how far local influences, peculiarities of administration or tenure, climate, soil, water, density of population, systems of cultivation, etc., have tended to mitigate or intensify the inevitable effects of famine." They required an examination of various systems of relief; they demanded an investigation as to the future protection by irrigation and forests; they called for an enquiry as to the possible improvement of agriculture under State encouragement; as to the extension of communications; and as to the organization of agricultural statistics.

3. It would be unprofitable to attempt in these prefatory remarks to follow the Famine Commissioners in their conscientious and careful investigation of the subjects committed to them for examination. I desire only to draw prominent attention to the fact that the policy of Agricultural Departments in India must continue to be based upon the requisitions of the special Commission appointed under orders from England, and that the public both in India and England have a right to know what that policy is and how it is carried out.

Questions put from time to time in Parliament indicate that doubts on the subject still exist. In one enquiry, to which a reply has recently been formulated, information has been demanded as to the extent to which the Famine Commissioners' recommendations have been carried out. In another it has been asked how far Dr. Voelcker's recommendations are covered by those of the Famine Commissioners, other enquiries have called for investigation in fields which are already under examination by Agricultural Departments in pursuance of the Famine Commissioners' suggestions and which concern in one way or another the condition of the agricultural population in India.

4. The Famine Commissioners themselves dealt, as far as they could, with most of the matters to which their attention was called, but they were obliged to admit that their time was too short, their data too incomplete, and their information too imperfect to enable them to arrive at safe conclusions on the greater number of the issues which they formulated. They closed their report with a demand that the Imperial and Agricultural Departments, of which they recommended the formation, should prosecute the enquiries which they had begun in such a way as to enable Imperial and Local Governments to decide on the measures necessary to secure the maximum agricultural prosperity of the country.

In 1881, with the sanction of the Secretary of State, an Imperial Department was formed with express instructions to arrange with Local Governments for the formation of an Agricultural Department in each Province. The main objects which, in pursuance of the recommendations of the Famine Commissioners, the Departments were to hold in view were broadly described by the Secretary of State in the following terms:—

Fuently.—More complete, and systematic ascertaining and rendering available of the statistics of vital, agricultural, and economic facts for every part of India,

*President's Opening
Address—contd.*

in order that Government and its officers may always be in possession of an adequate knowledge of the actual condition of the country, its population, and its resources.

Secondly.—The general improvement of Indian agriculture with the view of increasing the food supply and general resources of the people.

Thirdly.—Better and prompt organization of famine relief whenever the actual approach of famine may be indicated by the statistical information.

5. The Secretary of State's programme was accepted by the Government of India in the Resolution of 1881, in which, while the formation of Provincial Departments was directed, the objects before them were briefly summed up with reference to the Secretary of State's injunctions, as 'agricultural enquiry,' 'agricultural improvement,' and 'famine relief.' The last named of these three objects required the most urgent attention, and steps were therefore at once taken, while the Provincial Departments were being formed, to draw up codes regulating famine administration. These have been lately revised, and there is now reason to believe that the approach of scarcity is everywhere fully met by prompt measures for the protection of affected tracts, and that ample relief is ensured to all who may require it during any period of famine. The subject of famine relief need not, therefore, come under consideration at the present Conference, which will deal only with the subjects of agricultural enquiry and agricultural improvement.

6. Taking agricultural enquiry first, it may be noted that these two words cover an extensive field. They include a very large proportion of the requisitions made in their voluminous reports by the Famine Commissioners and Dr. Voelcker. The first step towards a sound scheme of agricultural enquiry was obviously to organize a machinery for collecting information. Fortunately in almost every Province this already existed in the village land-record establishments, which only needed to be properly trained and supervised in order to meet initial requirements. As urged by Sir Henry Durand in 1866, when agricultural departments were first proposed, "we are already in possession of a splendid local machinery in our local establishments closely connected with the operations of agriculture," and it was Lord Mayo himself who insisted that this should be "utilized in the collection and production of those Agricultural Statistics, and in the dissemination of knowledge, which are so essential to the development of agriculture."

7. Fortunately also the organization of the land-records establishments met an administrative need in providing a machinery which could be utilized in the assessment of land-revenue and in the maintenance of a record-of-rights, on a system which has resulted in an important saving of State expenditure, amounting to several lakhs of rupees per annum. The formation of the so-called Agricultural Departments has, therefore, resulted in a financial gain. Independently of future economies, it has been estimated that the Imperial and Provincial Departments have, by introducing an improved system of land-revenue administration, already saved something like 200 lakhs of rupees. An indirect financial advantage has also been secured both for the State and for the agricultural community by the simplification of the procedure in suits relating to land in consequence of the maintenance of a clear and fairly accurate record-of-rights. It is hoped, moreover, that the record-of-rights will as time goes on be recognized as the only record that need be maintained for registering transfers of rights and interests in land, thus enabling us to introduce into India the system of registration which Sir Henry Maine described "as the greatest legal discovery of the age," and which he contended could, if the village land-record establishments were properly organized, be adopted in India more easily than in any country in the world.

8. The land-record establishments have now been organized and trained in the majority of Indian Provinces. In Assam, Burma, the Punjab, the North-West and Central Provinces and in Madras the arrangements may be said to be fairly complete. In Bombay active measures have been taken in the same direction. In Bengal, difficulties, attributable to a long disuse of village establishments, have existed which it is hoped may be overcome, at any rate in Behar in connection with the survey. In one important Native State, Gwalior, the system has been introduced with much financial success, and there is reason to believe that the example will be followed in some other Native States.

9. I have on this occasion, as heretofore, dwelt upon the financial advantages resulting from the organization of the land-record machinery, without which no safe measures can be taken in pursuance of the Famine Commissioners' recommendations, because it is absolutely certain that the Agricultural Departments which the Famine Commissioners demanded would not have survived for a single decade if they had not been able to show that they paid their way. This danger I, for one, foresaw from the first, and it was signally proved in the requisition made by the Finance Commission appointed to reduce public expenditure that the Departments should, unless they could show that they were remunerative, be abolished. How the Famine Commissioners' scheme, as interpreted by the Secretary of State, could then have been carried out it is difficult to conjecture. The Departments, however, were in almost every case able to prove their financial value, and the Famine Commissioners' programme was thus saved. In these circumstances, no critic is justified in blaming them for the time and labour devoted to the organization and improvement of the land-record establishments, merely because the useful results due to their action are to some extent additional to those directly called for by the Famine Commissioners. The point is that the machinery utilized to

secure financial results is the very machinery wanted to provide the information and statistics demanded by the Commission. *President's Opening Address—contd.*

10. No one who has not been connected with the work appreciates the time and difficulty involved in bringing the village establishments up to the requisite standard of efficiency, and those who are disposed to impute to the Agricultural Departments undue delay in giving effect to the Famine Commissioners' requisitions ought to allow themselves an opportunity of examining the subject. Suffice it for the present to say that the number of petty officials who have had to be trained and taught to maintain the map and land records is not much less than 100,000, that when the work began a large proportion of them were imperfectly educated, while many of them were too old to be instructed and had to be gradually replaced by more competent successors. Also that something like 4,000 or 5,000 supervising officials had to be selected and trained in the duties of control. Even now the task is not completed."

11. The next step was to improve the system of village records in such a manner that they might serve both for purposes of revenue administration and for those which were indicated by the Famine Commissioners. This too has been accomplished almost everywhere by the Provincial authorities with the assistance of the new Departments, and the time has now come when, as anticipated in the Resolution of 1881, the records can be satisfactorily utilized for the purpose of effecting an analysis of the rural economy and condition of every agricultural tract. The system on which the analysis should be made was a question brought under discussion at the Agricultural Conference in 1890, but requires reconsideration in connection with Dr. Voelcker's report.

12. The Resolution of 1881 is quoted in the next paragraphs. The 'analysis' or investigation of agricultural tracts was intended to secure positive facts and precise statistics where the Famine Commissioners found only uncertain evidence and conjectural figures; to provide for our administration a solid groundwork of accurate and complete information; and to do away in the course of time with the loose assumptions and haphazard guesses which have led, or misled, so many well-intentioned reformers to the proposal of impossible schemes for the benefit of the agricultural population.

"India," wrote Sir John Strachey when the first Land-Record Department was founded, "is an agricultural country composed of a multiplicity of minute holdings, and almost every subject which we take in hand in connection with the administration of the country must be referred to the units of which it is formed. A measure which makes a very slight alteration in the condition of each unit may have a very important effect on the whole country, since what may be termed the atomic changes are combined by an enormous multiplier. It may seem a little thing to ensure the correct record of facts connected with a single field, but when we consider that the country is nothing but a *congeries* of single fields, the subject assumes an importance which is apt to be lost sight of in discussing the manipulation of a village register."

13. To return now to the scheme of agricultural analysis as defined in the Resolution of 1881. The programme was put forward in the following terms:—

"The chief duty of the Agricultural Department will be to deduce from the facts and figures supplied by the village records those conclusions or suggestions which the Famine Commissioners have shown to be necessary to the administration of a Province.

"8. In considering this part of the subject, it is necessary to point out that the agricultural inquiry should not be confined to the mere collection or collation of *statistics* in the ordinary acceptation of the term. An examination of the portion of the Famine Commissioners' report which deals with agricultural enquiry will show that, in recommending with reiterated force an intelligent system of investigation, their final object is to urge through its means, and as a practical outcome of its results, the policy of *maintaining agricultural operations at the highest attainable standard of efficiency*. The Government of India fully accepts this definition of a most important aim of agricultural enquiry. The maintenance of agricultural operations implies the full sustenance of agricultural labour and the complete provision of agricultural requirements, and in India this means that cultivators, their families and cattle, must be properly fed, and their need for labour, irrigating machinery, and agricultural implements adequately met. Now, insufficiency of food, as well as the deterioration or lack of mechanical appliances, must diminish the effectiveness of labour, and thereby reduce the produce of the country. If, therefore, through rack-renting or any unsuitable system of collecting rent, if from inability to obtain capital on reasonable terms, or if from accidents of season and other causes, the amount to produce becomes less than sufficient to provide the sustenance and appliances required by labour and land, it becomes the imperative duty of Government to ascertain whether any legitimate means can be provided to check the degradation of agriculture which must otherwise ensue. On the other hand, if by any means the efficiency of agricultural operations can be increased, a larger amount of produce will be available both for the support of labour and the provision of mechanical requirements, and also for the rest found from which the land-revenue of the country is derived. Thus, apart from any consideration of the suffering due to an inadequate food-supply, a great economic error is committed if the agricultural operations of the country are allowed to fall below the standard of full efficiency. The relief or prevention of such deterioration is therefore an object which should have prominence in the work of every provincial Agricultural Department.

"9. In investigating the conditions under which the agriculture of any part of a province is exposed to deteriorating influences, it is necessary, first to localize the evil, then to discover its cause, and finally to devise such protective arrangements as may remove or alleviate its injurious action. In India no causes tend more forcibly to the inefficiency of agricultural operations than the uncertainty of produce due to variation of seasons and the incompatibility of fiscal arrangements with this condition. The numerous indications which are given of agricultural distress in various parts of the country are found, with few exceptions, to point to the existence of these factors as its prime causes. . . . No assurance can be accepted that any province is secure

President's Opening Address—contd. against agricultural difficulties and distress until a detailed investigation of the condition of every part of it has been made and a system established under which a thorough knowledge of the circumstances of every village may be continuously maintained from year to year by competent officials. To this analysis of the rural economy and condition of each province the Governor General in Council attaches great importance.

"10 When such an analysis has in any province succeeded in ascertaining the cause of agricultural difficulties and distress in any locality in which they exist, the Agricultural Department should at once endeavour to strike at the root of the evil by positive treatment. It may be that the remedy will be found in the improvement of communications, the construction of canals or wells, the plantation of forests or fodder reserves, the supply of seed-grain and cattle, or the promotion of emigration. It may be that some reform in the fiscal system or in the laws relating to landlords and tenants is required in order to enable the cultivating community to protect its own agricultural interests. Careful enquiry will inevitably result in useful suggestions or in sound action."

14. The succeeding paragraphs are worth quoting in order to show that the more direct recommendations of the Famine Commissioners for positive measures of agricultural improvement were not lost sight of, but that it was *deliberately and advisedly* decided to defer any general measures of attempted reform in agricultural practice until a safer foundation of facts and statistics had been secured. Had any other course been pursued we should have had to encounter, not indeed the imputation of undue delay in giving effect to the Famine Commissioners' proposals, but the far more serious charge of wasting the public taxes in undigested schemes and extravagant action. Dr. Voelker has laid almost equal stress on the importance of this policy in his XVIIth chapter, in which he states that before any real improvement can be effected in agriculture, the institution of organized enquiry into existing facts and conditions is absolutely necessary. The Resolution of 1881 continued thus:—

"11. The Department having thus primarily directed its attention to those parts of the country in which agriculture is depressed or its result uncertain, may hereafter give consideration to the general improvement of agriculture by the introduction of new staples and implements, the trial of new industries, and the experimental adoption of new methods. In dealing with these questions, it may, as time goes on, become the duty of the Department to enquire how far the physical researches of the West may be beneficially applied to the agricultural system of this country, and to associate with itself in this investigation the assistance of qualified experts. Engineering science would be required for the construction of works of irrigation or of improved agricultural implements, the science of the veterinary surgeon will be necessary when the breeding or diseases of cattle are dealt with, the science of forestry is called for in arboriculture and reboisement, and science of divers kinds for the development of various industries. Finally, the science of agricultural chemistry will be demanded for the solution of many important agricultural problems.

"12. The Government of India desires, moreover, to express its conviction that in dealing with agricultural improvement the earliest ambition of the Agricultural Departments should be to secure the active aid of those members of the Native community who are sincerely interested in agriculture. It is after all only through and by the Native community that agricultural improvements can on any important scale be effected. Native gentlemen have experience and facilities for extending improvements which no official can hope to obtain, while in many provinces they have a large amount of capital available for investment in agricultural enterprises. They are familiar with the usages of the cultivating classes. They understand the existing system of Indian agriculture, and they are often acquainted with the local reasons which justify practices that may seem strange and illogical to an European observer. They can therefore best guide the course of agricultural improvement with the least disturbance of existing circumstances, and develop the true policy of progress in improving and adding to indigenous conditions without that subversion of ideas and methods which is likely to accompany the introduction of exotic reforms. To secure their co-operation is therefore an important object. Nor must it be forgotten that a further valuable source of information and advice exists in the European community of planters and landlords, who have already given a useful lead to Native enterprise in the adaptation of Western appliances to the agricultural system of the East.

"13. The views of the Government of India may be summed up by saying that the foundation of the work of an Indian Agricultural Department should be the accurate investigation of facts with the view of ascertaining what administrative course is necessary to preserve the stability of agricultural operations. It is desired therefore that the new departments should be so constituted as to give the fullest effect to this policy. The primary efforts of the departments should, when established, be devoted to the organization of agricultural enquiry, which has been shown to comprise the duties of gauging the stability of agricultural operations in every part of a province, of classifying the areas of the province according to the result of careful investigation, and of deciding what method of administrative treatment is suitable to each, so as to maintain agricultural operations up to the highest standard of efficiency possible under present conditions. From a system of agricultural enquiries thus conducted will follow the gradual development of agricultural improvement in its manifold variety, and the Government of India will be satisfied if, on the first constitution of an Agricultural Department, the organization of agricultural enquiry is placed in the hands of qualified officials, to whom may be committed the subsequent preparation of carefully-considered proposals for agricultural improvements."

15. It will be noted that the practical action suggested in paragraph 10 is of a more general character than are the positive measure indicated in paragraph 11. It has been possible, therefore, while the Agricultural Departments have been organizing the land-record system, to make some progress in the various directions suggested in paragraph 10. Communications have been vastly improved and extended by the Public Works Department. New canals have been opened. The construction of wells has been encouraged. Forests have been made more servicable to the rural population. Emigration has been promoted, and more liberal laws for the supply of agricultural advances have been introduced. Finally, in almost every Province the enactments dealing with landlords and tenants have during the past decade been amended or recast. It is true that much remains to be done, but what remains depends mainly on the investigations for which the Agricultural Departments are responsible.

16. The reforms or improvements of paragraph 11, which are of a more strictly agricultural character, depend to a still greater extent upon the results of careful enquiry and upon a protracted analysis of agricultural conditions. A diagnosis of the disease to which each agricultural tract is subject must be made before a treatment can be prescribed for it. General remedies can be, and have been, adopted for the general improvement of rural circumstances,

but special cures cannot possibly be attempted without risk of discreditable failure and financial loss until the diagnosis is complete. *President's Opening Address—contd*

17. Pursuing the analogy, we may notice that while the earlier paragraphs of the Resolution deal rather with the diagnosis of symptoms, paragraph 11 deals with the scientific examination both of suspected causes of diseases and of the remedies suggested. It was not, at the time that the Resolution of 1881 was written, foreseen how soon the aid of scientific experts could be called in, but it was intimated that this would be done as time went on. As a matter of fact, important action has been taken in this direction during the last twelve years. This was pointed out in the Resolution summoning the present Conference, in which it was explained that a system of scientific enquiry had been organized in those branches of investigation which were beyond the scope of the ordinary establishments, and beyond, it might have been added, the means and ability of the agricultural population itself to accomplish.

"With this object," it was stated, "there have been successively established the office of Reporter on Economic Products and the Civil Veterinary and Bacteriological Departments. The Departments of Meteorology and Geology already existed, but the attention of both has been called more distinctly than before to the work of practical investigation. At the same time the Trustees of the Indian Museum have consented to carry out through their staff enquiries connected with economic Entomology and Zoology, while the Botanical Survey, previously restricted to three Provinces, has been extended over the whole of India." It may be added that research in the field of economic and agricultural products has been thoroughly set on foot and already includes the completed compilation in a long series of volumes of all information obtainable to date on those subjects, while a comprehensive scheme for the investigation of cattle-diseases and the protection of agricultural stock against epidemics has been established.

18. Under all the heads named a programme has been framed for maintaining continuous and active investigation. But as the Resolution just referred to indicated—

"None of these departments or institutions were connected with agriculture proper, and from 1882 to 1889 representations were made to the Secretary of State that the scheme of enquiry could not be completed without an agricultural expert, who should organize and develop a system of agricultural investigation in those directions in which scientific control was wanted. In 1889, Dr. Voelcker was sent out to India by the Secretary of State—to advise on the best course to be adopted in order to apply the teachings of Agricultural Chemistry and in order to effect improvements in Indian agriculture." Dr. Voelcker's preliminary recommendations led to the appointment, in October last, of an Agricultural Chemist, who, with the aid of a laboratory assistant, appointed at the same time to teach in the Forest School at Dehra, will take the position of the expert asked for by the Government of India.

"His duties will be necessarily concerned with a larger field than that implied by the term 'Agricultural Chemist,' and it is one of the objects of the present Resolution to indicate to some extent what the duties and functions of the Agricultural Chemist will be.

"In the detailed report now submitted Dr. Voelcker makes numerous recommendations in the direction of agricultural improvement and reform, many of which cover the same ground as those of the Famine Commission. His suggestions come indeed mainly within the scope of the programme set out in the Resolution of 1881, to the principles of which the Government of India still adhere as forming the basis of the scheme of agricultural enquiry and improvement; and, although his suggestions point, as did the Resolution of 1881, to the ultimate establishment of positive measures for improvement, they do so with the same proviso that 'before any real improvements can be effected in agriculture the institution of organized enquiry into existing methods is absolutely necessary.' The Government of India desire, therefore, that for the present the main duty of the Agricultural Chemist should be to take his place in the scheme of enquiry rather than to institute what may prove to be premature efforts in the direction of agricultural improvement."

19. It will be desirable at this point to recapitulate under brief heads the steps which have been taken or enjoined to secure the fulfilment of the Famine Commissioners' recommendations. I have advisedly used the words 'steps' as indicating measures which must be adopted in logical sequence—

- (1) The organization of establishments for collecting agricultural facts and statistics.
- (2) The organization of a system of supervising and training the establishments.
- (3) The organization of a system of land-records to be maintained by those establishments.
- (4) The careful examination of each agricultural tract by the special Departments' recorded facts and statistics provided by the land-records.
- (5) The ascertainment of defects, if any, in each agricultural tract and their causes.
- (6) The suggestion of remedies for defects in each case.
- (7) The examination by experts of those cases in which defects and their causes or remedies require investigation.
- (8) The application of remedies.
- (9) The co-operation of the native community.

20. The present Conference has been convened to discuss under the light of Dr. Voelcker's report how the programme summarized in the preceding paragraph can be developed with the assistance of the Agricultural officer. Enough has been said to show that great progress has been made under the first three heads, and that under the next four much has been accomplished, though much still remains to be done. It is to these four measures and to one other not yet mentioned that our attention will have chiefly to be devoted. The eighth or the application

*President's Opening
Address—contd.*

of remedies, must, so far as it appertains to positive agricultural improvement, proceed slowly for two reasons:—

Firstly, because precise investigations, including the analysis of agricultural tracts and careful experiment by or under the direction of scientific experts, must be continued for many years before any safe conclusions can be drawn as to what suggested improvements can be safely adopted.

Secondly, because the agricultural population must be made capable, by reforms in educational methods, of adopting and assimilating improvements.

The second of the two reasons which demand the deferment of positive agricultural improvement indicates the measure to which I have alluded as 'not yet mentioned.'

21. It is somewhat remarkable that neither the able and comprehensive report of the Famine Commissioners, wide-reaching as it was, nor the opening Resolution of the Government of India in 1881, appreciated or foresaw the difficulty of introducing any important improvements in agriculture until the agricultural population had been taught in the schools in such a manner as to enable them to assimilate and utilize information conveyed to them. It was left to Mr. Nicholson at the Madras Conference to point this out. The Resolution of 1881 in the 12th paragraph, already quoted, dwelt, it is true, on the necessity of securing the active co-operation of the native community, but omitted to notice the necessity of so training them as to enable them to give that co-operation. The proposition put before the Conference is that such training cannot be secured by agricultural and technical schools, though these may be brought into the educational scheme hereafter, but must be commenced by a material change in the general system of education—a change which, it is believed, has in some Provinces already been begun. This is on the whole the most important question which the present Conference has to discuss.

22. The subjects for discussion are given in further detail in the Circular summoning the Conference. From one point of view it is fortunate that the main objects at present in view are confined to agricultural enquiry and to agricultural education, and that positive agricultural improvement, as defined in paragraph 16, must, if the views put forward are accepted, be cautiously attempted, for the present financial condition of the Empire is not such as to admit of promoting large and expensive schemes of agricultural experiment, however promising they may appear to be on paper. This remark does not of course refer to expenditure on the practical improvements of a general character referred to in paragraph 15 which are already in full progress. Considerable sums are already being expended by the State in the public works, and in the administrative measures which the Famine Commissioners recommended as conducive to agricultural interest, or to the amelioration of the condition of the rural population; but whatever cry may be raised, and from whatever quarter, that positive improvement in agricultural practices should be hurried on, it will be wiser to postpone action involving large expenditure until the schemes of enquiry and education have been carefully worked out. For these reasons the questions brought before the Conference have been primarily confined to subjects connected with either the development of the system of agricultural research or the practical education of the agricultural classes. The question how far measures should be taken for the more direct improvement of agriculture is one which Local Governments and Administrations will be invited to consider.

23. One point must be remembered in our discussions. The Conference is not invested with any powers to lay down any authoritative programme. Its functions are confined to the suggestion of a general plan as general principles for the consideration in the first instance of Local Governments and Administrations. It is clearly that a uniform policy should, so far as this may be possible, be adopted throughout India for giving effect to the recommendations both of the Famine Commissioners and of Dr. Voelcker. It is equally evident that it would be presumptuous for the Government of India to impose its own views upon the Provinces and that the policy adopted must be based on their advice. One method of procedure would have been to call for the opinions of the Provincial Governments upon Dr. Voelcker's report and for the Government of India to have deduced a general policy from them. But this procedure would have resulted in protracted correspondence and in an almost impossible attempt to reconcile contradictory views and recommendations. The discussions of the Conference are intended therefore to define the issues upon which Local Governments will be asked to submit their opinions and to clear the ground for the adoption of a practicable and reasonably uniform policy throughout India.

APPENDIX III.

Notes by Members of the Conference and others on subjects discussed at the Conference.

(1)

Note by MR. W. C. MACPHERSON, Offg. Director of Land Records and Agriculture, Bengal, on the Agricultural Ledger Service.

*Agricultural Ledger
Service (Mr.
Macpherson).*

1. Under the orders of the Government of India, the Provincial Departments distribute, according to a prescribed list, copies of special agricultural reports, pamphlets, notes, etc.

2. These are the papers which will be ledgered. They should include extracts from *Agricultural Ledger Settlement reports, Administration reports, etc.* *Series (Mr Macpherson)—contd.*

3. All these papers will find their way to the Office of the Reporter on Economic Products. I would suggest that it would be very useful that an index should be prepared every year in the Office of the Reporter on Economic Products, showing the papers which have been ledgered under every sub-head of the series. The Index may (1) be an annual index showing only new papers added during the year; or (2) it may be a complete index of all papers ledgered from the beginning. If course (1) be followed a complete index should also be periodically issued.

4. The important thing is that a person consulting the Ledger Series should be able to tell from the indexes that he has got all the papers containing information on a particular subject.

5. The papers as received should be numbered under each sub-head in the Office of the Reporter on Economic Products.

6. Perhaps the Reporter, or the Agricultural Chemist, would often add his own summary of the papers or his remarks. His contribution would of course be numbered and circulated.

7. The index may either be purely alphabetical, or it may be divided under the main heads appended to Revenue and Agricultural Department Circular No. 17—51, dated 4th May 1898. The sub-heads would follow in alphabetical order under each main head. Under each sub-head the papers would follow in order of date of publication. There would be cross-references. Thus under sub-head "Wheat" in the index reference might be made to "Saltpetre" for information regarding saltpetre as a manure for wheat.

(2)

Note by Mr. E. B. FRANCIS, Director of Land Records and Agriculture, Punjab, on the progress made in agricultural improvement in the Punjab.

In the Punjab one-tenth of the cultivated area is irrigated by canals which are the property of Government, and have in most cases been constructed by our Government since annexation; the principal being the Bari Doab canal irrigating about 600,000 acres, the Sirhind canal irrigating 700,000 acres, the Western Jumna canal irrigating 350,000 acres, the Swat River canal irrigating 100,000 acres, and the Chenab canal irrigating already 40,000 acres, an area which is rapidly increasing. *Agricultural improvement in the Punjab (Mr. Francis).*

The amount advanced by Government for agricultural improvements—that is to say, mainly for the construction of wells—averages three lakhs of rupees annually. There is no Government farm in the Punjab, but the Agri-Horticultural Gardens, Lahore, distribute considerable quantities of improved acclimatised agricultural seeds, some of which, especially various kinds of foreign cotton, of American maize, and of huskless barley, have become established in the Province. What is now wanted is sufficient land and a large enough agency to spread these improved seeds throughout every part of the Province to which they are adapted. Egyptian, Persian, and Arabian dates have been imported and freely distributed. Many thousands of fruit-trees have been distributed to hill districts from the orchards at Mahasu near Simla, and also to various districts from the Lahore Gardens. These include American and other vines. Superior kinds of English potatoes have been introduced into hill districts. Operations in regard to improved implements, water-lifts, etc., have been restricted by the small area of land available for experiments and the want of suitable agency, but I believe that much might be done if we had the means.

The Behea Sugar Mill has become popular in Delhi, Gurgaon, Karnal, Umballa, Jullundur, Hoshiarpur, Peshawar, and most sugar-growing districts, though the shallow evaporating pan introduced by the same firm, Messrs. Thomson and Mylne, has not yet come into favour. Improved iron ploughs have taken here and there, but the great want of the Province in this line is, I think, some form of weeding implement which can be worked by animal power.

No distinct improvement on the Persian wheel as a water-lift has yet been introduced, but some useful pumps for short lifts, such as occur in raising canal and river water, are being tried.

For a general improvement in staples, improvement of seed is essential, and also some improvement of the system of local trade whereby a cultivator might be sure of getting a superior price for a superior product. This is a matter in which it is doubtful how far official agency can suitably be employed.

(3)

Note by Mr. N. N. BANERJEE, Assistant to the Director of Land Records and Agriculture, Bengal, on the progress of agricultural improvement in Bengal.

1. The following note may be read in continuation of Mr. Fmucane's letter No. ¹⁹⁷¹/₁₃₈₈ (Agriculture), dated 9th September 1890, printed with the notes of the Simla Conference of October 1890. *Agricultural improvement in Bengal (Mr. Banerjee).*

2. The work done in the direction of positive Agricultural improvement in Bengal since the establishment of this Department in the year 1845 may be conveniently considered under the following heads :—

- (a) Experiments in agricultural stations.
- (b) Experiments in Wards' and Government estates, and through private persons.
- (c) Sericultural experiments.
- (d) Miscellaneous work done by the Department.
- (e) Agricultural statistics and analysis of districts.

3 (a) *Experiments in agricultural stations.*—Three experimental stations have been established in Bengal, *vis.*, one at Sibpur near Calcutta at the expense of Government, the second at Burdwan at the expense of the Burdwan Raj, and the third at Dumraon at the expense of the Maharaja of Dumraon. The Burdwan and Dumraon stations were established in 1885, soon after the creation of the Bengal Agricultural Department, and the Sibpur Farm in 1887. The stations are under the direct management of resident overseers, who have been imported from the Cawnpore Farm, on a salary of Rs50 per mensem, and are supervised by Messrs. B. C. Basu and N. N. Banerji, Assistants to the Director. A brief notice of the chief lessons indicated by the experiments made at these stations is given below.

Crops.—Potatoes.

4. *First.*—Potato seed imported directly from England, or from hill stations (*e.g.*, Naini Tal) where such seed has been acclimatized, yield a heavier outturn and outturn of a better quality than that obtained from seed of country varieties. The imported tubers are also harder, and can better resist the effects of drought and inundation.

Second.—High cultivation and liberal manuring prove profitable with the potato crop.

Third.—Mixtures of cow-dung and castor-cake, and of cow-dung and bonemeal, prove profitable and yield better results than any of these manures used singly.

Fourth.—Green manure judiciously applied gives excellent results with the potato crop.

Sugarcane.

First.—Planting sugarcane in straight and parallel trenches, as is done in Mauritius and other sugarcane-growing countries, is more profitable than the method so commonly adopted by cultivators in many parts of these provinces of sowing in irregular plough furrows.

Second.—Certain varieties of sugarcane (*e.g.*, the *khari* variety) may be grown (*rotated*) with profitable results year after year for several years from the previous year's stools.

Third.—A mixture of castor-cake and bonemeal forms an excellent manure for sugarcane and generally gives a larger outturn than either of these manures used singly.

Fourth.—Crude saltpetre is a profitable manure for irrigated sugarcane.

Paddy.

First.—A mixture of bonemeal and saltpetre proves a profitable manure for the winter paddy crop.

Cotton.

First.—The *khaki* coloured variety of cotton, known as Nankin cotton, yields generally better results than some American varieties.

Second.—The Garo Hills variety of cotton grows well on ordinary alluvial soils, and yields cotton with a high proportion of lint.

Wheat.

First.—Crude saltpetre is an excellent and profitable manure for irrigated wheat.

Second.—Green manuring with hemp gives good results with wheat.

Third.—The outturn and quality of wheat may be improved by introducing better varieties of wheat than those locally grown.

Oats.

First.—Oats can be easily grown in Lower Bengal, and as a rule succeeds better than wheat or barley.

Fodder crops.

First.—Grasses, such as *Sorghum saccharatum*, *Sorghum vulgare*, and *Beana luzurians*, can be grown profitably and without much trouble in Lower Bengal as fodder for cattle.

Second.—The outturn of *Sorghum saccharatum* can be profitably increased by the application of bonemeal.

Tobacco.

First.—Havana tobacco can be easily raised in Bengal.

Dhainchi (*Sesbania aculeata*).

First.—This is an excellent preparatory crop for cereals like oats and barley.

Ploughing.

First.—A soil-inverting plough like the Sibpur plough is superior to the country plough for breaking up new land. The latter acts very well when following the former, as it does the work of a grubber breaking up the clods, which are apt to form from the furrow slices turned by the soil-inverting action of the Sibpur plough.

Second.—A plough which inverts the soil gives a larger outturn of wheat and paddy than one which, like the ordinary country plough, breaks the soil without inverting it.

Manures.

First.—Dung and urine may well be conserved in pits lined with bricks in order to prevent soakage. If the weekly accumulation of dung, urine, and refuse straw be mixed up thoroughly with a *kodali* and stamped down by the feet, very little of the valuable constituents can be lost.

Silage.

First.—Grasses growing rank and becoming uneatable by cattle, can be easily and usefully converted into palatable fodder as silage.

5. In order to demonstrate some of the above results on a practical scale, two Model Farms have been recently established under the supervision of this Department, *viz.*, one at Dumraon, and the other at Managuri in the Jalpaiguri District.

6. (b) *Experiments in Wards' and Government Estates, and through private persons.*—*Experiments in Wards' and Government estates.*—Numerous experiments are made in Bengal in various Government and Wards' estates. Under arrangements made between this Department and the Board of Revenue, the latter provide small sums in many of these estates for the conduct of experiments and improvements. Most of these experiments are of a petty nature, and receive little or no supervision from this Department. In only a few places like the Western Duars in Jalpaiguri, Jheria in Manbhum, Modhupur in Cuttack, Dighapatia in Rajshahi, and a few others, are the experiments of a sufficiently important character to call for direct supervision by the officers of the Department. It may be said here that, generally speaking, few local officers and managers of estates take an active interest in agricultural experiments and improvements, and to this cause may be attributed the failure of the majority of experiments carried out in these places. The two agricultural officers of this Department are helped in supervising the experiments in Wards' and Government estates by two travelling overseers, on salaries of B40 and B25, respectively.

Private farms.—Several private individuals have sought the advice of this Department in managing their cultivation. Foremost among them is Mr. B. Pal Chowdhry, a wealthy zemindar and indigo-planter of the Nadia District, who has established a home farm of some 300 bighas of land in his country seat at Natuda. Two others are Mr. N. C. Boral, an attorney of the Calcutta Bar, and Babu Chandra Nath Chowdhry of Chatkabaria in the district of the 24-Parganas.

7. (c) *Sericultural Experiments.*—In the year 1886, in consequence of suggestions made by Mr. Wardle and others interested in silk, enquiries were made to ascertain the cause and decline of the Bengal silk industry. As the result of these enquiries, it was stated that the main cause of the decline of the industry was the spread of disease among silkworms. Steps were taken by Government to provide measures for eradicating the disease, and the services of Mr. N. G. Mukerji, a silk expert, were lent to the Bengal Silk Committee for this purpose. Since the middle of 1891, however, Mr. Mukerji has worked under the control of this Department, and the whole cost of his pay, etc., has been borne by Government. A central laboratory is maintained at Berhampore, and rearing stations have been established at Kalimpong, Pakhuria, Khulna, Baluakhali in Jessore, and Kagaohira in Malda, the experiments at all these places being conducted with a view to eradicating disease and producing healthier seed.

Aid was given last year in the shape of a grant from the funds of this Department to silk experiments conducted at Alipur by Messrs. J. A. Anderson and R. A. Lyall of the Silk Committee.

8. (d) *Miscellaneous work done by the Department.*—1st, Efforts have been made by this Department to popularize the cultivation of Buxar wheat and of hill potatoes, and large quantities of seed of these crops are supplied annually by this Department to private parties and to Government and Wards' estates for the purposes of experimental cultivation. The cultivation of Buxar wheat has shown that satisfactory results can be obtained with this variety of wheat only in certain parts of Bengal. The eastern and south-eastern districts of Bengal have been found unsuited to Buxar wheat, samples of produce from most of the places where experiments were made having been reported on by the Committee of the Wheat and Seed Trade Association to have lost all the characteristics of Buxar wheat. On the other hand, samples from

Agricultural improvement in Bengal (Mr. Banerji)—contd.

*Agricultural
improvement in
Bengal (Mr
Banerjee)—contd.*

Some parts of Northern Bengal have been favourably appraised. It has also been discovered from the reports of experimenters that Buxar wheat is more exacting of manure and irrigation than the local varieties cultivated in Bengal, and that where the crops have been well manured and irrigated favourable results have been obtained. Hill potatoes have generally given good results, and there is a gradually increasing demand for seed tubers of seed grown in the hills. Last year the amount of wheat seed distributed was 140 maunds, and that of potatoes 180 maunds. Besides these, cuttings of improved varieties of sugarcane, improved seed of jute, paddy, oats, barley, and other crops, as well as manures, such as bonemeal and saltpetre, have also been supplied on payment of cost to Wards' and Government estates and to private parties.

9. *2nd, Introduction of improved implements*.—The question of supplying Bengal raiyats with an efficient and cheap plough has occupied the attention of the Department since its creation. Several new soil-inverting ploughs provided with iron mould-boards were invented and brought to the notice of the public by the Department. Among these, the Burrakur cast-iron and Sibpur wrought-iron ploughs have been more favourably reported upon than any others. The Burrakur plough was made at the Burrakur Iron Works by the Superintendent under the instructions of officers of this Department. During the first three years 1,273 of these ploughs were sold, but though acknowledged in most quarters to be an improvement on the native implement, the plough failed to be popular on account of its weight and material. The Sibpur wrought-iron plough was invented and perfected by Mr. Ambica Churn Sen while he was connected with this Department. Its efficiency is generally acknowledged, but it is objected to by raiyats on account of the heaviness of its draught, and the demand for it is consequently not very great. A few Beheea three-rollered mills and chain pump lifts have been supplied on application by this Department to Wards' and Government estates and private individuals.

10. *3rd, Introduction of valuable trees*.—Efforts have been made by this Department with the aid of Dr. King, Superintendent of the Royal Botanical Gardens, and of the Agricultural Society of India, to introduce the edible date-palm into the drier parts of Bengal, the divi-divi (*Casalpinia Coriaria*), the pods of which yield a valuable tan, into the Southal Pargannas, the *Eucalyptus* into Hazaribagh, *Casuarina* trees into Purn, valuable timber trees such as teak and mahogany into Rajshahi, and fruit trees, such as the apple, pear, plum, peach, orange and the grape-vine, into Hazaribagh. The efforts of the Department have not been very successful in this direction.

11. *4th, Utilization of bones as a manure*.—An attempt is being made to popularize the use of bone-manuring in Bengal. For this purpose, the manufacture of bonemeal has been introduced as a jail industry at the Jalpaiguri, Chapra, and Darjeeling Jails. It is found that bonemeal can be made by means of the native *dhenks* at a much cheaper cost than what it is sold for by the Calcutta mills, and the crushing is rendered much easier by a previous process of fermentation in pits with the help of dung, urine, ashes, and lime, etc. Large quantities of meal made at these jails have been sold to the tea and indigo planters in Jalpaiguri and Darjeeling. Two gentlemen—Mr. Stalkartt of Hopetown, Sonada, and Mr. Thomson of the Goodhope Tea Estate, Jalpaiguri—have purchased large quantities of bonemeal from the Jalpaiguri Jail and found it useful, and there is a likelihood of the manure becoming ere long popular in tea gardens. Numerous experiments have been made in order to induce raiyats to take to the use of bonemeal, but although in several cases good results were obtained by raiyats from the experimental use of bonemeal, no raiyat has as yet come forward of his own accord to use the manure. Experiments have also shown that bone ash, which is easier of manufacture and not more expensive than bonemeal, is a very good manure even on soils on which the use of bonemeal has failed to produce any effect.

12. *5th, Establishment of a Veterinary Institution and improvement of the Bengal breeds of cattle*.—The scheme for the establishment of a Veterinary Institution to provide an agency through which Government can take action in the matter of the improvement of cattle, and the prevention of cattle-diseases, has been successfully developed with the assistance of munificent donations from Babu Sheo Buxh Bogla of Calcutta and Sir Dinshaw Manokji Petit of Bombay. Veterinary Captain Gunn, who has been appointed Superintendent of the Civil Veterinary Department, Bengal, has been placed in charge of the Institution, which will shortly be opened. The Institution provides for the accommodation of fifty students, who will undergo a thoroughly practical course of instruction in equine and bovine pathology.

13. During the last few years, efforts have also been made by this Department, pending the establishment of the Institution, to improve the breed of cattle by supplying good up-country bulls to jails. Favourable reports have generally been received of the stock got by the bulls, but it is doubtful whether they have produced any very marked improvement on the local breeds of cattle.

14. *6th, Emigration to Burma*.—The question of relieving the surplus population of overcrowded districts engaged the attention of the Directors of the Agricultural Departments at a Conference held at Delhi in the year 1888, and it was then found desirable to promote emigration to Burma from the congested districts of Behar. Steps were taken to acquire land under favourable circumstances for Behar capitalists, the Agent of the Maharaja of Dumraon obtaining a grant of 10,000 acres of land, and arrangements were made by Government with the British India Steam Navigation Company to carry emigrants to Burma at a reduced passage rate of Rs 5 instead of Rs 10 in consideration of a subsidy of Rs 8

a head paid by Government. Recruiting agencies were opened in various parts of the tracts to be relieved, and the first batch of emigrants collected by the Agent of the Dumraon Raj left for Burma in June 1891. Up to the end of the year 1891-92, the total number of emigrants from Behar was 105. Last year the number rose to 313, consisting of 191 adults, 89 children, and 33 infants. It is reported by Mr. Mackay, who has taken an active interest in the scheme, that the movement is becoming popular and will doubtless spread. Several men of the first batches of emigrants have returned to their homes with their families and friends, and speak well of the country visited by them and their prospects. The Beharis have been found unable to compete with Madras coolies employed in factories in towns, but they do better as agriculturists.

Agricultural improvement in Bengal (Mr. Banerjee)—contd.

15. *7th, Agricultural Exhibitions.*—This Department has pecuniarily and in other ways encouraged the efforts of private societies and individuals to hold agricultural exhibitions as a means of educating the agricultural classes. The exhibitions are annually growing more popular among the agricultural classes and are increasing in number. Advantage is taken of them to demonstrate the working of improved implements and machines, to exhibit improved products obtained from experimental farms, and to distribute pamphlets and notes prepared by the officers of this Department, both in English and in the vernacular, on the results of agricultural experiments conducted on the farms under the Department, on improved methods of cultivation, and on the use of manures and improved implements.

16. *8th, Agricultural statistics and analysis of Districts.*—One of the chief duties of the Department has been the compilation and publication of estimates and forecasts relating to rice, wheat, jute, oil seeds, cotton, to the important *bhadoi* and *rabi* crops, and the compilation of returns of agricultural statistics relating to areas under cultivation, prices of commodities, incidence of land revenue, and varieties of tenures. Although from the want of adequate agency for the collection of such statistics in Bengal, these returns cannot lay any claim to strict accuracy, they have proved useful in giving approximate ideas of the extent of cultivation, of the amount of exportable surplus, which has been found useful to the mercantile community, and of the land system prevailing in these provinces.

17. *Analysis of Districts.*—The officers of this Department have also prepared useful reports on the agriculture of four districts of these provinces, *viz.*,—Burdwan, Dacca, Lohardagga, and Cuttack.

(4)

Notes by MESSRS. H. Z. DARRAH, Director of Land Records and Agriculture, Assam, and E. A. GAIT, on special duty, Assam, on the subject of District analysis in Assam.

With reference to Resolutions II and III, on page 9 of the Proceedings, we think it should be placed on record that, as far as Assam is concerned, there are large areas for which no abstract of village facts or statistics would be of any value whatever. These are tracts consisting of villages, the whole or greater part of the cultivation of which is fluctuating, where in one year a large area under crops would be shown and the next year there would be nothing but waste. For such villages any abstract of the statistics would be misleading; for though the figures would denote a very sudden and serious deterioration in value, the change would nevertheless be only a normal one and need give rise to no alarm. For the real fact would be that no calamity had occurred, but that the land having been used for some years was considered no longer worth cultivating, and was consequently abandoned. This is a state of things which occurs in a large number of villages in Assam. It might be said that these villages would be known to the local authorities, and that the figures would be understood and would cause no anxiety. This is, of course, correct, but it is possible that confusion might arise between villages as to which the alterations in figures mentioned above would indicate no deterioration and those in which such changes would mean very serious loss. Therefore it should, we think, be free to the Local Government to select the tracts for which the abstracts of village statistics are to be prepared, and to direct in what tracts nothing in this direction should be done. Therefore we think the Resolutions referred to go a little too far in saying that where agricultural statistics are compiled, some system should be adopted under which the leading facts and statistics should be abstracted. In Assam such abstracts would only be of utility in certain specified tracts.

Agricultural analysis (Assam, Darrah and Gait).

(5)

Notes by MR. E. B. FRANCIS, Director of Land Records and Agriculture, Punjab, on Agricultural analysis.

In the Punjab a monograph has been drawn up annually for the last ten years upon some one important industry under the direction of the Financial Commissioner. The enquiry has been made by a selected officer with the aid of reports from district officers. In these monographs a great deal of valuable information has been brought together in a very convenient form. We have now proposed that we should go on to deal in a similar way with various agricultural subjects, taking up one or two each year. All available information would be collated by a selected officer, European or Native, under the supervision of the Director of Agriculture. A series of monographs might be written on the more important crops of the Punjab. Something of the sort was actually done some time ago, in the matter of *masse*, and another compilation was made

Agricultural analysis (Mr. Francis).

*Agricultural
analyses (Mr.
Francis)*
—contd.

of information regarding *wheat*. Besides the series of crops, we might choose for similar enquiry such subjects as water-lifts, tillage implements or processes, harvesting processes, grain storage, ensilage or hay-making, breed of cattle, dairy work, etc. etc. On most of these subjects something has already been written. The Agricultural Chemist might advise us as to the method on which our enquiries should be conducted and the monographs compiled. The Punjab members are now glad to find that our Programme for this Province as above described will fit in well with the view which appears to be held by the Conference that the agricultural enquiry should proceed by subjects and not by local areas, or, to express it otherwise, that it should take the form rather of a ledger series than of a gazetteer. We have our own proposals regarding the compilation of a Provincial Gazetteer of Agriculture in which the plan would be according to districts or other local areas, and comprise the whole field of agricultural practice in each, but the subject now under discussion is the mode in which the Agricultural Chemist can co-operate with the Provincial Agricultural Departments, and it is mainly in that part of the enquiry which will proceed by subjects that we can work together.

(6)

Note by Mr. B. C. Basu, Assistant to the Director of Land Records and Agriculture, Bengal, on the compilation of a Gazetteer of Agriculture.

*Agricultural
Gazetteer
(Mr. Basu)*

1. It is proposed to entrust the duty of compiling a gazetteer of existing agricultural methods to the Agricultural Chemist. It will involve the collection and collation of facts and statistics contained in gazetteers, settlement reports, and other such sources of information, and to require both personal investigation in the field and continual communication with the officers of the Agricultural Departments.

2. As far as the existing sources of information regarding economic products, their cultivation or manufacture, their consumption and exports, etc., are concerned, Dr. Watt's Economic Dictionary has probably left very few that can be laid under contribution, but in two respects the Dictionary is either deficient or ill-adapted as a book of reference on agricultural subjects. These are—

(1) That many subjects of agricultural importance—*e.g.*, the different processes of tillage, irrigation, conservation and change of seed, the utilization of night-soil, drainage and embankments, etc.—do not directly fall within the scope of the Dictionary, and have not therefore been touched upon or only incidentally referred to.

(2) That much of the information on agricultural subjects given in the Economic Dictionary is more or less imperfect and generally undigested. That it is so, is no fault of the Dictionary. The information it sets forth is after all second-hand, and it would be scarcely an error to say that there are very few agricultural subjects in India which have been subjected to a complete, systematic and (I may say also) scientific study, and on which complete and reliable information is available. A few subjects of comparatively minor agricultural importance, such as *ganja* and *tea*, have been studied with a thoroughness that leaves little to be desired: it is desirable that subjects of far greater importance should receive proportionate attention. If we turn to the article on Rice in Dr. Watt's Economic Dictionary we will find an enormous amount of information about the cultivation of the staple in different districts in each province. To be made practically useful, all this information should be systematised,—that is, given in order under each head of cultivation, the differences in practice between different districts being traced to the varying causes of climate, soil, influences of race or caste, and other causes. It will not be enough merely to group the different classes of rice as *aus*, *aman*, or *boro*, but information should be given as regards each distinct variety, its characteristics in respect of cultivation and growth, its quality as judged by size, colour and digestibility, and its merits as compared with those of others which are grown in the same situations. I would have each important agricultural subject taken up and studied in all its bearings as thoroughly as our resources will permit. I believe in seeking such information we shall have to depend more on practical enquiry in the field and the laboratory than on the existing records of Government.

3. I would suggest that a definite programme should be laid down, setting forth the different subjects of enquiry to be taken up in order, and that when a certain subject has been taken up, the Agricultural Chemist might be asked to prepare a list of the heads under which information is wanted, to consult and draw upon all available sources of information, and where these fail, to supplement them by scientific investigation conducted by himself and his assistant, and personal enquiry in the field made by officers of the Agricultural Departments. Mere official enquiry through the medium of local Revenue officers would succeed in eliciting little useful or reliable information, at any rate in Bengal; and in every case in which information will be called for from Provincial Departments for the purposes of the gazetteer, Agricultural officers should be deputed to collect it by actual enquiry in those places where the information can be had first-hand. If we were to call upon district officers for information about varieties of rice, for instance, we would no doubt be furnished with returns exhibiting a bewildering array of names, with probably some attempt at describing their characteristics, some being defined as red, large, and growing in deep water, others white, fine and short-stemmed, and so on; but information of this character is as little useful as it is reliable. We would have no means of identifying the varieties of one district with the same varieties grown in

another, but known by different names, of comparing their relative merits or their adaptability to particular conditions of climate and soil, and of knowing a host of other particulars, which one must know before coming to a decision as to the possibility of improving the cultivation of rice. In collecting information about rice,—that is, so far as it can be had by field enquiry and observation, the Agricultural Department in each important rice-growing province should depute one of its officers to select typical areas in each of its geographical divisions, where he should try to collect as much reliable information as is relevant to the subject, and verify the statements of cultivators, and others, by independent observation. In this way, and in this way alone, can information about the existing agricultural practices of the country be obtained, which cannot be challenged for accuracy, should be good for all times, and may eventually lead to improvements.

4. The system of recording agricultural information derived from numerous sources in small leaflets, and arranging these in ledger form for facility of reference, has been recently introduced by the Government of India. The duty of arranging and, when necessary, of compiling the leaflets has been entrusted to the Economic Reporter to the Government of India. This work may be allowed to go on *pari passu* with the compilation of the Gazetteer, but it may be transferred from the Economic Reporter to the Agricultural Chemist, who will be the fittest person to undertake it.

(7)

Note by MR. W. C. MACPHERSON, Director of Land Records and Agriculture, Bengal, on the question of providing agricultural experts in the various Provinces.

1. We have been asked to state what is the staff of experts required in our Provinces both to advise and direct and also to fill the posts of managers of experimental farms; also to say how this staff should be provided. *Agricultural expert staff (Mr Macpherson).*

2. I have first to state that in Bengal the Department has three agricultural experts of a high status, all graduates of the Calcutta University and of Crensester College. One of these, Mr. Nitya Gopal Mukherji, is entirely occupied with experiments and enquiries directed towards combating silkworm disease and producing healthier "seed". The other two officers, Messrs. Bhupal Chandra Basu and Nagendra Nath Banerji, are employed partly in the supervision of the three experimental farms at Sibpur, Burdwan, and Dumraon, and in supervision of the experiments (chiefly in growing new staples or improved seed) in Wards' estates and Government estates and in distributing improved seed, and partly in compilation of agricultural statistics and forecasts in the Director's Office. In the second branch of work, Messrs. Basu and Banerji under the Director's supervision attempt to do for Bengal what Major Craigie does for the United Kingdom. The statistical portion of their duties takes up so much of their time as to prevent them from giving the careful attention to the management of the experimental farms (*e.g.*, especially at the manuring and weigment seasons) which is essential for a satisfactory record of the experiments. To my thinking a really efficient Agricultural Department in Bengal would require to have nine officers of the status of Messrs. Basu and Banerji,—that is, an officer for each Commissioner's division, or on an average one officer for five districts or 15,000 to 20,000 square miles. These are the officers who should do the work of making the agricultural analyses of the districts of Bengal and who should record the existing agricultural methods and practices. They should belong to the Provincial service of Deputy Collectors. I do not entirely agree with Dr. Voelcker that it would be a matter for regret that these officers should pass after a time into the regular line. From our point of view it seems to me to be an excellent thing that an officer like Mr. Ambica Charan Sen should come to be the head of a district. A Collector has great powers of good in his district and might be able to do much to improve agricultural practice. The supply of experts like Mr. Basu and Mr. Banerji in Bengal has ceased with the extinction of the Bengal Crensester scholarships and by the limits which financial reasons impose upon the number of such experts who can be paid by Government.

3. For the management of the experimental farms or stations a lower grade of experts is required to work under the experts of the higher grade. We pay our present farm managers Rs50 a month. All the three managers have been imported from the Cawnpore farm. There is no indigenous supply of such men. If a demand should be created for them by establishment of more experimental stations and farms I have little doubt that Bengalis would qualify themselves for such posts and would go through the necessary courses of study at Poona or in Bengal if a training school should be provided. They would accept less than Rs50 a month, I think, to begin with, *e.g.*, as probationers, if they had prospects of getting into the higher grade of experts hereafter. I look forward to a time when every district in Bengal (3,00 square miles) will have at least one experimental farm or station. For the present, however, I see little prospect of largely increasing the number of experimental farms and stations; and if more money were at once forthcoming I would prefer that it should be spent in Bengal in paying another officer of Mr. Basu's class and in more careful management of the farms we have rather than in establishing more farms. I say nothing here about the need for training agricultural teachers (who might properly be included in the class of experts) because the extent to which agriculture is to be introduced into the departmental system of education has yet to be determined. So with regard to insisting on some knowledge of agriculture being required from our future Land-Record keepers and Land-Record Inspectors. It is premature in Bengal to say anything on this subject; but I should personally be in favour of requiring such a qualification.

Note by Mr. J. O. MILLER, Director of Land Records and Agriculture, North-Western Provinces, on the Agricultural expert staff in those Provinces.

Agricultural expert staff (Mr. Miller). 1. It is impossible to carry out Dr. Voelcker's programme for Agricultural enquiry in the North-West Provinces without the provision of a trained expert staff. At present the Assistant Director, who is a member of the Statutory Civil Service, and has been trained at Cirencester, is the Director's technical adviser on agricultural matters, but a part of his time is taken up with Land-Record work, from which it is, under present arrangements, impossible to set him free.

2. I think it is essential that the agricultural work of the Department, including agricultural enquiry generally, and the conduct of experimental farms should be directed by a trained Agricultural expert, devoting his whole time to the work, and not looking for promotion outside the Department. This trained expert should in my opinion be a European. The cases will be rare in which native officers capable of efficiently supervising the whole of the agricultural work of the Department are forthcoming; and at present in the North-West Provinces our only trained natives are members of the Statutory Civil Service, and look to the ordinary line of that service for their promotion. The Assistant Director on the Agricultural side of the Department should understand that his future prospects depend entirely on his success in agricultural work.

3. There is only one Government experimental farm in the North-West Provinces at present, but the question of opening one in Oudh was recently mooted, and in several districts there are private experimental farms in the management of which the owners would probably be only too glad to consult the expert Assistant Director. There would be ample work for him in inspecting and advising in the management of these farms, and in dealing with the agricultural work of the Department generally; the greater part of which, as far as office work goes, falls at present on the Director himself, as the native assistant finds his time fully occupied in the management of the farms, usar reserves, etc., and routine correspondence.

4. The expert Assistant Director would require, either at once or in course of time, one or more assistants as Agricultural Inspectors. Their number would depend very much on the extent and number of the subjects taken up for enquiry. Men of the class we have recently obtained from Saidapet for our Agricultural School would do admirably for such work. We cannot hope to get such men in the North-West Provinces on a salary of less than ₹50 per month, and I doubt if even this sum would tempt men who have been educated at Poona and Saidapet unless hopes of fairly rapid promotion were held out; and we could not hope to get really good men unless there was at least one post in the Department on high pay and to which they could aspire.

5. There has been some discussion about the agricultural education of Revenue Inspectors or Kanungos. I doubt the advisability of making these men into highly-trained Agricultural experts; and it is certainly impossible to attempt this at present. All we can aim at at present, is to introduce into the ranks of our Revenue Inspectors a number of men whose education has led them to take some interest in agriculture, and I hope we shall gradually attain this end through the medium of the Agricultural School we have recently opened, as well as by the opening of Agricultural classes in our schools.

Note by Mr. E. B. FRANCIS, Director of Land Records and Agriculture, Punjab, on the expert staff required in the Punjab.

Agricultural expert staff (Mr. Francis). The Punjab possesses at present no agricultural staff whatever. I consider that the appointment of an agricultural expert as Assistant to the Director of Land Records and Agriculture is most essential for the further progress of agricultural enquiry and improvement. It might be possible to meet part of the cost of such an appointment, as Mr. Wilson has suggested, from Courts of Wards' estates, who would certainly derive immediate benefit from the services of such an official.

I do not think that in the near future any more agricultural establishment will be wanted; but if an experimental farm were established, that institution would, after five or six years' experience, require to be backed up by some half-dozen demonstration farms, each of which would require a trained agriculturist as manager on pay of about ₹50 per mensem.

Note by Mr. E. C. OZANNE, Survey Commissioner and Director of Land Records and Agriculture, Bombay, on the Agricultural staff existing and required in Bombay.

Agricultural expert staff (Mr. Ozanne). In Bombay, Mr. Mollison, M.B.A.C., is the only Agricultural expert at present employed as such. Besides his duties as Superintendent of Farms, he lectures on Agriculture to the students of the Agricultural Class of the College of Science and gives practical instruction on the farm. Another expert, Mr. P. P. Mehta, M.B.A.C., who was a diplomate of the Madras Agricultural College before he entered the Royal Agricultural College, was till recently employed as Superintendent (pay ₹250) of a Government farm. He has now been transferred

to the Survey and Settlement Department in order that he may qualify for the post of Divisional Inspector, Land Records and Agriculture. For the management of farms Superintendents are available from among the passed students and diplomates in Agriculture, provided that they are further qualified in practical knowledge by apprenticeship on a farm. At present there is only one Government farm, but another is being established to take the place of the Bhadgaon Farm, which has been sold. There is no other agricultural staff in the Presidency. In the ranks of the Kanungos there are some few passed agricultural students, but though the agricultural element in this staff is greatly to be desired, the existing inducements are so insufficient that an inferior class of men only is attracted by the University diploma, and even for those who take the diploma there is little chance of Government employment. In the Baroda State the Professor of Agriculture and Botany, Mr. Middleton, has also an experimental farm. The Baroda College is affiliated to the University for the purpose of the diploma. Diplomates in Baroda are entitled to claim employment in the Revenue Department, some of the best on appointment receiving pay as high as Rs 80. It is most desirable the higher ranks of the Revenue Department proper should include a material proportion of men who have had an agricultural training, but they can only be secured by much greater inducements than those now afforded to the best students to take up Agriculture at least as an optional subject, to fit them for appointment in the regular Revenue line. This point is very sufficiently dealt with in the proceedings and in Dr Voelcker's report.

Agricultural expert staff (Mr. Ozanne)—contd.

(11)

Note by Mr. H. F. CLOASTON, Commissioner of Revenue Settlement and Director of Land Records and Agriculture, Madras, on the Agricultural staff existing and required in the Madras Presidency.

The existing agricultural staff in the Madras Presidency is shown in the margin. It is additional to the Director, who is a member of the Board of Revenue. This staff will suffice for the present needs of the Presidency and will be employed in the management of the five school experimental farms which the Madras Government proposes to establish, but the opening of which has been deferred in deference to the wishes of the Government of India pending the consideration of Dr. Voelcker's report.

One officer on Rs 750-50-1,000.
One do on Rs 200-10-250.
Four officers on Rs. 60-20-150.

Agricultural expert staff (Mr. Olaytown)

(12)

Note by Mr. E. C. OZANNE, Survey Commissioner and Director of Land Records and Agriculture, Bombay, on the duties of the Agricultural Chemist.

1. I hope we may take it as settled that the recommendations made by the last Conference should be fully affirmed by this as regards the duties and position of the Agricultural Chemist and the Assistant Agricultural Chemist. These recommendations were made after very full discussion, and have been elaborated by Dr. Voelcker in his report, which, it seems to me, should be looked on as the Manual of the Agricultural Department in questions concerning agricultural enquiry, experiment and improvement, as well as agricultural education. I for one am able to accept Dr. Voelcker's recommendations in their entirety on these points, and I move that this Conference should now so accept it.

Duties of Agricultural Chemist (Mr. Ozanne)

2. It seems now the time to formulate the rules referred to on page 12 of the proceedings of the last Conference.

3. It was considered in 1890 premature to lay down "any conditions as to the selection of special districts for close study." It seems now the time to specify these conditions.

4. Our Agricultural Chemist is with us. He has had a year of local study, and though for the reasons given by the President in the remarks which he has just made, the Conference could not be convened earlier, the time has not been lost. Dr. Leather must learn the agriculture of India before he can be an Indian Agricultural Chemist. It is not, I think, part of his duty (I make this remark with reference to the conversation at this Conference on Monday afternoon) to make any agricultural enquiry, i.e., enquiry into existing methods of agriculture, except for his own information or directly in connection with any special subject which he may take up for his scientific study.

5. A general, though somewhat untrustworthy, account of local agriculture in each district or province is now available to him in various publications, viz., Provincial Gazetteers, Wallace's India, Voelcker's Report, Watt's Dictionary, and more detailed accounts in Settlement Reports and publications of a special nature, some of which are referred to in the VIth Resolution at the foot of page 2 of the proceedings of the Conference of 1890. These he will use at his leisure or in connection to his tours. But agricultural enquiry into existing agricultural methods and practices must devolve on Directors with their assistants and agricultural experts.

6. The first step to be prescribed is, I think, that Dr. Leather should visit existing experimental farms. He has thoroughly visited Cawnpore. He should now visit Nagpore, and then Poona, and then Madras. If he stays, say, a couple of months in each of these provinces this year, he will give each farm a great deal of assistance. He will know what each farm can

Duties of
Agricultural
Chemist (Mr.
A.

do, and will help to institute on the farms a commencement of enquiry into the problems which are most pressing in the neighbourhood of these farms. Thus to speak for Poona, the problems most urgent are—

- (1) the study of the feeding of, and feeding stuffs for, dairy cattle. He may assist the local enquiry into this matter and should certainly fully know what is being practically tested by enquiry and experiment now under Mr. Mollison, the Superintendent of Farms, Bombay.
- (2) the most economical system of manuring sugarcane. I am confident that his study will prove that the present available supply of manure can be by more judicious use made to supply a far larger area of cane than it now does.

7. In these two important enquiries any improvement shown useful will be immediately imitated. The enquiry can be systematized and carried out on the farm and then demonstrated. In both these enquiries, though Poona may be the *locale*, the results can, *mutatis mutandis*, be generally made useful to the whole of India. I think that no place in India can offer the facilities for the enquiries which Poona can. At Poona both enquiries can be taken up *at once*, and for the general conduct of both there is a fully competent agricultural expert of experience available, and there is the Laboratory at hand. Dr. Leather will have to visit Poona from time to time, but these visits will not monopolise his time. I say that two months now, in January and February, will suffice. But in the rains Dr. Leather may need to visit Poona again.

8. I have no doubt that both at Nagpur and Madras similar enquiries may be set on foot, so that three provinces will be served in one year. The North-Western Provinces has had a whole year, and I think that the Punjab, Bengal, and Assam will be content to wait for one year. Once this tour of India has thus been made, Dr. Leather will be in a position to know where his visits are most needed and where and what enquiries are most important.

9. I trust it is not presumptuous to ask for this programme. Other provinces have not the facilities for Dr. Leather's study so ready to hand, and meanwhile other provinces may still refer to the Agricultural Chemist for advice, or for analyses through his assistant. All this presupposes that Dr. Leather should have the completest command of the services of his assistant. In one respect only, as decided by the last Conference, can the assistant, without detriment to his principal duties, be otherwise utilized, *i.e.*, in the teaching of Agricultural Chemistry at Dehra and Poona. I trust that this will be fully admitted. If as analyst there is other work for him to do, the duties of the Assistant Agricultural Chemist as analyst should be devoted primarily to analysis in connection to Dr. Leather's enquiries on Agriculture, and secondarily to other enquiries.

(13)

Note by MR. B. C. BASU, Assistant to the Director of Land Records and Agriculture, Bengal, on the system to be adopted in arranging for the analysis of soils, water, manure, etc.

Analysis of soils,
water, manure, etc
(Mr. Basu)

1. It is understood that all analytical work is to be undertaken by the Agricultural Chemist to the Government of India and his assistant. The scope of scientific investigation by these officers is sketched out by Dr. Voelcker in paragraph 419 of his report. It includes among others the following subjects:—

- (1) Exhaustion of soil by the existing mode of cultivation, and the expert system (by which the sale of crops off the farm is probably meant);
- (2) chemical quality of different soils, including alluvial and special soils, like the black "cotton" soil;
- (3) nitrogen in rainfall;
- (4) assimilation of atmospheric nitrogen by the *Leguminosae*;
- (5) *usar* soils and their reclamation;
- (6) comparative merits of canal and well water for irrigation;
- (7) composition of various manurial substances, and their applicability to particular crops, including new substances which are not as yet used as manure;
- (8) conservation of manure;
- (9) composition of food products and of fodder crops;
- (10) composition of butter and ghee, etc.;
- (11) causes affecting outturn of sugar, and
- (12) enquiries in connection with the cultivation and manufacture of indigo, tea, coffee, and tobacco.

The enquiry into the subjects enumerated above will have to be conducted for the most part by means of analysis in the Laboratory. I beg to record below my remarks with regard to each of the above heads of enquiry:—

No. 1.—This may be taken up. Like the Rothamstead experiments, the enquiry, if continued for a sufficiently long time, may yield interesting information, although of little practical value. The enquiry may be conducted at one place only.

No. 2.—The enquiry into the character of different types of soils may lead to useful results. I have a suspicion that the laterite soils of Chota Nagpur and Western Burdwan, and soils derived therefrom, are deficient in phosphoric acid, several experiments having shown that they

readily respond to the action of bones, whereas the clay alluvial soils of Bengal and Bihar do not appear to derive any benefit therefrom. It may be useful to enquire why bones fail to act on the latter class of soils, whether the failure is due to the stiffness of the soils, to their richness in phosphoric acid, or to the excessive presence of lime. I would recommend that all the distinct types of soils in Bengal be subjected to analysis. It would be necessary to have several specimens of each kind analysed in order to admit of accurate conclusions being drawn. In making a study of soils, it is desirable to take up one province at a time, and complete the enquiry so far as that province is concerned, before taking up another. It is not absolutely certain that the mere analysis of a large number of soils will lead to any direct practical results. In many cases chemical analysis in the Laboratory may require to be supplemented by analysis with the help of crops on the system advocated by M. Georges Ville.

Analysis of soils, water, manure, etc (Mr Bass)—contd

Nos. 3 and 4—These enquiries are sure to lead to very interesting information, although not of directly practical value. It has been discovered in recent years that a certain order of plants (the *Papilionacea* sub-order of the natural order *Leguminosae*) are capable of absorbing atmospheric nitrogen through the medium of a species of microbes living in small nodules formed on the roots of those plants. This discovery has made it intelligible why pulse crops are so useful to grow in rotation with cereals, and why leguminous crops are almost invariably resorted to not only in India but also in other countries for purposes of green manuring. I have examined numerous papilionaceous plants; among others, *dhanche* (*Sesbania aculeata*) and *arhar* (*Cajanus indicus*), and have invariably found nodules on their roots. They were especially abundant on the roots of some *dhanche* plants I examined. It is probably due to this cause that *dhanche* is looked upon as an excellent restorative crop in Bengal. The subject of the absorption of nitrogen by plants deserves a thorough enquiry, but the enquiry may be confined to only one locality, preferably where the Laboratory will be situated.

No. 5.—This subject does not much concern Bengal. The extent of *usar* in Bihar is very limited.

No. 6.—The comparative merits of canal and well water for irrigation have afforded much matter for dispute in Bengal as well as in the Upper Provinces. Please see the report of the Commission appointed to enquire into the working of the Sone Canals. It is alleged by rayats in South Bihar that the Sone water is injurious to soil; why, they or anybody else cannot as

* Dr Voelcker on page 77 of his Report says that in none of the investigations has a single record been given of the actual temperature of either canal or well water. This is, however, not so, as Mr. Scott in his "Manual of Opium Husbandry" has recorded certain results of experiments made by him as to relative warmth of well and canal water (*vide* the Hon'ble Rai Jai Prakes Lal's dissent in volume I of the Sone Canals Commission's Report)

yet say. Some suppose it is cold,—that is, as compared with well water; others allege that it contains a proportion of fine impalpable matter which settles in this soil and clogs its pores. All these points remain to be settled by scientific enquiry. Again, as far as my study of the literature of canal irrigation goes, it has never been demonstrated that canal water applied in the

same quantity and with the same care and scrupulous economy is as beneficial as well water, although very frequently its actual inferiority is explained by the extravagant manner in which it is used by the cultivators. The Bengal Government might request Dr. Leather to take up the enquiry above suggested.

No. 7.—*Composition of existing and new manures*—Numerous experiments are made in our farms with different manures, like cattle-dung, crude saltpetre, etc., of which the composition is extremely variable. Statements like this, for example, that a given amount of cattle-dung is a better manure than a given quantity of crude saltpetre for a particular crop, have little meaning, unless the composition of either is known. One sample of dung may be twice as valuable as the other, its actual value as manure depending upon the food of the cattle and the method of conservation of the manure. It may be desirable to have samples of all manures used in comparative experiments analysed, so that their true chemical value may be known. This would, however, involve too much work for the Agricultural Chemist and his assistant. Only selected samples may be, therefore, analysed. The compositions of many manures like bone dust and various kinds of oil-cake are pretty uniform, and a few analyses may suffice to yield all the information about them.

No. 8—The enquiry on the subject of conservation of manure is very important; it can be prosecuted by the Agricultural Chemist at his head-quarters. The methods of conservation of dung followed in different farms may be tested by having samples analysed from time to time. In the Sibpur and Dumraon Farms we endeavour to save every ounce of excrements, solid as well as liquid; they are mixed with as much refuse straw as is available, and the mixed mass is kept in pucks pits, where it is mixed up from time to time and then trodden firm with the feet. It is desirable to ascertain by analysis whether, and to what extent, manure so made is superior to the ordinary cattle-dung.

Nos. 9 and 10.—*Composition of food products and fodder crops*.—This work may be left entirely to Dr. Leather and his assistant, and all that Provincial Departments may be called on to do is to supply them with typical samples of every kind of food product and fodder crop that they may call for.

No. 11.—This subject opens up a very wide field of investigation, and has been gone over by many eminent chemists in Europe. If, however, it is decided to take up this subject for enquiry, I would suggest that attention should be first drawn to a study of the variations in the percentages of crystallizable sugar undergone by different varieties of sugarcane in different periods of growth. I have often found a man accusing the rayat of cutting canes when

Analysis of soils, water, manure, etc. (Mr. Bann)—contd.

they are either too raw or too ripe, with the result of a diminished outturn, but I have never found any one defining the symptoms which show the proper stage of maturity. An enquiry into this subject may lead to much practical good. It may be also useful to ascertain the difference in respect of grain sugar between samples of jaggery prepared in shallow iron and deep earthen pans.

No. 12.—Enquiries in connection with the cultivation and manufacture of indigo, tea, and coffee should not, as Dr. Voelcker says, be ordinarily undertaken by the Agricultural Chemist. These industries are in the hands of wealthy and influential people, who can well afford to engage chemists on their own account. The cultivation of tobacco offers a useful field of enquiry. Why Indian tobacco is generally defective in burning quality; whether the fault can be remedied by suitable manuring—*e.g.*, with potash manures—are questions which may well be included in the scope of enquiry of the Agricultural Chemist.

2. In Bengal we have done practically nothing in the way of having soils, water, manure, etc., analysed. Mr. D. B. Allen, when in charge of the Dumraon farms, had some samples of soil analysed by Mr. Kinch of Cirencester. Beyond these, very few analyses have been made either at the instance of Government or private individuals. I hear Mr. Bamber, who was employed for two or three years by the Agra-Horticultural Society of India and the Tea Planters' Association in enquiring into the cultivation and manufacture of tea, has made some analyses of tea soils, but his report does not appear to have been yet published.

3. We should have much liked to have a Provincial Laboratory in Bengal. Dr. Leather and his assistant will be hardly able to cope with the work thrown on them. The Bengal Cirencester scholars had a good training in analytical work, and it is said that their knowledge in this particular was not in the least utilized. One of them, Mr. G. C. Bose, showed himself so proficient in analytical chemistry, that Professor Kinch had him elected as a Fellow of the Chemical Society. A small Laboratory might be very advantageously established in connection with the Sibpur Farm.

4. It is necessary to lay down some definite lines of enquiry, which the Agricultural Chemist may be called upon to take up in the beginning. He should not be required to take up any new line of investigation until one or more of the subjects previously prescribed have been thoroughly investigated.

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Note by MR. B. RIBBENTROP, C.I.E., Inspector-General of Forests to the Government of India, on the reboisement of the heads of destructive ravines.

Reboisement of heads of destructive ravines (Mr. Ribbentrop)

1. In the discussions, which followed Captain Chapman's interesting account of the restoration of ravines, the correctness of the principle, that all such improvements must proceed from the head downwards, was unanimously acknowledged. This may be sufficient as regards ravines with a gentle incline and somewhat removed from the hills; but when the periphery of the ravines to be dealt with includes head-waters situated in mountainous or hilly ground, it is necessary that the barrage work should be accompanied and even preceded by an afforestation of the higher portions and the steeper slopes, the denudation of which is the main cause of the existence of ravines and torrents. Without such afforestation the works of reclamation result in a constant and frequently ineffective struggle against nature, a fact which has been fully recognised in France, which, of all European countries has, during the last 30 years, taken the lead in reclamation works of this kind, and which is consequently able to show the best practical results.

2. The magnitude of the works carried out in that country can be gauged by the note appended to the introduction of E. Thierry's "Restauration des Montagnes, comition des torrents, reboisement," when it will be seen that, from 1861 to 1888, 144,000 hectares were treated at a cost of 51,670,000 francs.

3. The French literature on the subject is very complete as regards the subject in question, and I would strongly recommend the study of the book above quoted, and of the work of Alexander Surell, "Etude sur les torrents."

4. The whole of the introduction of Thierry's book should be read, but I would draw special attention to the paragraph on page 9, which runs as follows:—

Voici l'ordre qui généralement a été suivi pour l'exécution des travaux :

- 1° Tracé des *perimètres* des terrains à reboiser ou à maintenir boisés;
- 2° Reboisement des parties stables;
- 3° Fixation des terrains instables, en commençant par les ravins et en terminant par la branche principale des torrents;
- 4° Reboisement des terrains instables au fur et à mesure de la fixation des torrents et ravins, sans laquelle l'instabilité des parties voisines était incurable.

(15)

Note on Agricultural Education prepared by SIR E. BUCK, Secretary to the Government of India, Department, Revenue and Agriculture, in connection with the Home Department's quinquennial review of Education in India.

Agricultural education (Sir E. Buck).

1. Agriculture, as the occupation of a large majority of the people of India, deserves separate and special consideration. A system of teaching which will tend to make an agriculturist

intelligent and capable of assimilating new ideas is, in the present stage of educational progress in India, more required than actual instruction in anything like agricultural science. There is, in fact, greater need for such reforms in the general educational system as will make it suitable for an agricultural people than for agricultural colleges of a high standard. Mere literary training does not lead towards the end in view. Agriculturists, above all others, require to be taught how to observe and how to draw inferences from observation; to receive in fact instruction of a practical character. Agricultural
education
(Sir B. Buck)—
contd.

2. It is not, however, necessary or even expedient that a practical education should in the earlier stages of instruction be technical. The charge was laid against the educational system formerly prevailing in the rural schools of England that it actually unfitted the children of farmers for an agricultural career. Nevertheless, wrote Mr Jenkins, the author of the second Report published by the Royal Commission on technical instruction, there need be nothing in any scheme of rural education specially designed for the agricultural classes which should unfit the children for any other career for which individually they may be better suited. The Government of India hold the same view. The education of the eye and the hand simultaneously with the instruction of the mind is the basis of all technical training, and is not less required for other trades than for those pursuits in which agriculture is involved.

3. In the preface to the Syllabus adopted by the Educational Department for rural schools in France, it is laid down that teachers should commence by directing the attention of pupils to visible and tangible objects which they should make the children see and feel, and thus put them face to face with concrete realities from an intelligent comprehension of which they will be led, by a gradual exercise of their reasoning faculties, to the formation of abstract ideas. And in the Report of the Royal Commission already quoted, it is urged that rural education should be based on what a child can see round him. These principles, if accepted, lead to the inevitable conclusion that any system of practical education, for whatever class of children, whether agricultural or not, it is intended, must in rural schools acquire an agricultural colouring simply because the surrounding objects are themselves agricultural.

4. The same argument applies to the maps, lesson sheets, and reading books employed in a course of elementary instruction suitable for village schools. These should all deal with subjects familiar to the pupils. It is advised, indeed, by some of the best educational authorities in Europe that instruction in the interpretation of maps should be commenced by teaching children how to understand the map first of the school premises; next of the group of houses in the neighbourhood of the school or of their own dwellings, and then those of the estates by which they are surrounded. In almost every province of India such maps are readily procurable. So, too, pictorial lesson charts should illustrate objects such as plants and insects destructive to them which can be found in the neighbouring fields.* Again, reading primers should contain lessons descriptive of subjects which are not merely familiar to the pupil but likely to be of practical interest to him in later life. The diseases to which cattle are liable, the connection between epidemics and want of sanitary precautions; the advantage of using brood mares in the plough; the elementary facts of botanical science;—such subjects as these can be made quite as interesting as incidents taken from foreign history or European life such as have too often constituted the main contents of many of the reading books in use.

5. In some Provinces, *e.g.*, the Central Provinces, steps have been taken in this direction. It must, however, be remembered that the ultimate objects at which the education of an agriculturist aims are not all of them directly connected with the tillage of the soil. It is of importance to every cultivator that he should be able to understand and interpret the meaning of entries in a cadastral map; that he should have a proper acquaintance with the system of rural accounts; and that he should be able to read and comprehend the land-records maintained by the official staff. For these purposes he should receive instruction in drawing, arithmetic, and such simple surveying and mensuration as can be easily taught to any boy. It is equally desirable to bear in mind both that the objects enumerated in the preceding paragraph are often of as much importance to those who, though not actually tillers of the soil, are likely in after-life to hold any interest in land as to those who cultivate it, and that instruction in the direction indicated is as useful for general purposes of education as any other kind of teaching. It is perhaps even more useful. And the opportunity may be taken to draw attention to the circumstance that drawing, which on other grounds is now acknowledged as an essential element in every sound educational course, is of special importance in connection with agricultural and indeed any technical training, not only as an introduction to survey and map-reading, but also as a guide to the comprehension of the diagrams and illustrations contained in the technical works which it will be necessary for any student who may ultimately seek a more complete education in agricultural or other special science to consult.

6. The next point to consider is that in order to qualify teachers in village schools to give a practical turn to rural education, they must be themselves properly taught how to accomplish this object.

7. The Government of India have elsewhere accorded their approval to the views which were expressed on this subject at the Agricultural Conference held at Delhi in 1888, when it was urged that the measure most immediately demanded was that of educating teachers. Whether this should be effected by mere reforms in the curriculum of the higher schools and colleges or by

* Exemplar charts of this kind have already been prepared in the Imperial Department of Revenue and Agriculture and can be supplied on requisition to any officials who may require them either as models or for use in schools.

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—contd.*

the establishment of normal schools for instruction is a question which may be left for the consideration of Provincial Governments and Educational Departments. In the 23rd paragraph of the Resolution issued by the Government of India in the Home Department in 1885, a recommendation was made that Committees should be formed for the discussion of questions connected with technical education, and it is suggested that a Committee with which the Agricultural Department should be associated should in each province be formed at an early date for the special purpose of considering what reforms should be effected in the system of rural education with the view of rendering it of the greatest possible service to the rural classes without affecting its utility to children who are likely to follow other than a purely agricultural avocation.

8. The subject of a technical and scientific training of an advanced character in agriculture must be considered an entirely separate one. It is questionable whether the time has yet come to offer, except to a very limited extent, a high-class agricultural education to any section of the people. The special conditions of soils and climate in India as affecting agriculture are not yet sufficiently investigated to admit of authoritative instruction in agricultural practices and reforms. Measures have been taken, both by the Imperial and Provincial Governments, to institute systematic enquiry and experiment in connection with agriculture under the guidance and direction of competent experts, and while these are proceeding, perhaps for many years to come, it would seem preferable to prepare the agricultural classes to be able to assimilate and receive such technical instruction as may at some future time be afforded to them, rather than to establish agricultural colleges on any European model, or upon a prematurely ambitious scale. It was properly urged in the note * on Agricultural Education, published under the authority of the Madras Government, that the first step necessary in the direction of agricultural improvement was the "ascertainment of possibilities."

The second was to raise the intellectual level of the agricultural classes sufficiently to enable them to adopt such "possibilities" as might be discovered by scientific investigation. Both processes are necessary, though the one is independent of the other, and both require a considerable period for their accomplishment. But until both have reached an advanced stage, it is doubtful whether any widespread improvement in Indian agriculture of a satisfactory character can be expected, or whether expenditure on educational institutions of a high standard will be of much practical use.

(16)

*Agricultural
education (Mr
Middleton)*

Note on Agricultural Education by MR. T. H. MIDDLETON, Professor of Agriculture, Baroda College.

1. At the Conference held here in 1890, the general question of agricultural education was very fully discussed, and I think that at the present meeting it would be advisable to lay down the policy which should be adopted in the introduction of agricultural instruction into Indian schools and colleges. In doing so, I do not think that we should attempt to provide for the wants of the cultivating classes only, for even were it practicable to limit our education to them alone, which it is not, it would be unwise to do so for obvious reasons, some of which have just been alluded to by our President. In India, as in France, agriculture should occupy a prominent place in the system of national education, and although it must be many years before we can have here the highly perfect educational machinery which they have in that country, I may perhaps now be permitted to indicate the nature of the programme which I think might be advantageously adopted in laying the foundations of a similar system of education in India.

2. Briefly, my ideas on the subject are, *first*, that we should have a limited amount of higher education at institutions in which the teachers would be engaged more in experimental work than in the class-room; *second*, that as soon as possible teachers should be trained and textbooks prepared for primary schools, and when some progress had been made in this direction that, *third*, we should take up the question of secondary agricultural education in high schools, etc.

3. In a memorandum addressed by me to His Highness the Gaekwar on the subject of agricultural research stations, copies of which have been circulated to some of the members of the Conference, I have tried to show that sound agricultural teaching must in India be preceded by research; for the conditions under which agriculture is carried on in this country are so very unlike those of Europe, that the material which agricultural teachers there find provided for them is of comparatively little value to us here. Satisfactory research can best be carried on by a staff partly European and partly Native, and the first work of a teacher brought from Europe should be to train assistants who will help him in acquiring an accurate knowledge of the principles of Indian agriculture.

4. As a teacher, I would like my materials and subject-matter to be as perfect as possible before introducing them to the Indian student. To begin with, I would like most time to be given to experimental enquiry, and I do not think that we should push higher education further than is absolutely necessary in the meantime.

5. There are two reasons for which in the interests of education itself, higher instruction should not be made cheap and common at the beginning. They are: (1) That the Indian teacher is not yet able to give the pointed practical illustrations of principles which confer much of the value on the agricultural lectures given in Europe, and partly it is for this reason that the common Indian Agricultural student has not that practical knowledge (or rather I should say that practical turn of mind, for no student can have much practical knowledge) which is desirable. (2) That we have, as a rule, an unsympathetic public to deal with. The answers given to the questions of the Madras Agricultural Committee showed in many cases that those who sent in replies mistook entirely the province and nature of teaching. Disappointment was expressed because Saidpet students were not able immediately upon leaving college to improve upon the local agricultural practices; and it was frequently pointed out that the graduates of that college (graduates be it remarked who were engaged in pursuits having little or nothing to do with farming) were not practical men. The task of the agricultural teacher would be less difficult if the public could be made to understand that lectures, text-books and college education generally cannot give a student experience, and that the teacher's object is to train his students in such a way that they may know how to set about the getting of experience for themselves, but this the public will not do; as in Madras, they will continue to entertain unreasonable expectations, and for this reason, as an agricultural teacher would prefer, as I have said above, that our colleges and our students should be few for the present.

6. But the majority of the members of the Conference are anxious to obtain some agricultural training for Revenue and other officers, and for this reason it may be necessary to make higher education more popular than I personally should desire. I have said above that the agricultural education which we can now give will be much less perfect than that which the future will enable us to offer, but I think that even now our agricultural colleges at Saidpet, Poona and Baroda are able to turn out students who for Revenue work have had a training more practically useful than that given during the B. A. course. This opinion is shared by others—*vide* the remarks of Dr. Cooke on page 48 of the Proceedings of the Conference of 1890. If Government desires to have men so trained it is only necessary to offer a few appointments, in which the prospects are fair, in order to secure any number of candidates.

7. Having established central institutions for higher instruction, the next step should consist in introducing agriculture into primary schools. This could be done gradually in each province, beginning with the district in which the cultivators were most advanced, for it would be in such districts that the children of the cultivating classes would be in greatest proportion in the higher standards of the schools. The training for the school teachers would have to be provided at primary normal schools, each of which would require an efficient agricultural teacher and a farm. In the beginning, and in those provinces where there are colleges, the normal school should be near the higher institution, and the same farm might with advantage be used for both. To begin with, the primary school teachers would only be employed in explaining the lessons contained in the agricultural readers prepared under the orders of the Departments of Agriculture and Education in each province, but a forward move would soon be possible. A few years would show which of the primary school teachers possessed most aptitude for the work, and these might be encouraged to attend short extra courses of instruction chiefly of a practical character, at the Presidency farm. Successful men would be given certificates and would be appointed to those vernacular schools which teach up to the highest standard. In these better-class schools, after having passed through Standard IV, the course of study might with advantage bifurcate,—those boys who required a literary training taking one line, those who meant to take up agriculture another. A system of the foregoing kind exists in the "superior primary schools" of France. When once established in the most forward districts of a province, primary education could be gradually extended to other districts, as the spread of the agricultural classes in normal schools became possible.

8. We come last to middle class or secondary education which in our circumstances presents the greatest difficulties. From the boy at the primary school not very much is expected, and a certain amount of useful knowledge for him may be easily embodied in text-books, and I should hope be successfully explained by the class of teacher just referred to. Students in colleges, on the other hand, are few in number, and can be provided with good teachers, who would be to a great extent independent of text-books, their own notes and the aptitude of the pupils making up for the deficiency. If, however, we are to introduce agriculture into our middle class schools, we must not only have very good text-books, but a considerable number of well-trained and practical teachers. The former have still to be written and the latter to be trained. Whenever they are available we might begin to introduce a good agricultural course into high schools, and the extension would, as in other cases, come with time. There are at present agricultural classes attached to several of the high schools of Bombay, but the students learn next to nothing of Indian agriculture. They are as a matter of fact taught about English agriculture from text-books written for England, and the results are anything but satisfactory. If we attempt to teach agriculture in high schools, it should be of a purely Indian and chiefly of a provincial character. The students should learn thoroughly about local agriculture; comparative agriculture, as it is sometimes called, is beyond the ordinary high school boy. Provided a high school had a good farm and a good agricultural teacher, I should like to see a course of study provided from the fifth standard upwards for boys who had not the means nor the wish to go up to the University, but who intended to appear for what we in Bombay call the school final certificate. This course would embrace, instead of Euclid, Algebra and ancient languages, such subjects as

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Agriculture, Surveying and Measuring, Botany and Physical Geography, and would be intended for boys entering the lower grades of the public service. In addition to the more special agricultural teaching at high schools, advantage might be taken of the farm and teacher to give a few lessons on agricultural subjects to all school-boys above a certain age.

9. In the case of both colleges and primary schools agricultural instruction should, as Dr. Voelcker says, find a place in existing institutions. As regards middle class schools, I will not attempt to pass an opinion. The question is, will the middle class education given in connection with high schools be sufficient for the wants of the country? This question is one which each province must answer for itself.

10. In Bombay we have two colleges, in Madras there is one, but other provinces are unsupplied, and in these at least it would, I think, be found necessary to establish agricultural schools like that at Nagpur, in which Revenue Inspectors and other District Officers might be trained.

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Address on Agricultural Education delivered at the Industrial Conference at Poona on Monday, the 4th September 1893, by Mr. G. V. JOSHI, Secretary to the Poona Industrial Conference, and laid before the Agricultural Conference by Mr. E. C. OZANNB, Survey Commissioner and Director of Land Records and Agriculture, Bombay.

"Knowledge is Power."

Agricultural
education
(Mr Joshi)

1. Agriculture is no longer what it once was—rude, rustic husbandry, a simple manual mechanical operation, an empirical pursuit. All over Europe and America, it is now regarded as an industrial art of a highly complex and difficult nature, requiring for its successful prosecution an application of several sciences. Agriculture takes its rank "as a scientific occupation," and it is deemed essential that the farmer, quite as much as the surgeon and the engineer, should receive proper instruction in his work; and his efficiency is measured, as is that of every other industrial worker, by his ability to get the largest return with the smallest expenditure of time, labour, and material resource. And agricultural education, as is now understood, in the advanced countries of Europe includes a systematic course of technical instruction in the theory and practice of agriculture, thus regarded as an industrial art, and embraces in its range a wide sweep of varied scientific knowledge in its manifold practical applications to the cultivation of the soil.

2. In all countries and at all stages of progress, such education, when evenly and widely diffused among the rural classes, must be of incalculable benefit to the progress and improvement of agriculture. For in this, as in every other field of productive industry, science and science-guided skill are in these days indispensable requisites of practical success, leading to the maximum economy of effort and material means. And the trained farmer, with his trained eye and hands and the moral resourcefulness which his training gives him, will do his work infinitely better than one left to the guidance of his untutored mind and crude experience.

3. But in agriculture, even more than in any other industry, is the help of scientific knowledge and training indispensable. For it is in one sense an exceptional industry which, unlike every other, is subject to the economic law of *diminishing returns*. As J. S. Mill remarks (*vide P. E., ch. XII*), "After a certain and not very advanced stage in the progress of agriculture, it is the law of production from the land that in any given state of agricultural skill and knowledge, by increasing the labour, the produce is not increased in an equal degree; doubling the labour does not double the produce; or, to express the same thing in other words, every increase of produce is obtained by a more than proportional increase in the application of labour to the land." With the help of science and scientific education, it is always desirable to endeavour to minimise this inevitable waste of energy involved in this pursuit.

4. In countries where there are limitless reaches of virgin soil at command, agricultural education, however useful and desirable *per se*, is not deemed absolutely necessary. The need of scientific methods of agriculture is not felt, increase in production to meet the requirements of a growing population being easily secured by extension of cultivation to fresh areas. In the United States, Canada and Australia, the effort is rather to get out of the land the maximum return it can yield in proportion to the labour employed, and additional labour and resource are carried elsewhere. Here scientific farming is unnecessary, and is considered too costly a method, and simple fallowing is the easy restorative means adopted.

5. But in old and populous countries, where cultivation at a comparatively early stage reaches its limits of expansion, and tends, with the advancing needs of an advancing population, to become—in the normal course of progress—more and more *intensive*, applied science is required to help in the change, and agricultural training becomes an economic necessity. In most European countries such a change from *extensive to intensive* agriculture has taken place within the last fifty or sixty years, and one of the most powerful means, by which the change has been carried out, has been a wide diffusion, under a carefully planned and graded system of agricultural education and through a skilfully constructed and wide-branching machinery, of sound scientific agricultural knowledge among all classes of rural society.

6. In India there is an industrial dead-lock of a most severe and formidable type. Agriculture is with us the one sheet anchor of our economic life, the one staple industry, to which we trust to meet the wants of our growing numbers, to provide for an expanding export, and to pay for the growing charges of a progressive administration. And yet no industry could be in a worse plight. The limits of agricultural extension have long since been, in most Provinces, reached and even overstepped, and, notwithstanding, evidence is accumulating as to *positive agricultural deterioration* all over the country, notably in the North-Western Provinces and Oudh, in Madras and in our own Presidency. The exhaustion of the soil under an exhausting system of cultivation is fast proceeding and the agricultural outturn per acre is on an average

Country.	Bushels per acre.
United Kingdom	30
France	20
Germany	18
Belgium and Holland	26*
Italy	15
Russia	16
Europe	15
India	11 5

even less than 12 bushels—a measure of yield about the lowest by comparison (*vide* marginal table) in all the world, and now even the food-supply of the country is in serious danger! The industry continues in its old grooves and the ryot is left to struggle as best he may in his helpless ignorance, no effort being made to call to his aid the resources of science and scientific training. Surely this is not as it should be. The situation is full of peril and, as the Famine Commissioners write, it is "essential that technical knowledge should be called in to enable the productive

powers of the soil to be applied in the most effective manner, not merely to add to the wealth of the country, but to secure a good supply which shall keep pace with the increase of population." Thus a comprehensive scheme of agricultural education intended to raise the general plan of rural intelligence and agricultural work is, with us, not a mere educational desideratum, but an imperative economic necessity, an indispensable help to agricultural improvement, which we can no longer afford, under penalty of chronic famines and disaster, to neglect.

7. Under these circumstances it is satisfactory to observe that the situation and its requirements find such general recognition. Government acknowledges, in the fullest manner, its obligations in the matter of providing agricultural education for the landed classes, and practical measures are being organized in most Provinces. And what is still more encouraging, even the landed classes themselves are coming forward to help the movement,—*e.g.*, the Talukdars of Oudh and the landed gentry of Gujerat.

8. Clearly, it is most important that the new efforts should proceed on lines shown by experience to be good and safe, and the question for consideration is what should be our working plan in our new departure? A well-defined programme is essential, otherwise there would be waste of energy and the risk of eventual failure.

9. We will begin with a brief survey of the European systems of agricultural education as described in the Royal Commission's Report on Technical Education.

10. It is necessary to premise that in these European countries the entire fabric of industrial instruction—agricultural and other—rests on the solid foundation of a widespread primary education, which is general and in some cases even compulsory by law. A strong substantial basis of general education and knowledge is thus ensured, on which special instruction in the arts and sciences proceeds along varied lines in well-ordered sequence. In France, in Germany, in Denmark, in Belgium, in Holland,—in each of these countries there is a complete and elaborate system of agricultural education, constructed on the basis of an advanced course of elementary instruction. Well-equipped institutions are provided for every grade and class of agricultural workers, from the small tenants and farm-labourers to the large landed proprietors. The instruction imparted is varied and adapted to the varying requirements of the different landed classes. Practice is more or less combined with science, and specially in Germany even general education is continued alongside of technical in all the lower stages of the specialized agricultural course. Almost invariably each one of these institutions has a farm or a garden plot attached to it for purposes of experimental demonstration or illustration. The special education is highly prized and eagerly sought after, and trained pupils of these agricultural institutes readily find employment as farm bailiffs, managers and superintendents, or, in the case of the higher landed classes, return to their own estates and carry out agricultural improvements. It is remarkable that, in most countries, these institutions owe their origin to the State initiative, and are largely maintained by the aid of State subventions. Of these, the French system is, by general consent, the best and the most advanced; and as it seems to offer to us a suitable model for imitation, a fuller account of it might not be deemed out of place.

11. In France primary education is universal and compulsory by statute, and in all primary schools instruction in agriculture is given after the lower elementary stage is reached as an optional *special* side. On this basis rests the entire system of special education in the country. The agricultural institutions, as at present organized, are of three grades—*higher, intermediata, and lower*—and range themselves as under :—

French Institutions.

- 1 Institut National Agronomique.
- 3 Regional Schools of Agriculture.
- 9 Practical Schools of Agriculture.
- 2 Shepherds' Schools.
- 23 Farm Schools.

Agricultural education (Mr. Joshi)—contd.

- 1 School of Horticulture at Versailles.
- 4 Small Schools of Horticulture.
- 23 Agronomic Stations.
- 55 Departmental Professors of Agriculture

12. Of these, the *Institut National Agronomique* is the highest agricultural institute in France, intended to impart the most finished course of instruction in the specialized department of agriculture. The admission test is high—a science degree or its equivalent. The course extends over two to three years, and is a most elaborate one. Besides mechanics, general and agricultural chemistry, geology, zoology, physiology, botany, etc., the curriculum includes, among the subjects taught, agricultural technology, comparative agriculture, administrative law, and rural legislation. The plan of instruction embraces, besides theoretical instruction in the advanced sciences, practical exercises in farm work, laboratory practice, agricultural discussions, and excursions for observation and study.

13. The pupils number about 120, and pay a fee of £12 a year. The State grant for the institute is £10,000, and two travelling scholarships are awarded every year to the first two successful candidates who pass the final tests, to encourage a study of the agricultural systems of foreign countries. As to the status of the pupils, one-half of them are sons of landowners intending to farm their own properties, and the other half is composed of young men whose future callings may be thus epitomized:—

- (1) Officers of the Government Department of Agriculture.
- (2) Professors of agriculture in the departments and at the regional schools, directors of farm schools, etc. There are about 100 such places in France.
- (3) Directors of agricultural experimental stations and agricultural laboratories.
- (4) Directors of sugar manufactories, distilleries, etc.
- (5) Agricultural engineers.
- (6) Large tenant-farmers, or managers of agricultural companies in Algeria, etc.

14. Next come the *regional* schools—"one for a certain number of departments forming an agricultural region." The courses of study have special reference to the agriculture and agricultural requirements of the several agricultural "regions." These schools are secondary institutions, each with a large experimental farm, designed for young men who are sons of proprietors and farmers and others who desire to devote themselves to agricultural pursuits. Those who pass the final test receive a diploma from the Minister of Agriculture. The diploma is highly valued, and the passed men readily obtain good situations. These schools are maintained by the State. The regional school of Grignon is the best, with a roll of about 100 scholars, the annual charge coming up to £15,000 paid by the State. These regional schools are very popular and are of special interest, as being placed in direct touch with the agricultural life of their respective "regions."

15. Next in the scale we have the *practical schools of agriculture*, founded for the sons of well-to-do small farmers. The cost is borne partly by the Central Government and partly by the local departments. The instruction given is thoroughly practical, with only a small admixture of theory, and is in several schools combined with general education. The agricultural course varies according to the diverse cultural conditions of the several districts, and the subjects include agriculture and rural economy, the breeding, management and feeding of cattle, measurement and levelling, agricultural book-keeping, construction and use of agricultural machinery, and rural law.

16. Lastly, as forming the substructure of the edifice, we have a large number of farm schools for the benefit of the small farmers and farm-labourers. The pupils are termed "apprentices," and are bound to work on the farms for 2 to 3 years. In each school the number of apprentices admitted varies with the size of the farm; the apprentices are lodged and boarded at the expense of the State, which pays £10-16-0 a year for each apprentice, including medical attendance. The design of the farm-school is authoritatively laid down, the farm giving the apprentices the best professional education and serving as a model to the whole district, as a profitable example of cultivation, while the "director in his school has to explain the most important operations to his pupils in the most simple manner, both practically and theoretically." The object of the farm-school is to train good cultivators and not men of science. These schools are all State institutions. The successful apprentices get certificates and small presents of money. They go back to their fathers' farms or proceed to superior agricultural schools, or obtain situations as farm-bailiffs or foremen on large farms; they are eagerly sought for on holdings where high farming is practised and improved machines are used.

17. Besides these there are numerous special schools of horticulture, forestry, cheese-making, etc., and we have also various normal schools for the training of agricultural teachers.

18. Finally, the whole organization of agricultural education is supplemented by the appointment of Travelling Departmental Professors of Agriculture. The salaries of these professors range from £120 to £180 per annum—all paid by the State. These professors are assigned a most interesting function in the general scheme. Besides teaching in the normal schools, they go about the districts delivering lectures on practical agriculture in the different communes of their several departments to the teachers and agriculturists of the "regions;" discussions follow; and an exchange of views and experiences takes place. The following citations from

the Minister of Agriculture's (M. Tirard's) instructions to these professors will be read with interest:—

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Josh)—contd.*

"Your mission is to keep the cultivators informed respecting modern discoveries and new inventions of economical and advantageous application, so as to let them be ignorant of nothing which it is to their advantage to know, but to lead them forward in the general movement of progress in which they participate to so small an extent owing to their isolation. You will have to instruct them as to what reforms they may introduce in the processes of cultivation, in the selection and feeding of animals. You will also call their attention to the preparation of manures, their utilizations, the way in which to increase their quantity by making use of fertilizing materials which are too often lost in the country districts. You will show to them the advantages which arise from a good choice of seeds, and of the varieties of plants cultivated, and more particularly how to extirpate weeds which take the place of useful plants, how to combat parasites of all kinds which ravage the crops, etc., etc. You will develop in them the love of progress and that spirit of initiative which causes them not to expect all from circumstances, or in due time, but from their own efforts. You will take care to cite as examples the results obtained by enlightened cultivators who employ good methods. You should, in short, exert yourself to describe in each locality what agriculture ought to be, and, after examination, you should indicate what should be done. It is in confining yourself to practical improvements, to operations which have been tested, and which have an immediate interest, that you will be enabled to gain the confidence of the cultivators and attain the desired end. In addressing cultivators and practical men who have the knowledge for themselves which tradition gives—that is to say, the slow and patient observation of facts from generation to generation—you should dwell only upon well-known truths and principles clearly proved by science. You will lay before them, therefore, only well-established facts, and you will limit yourself to the recommendation of improvements sanctioned by experience. It is also your business to secure the co-operation of agriculturists and agricultural associations, in order to organize them, and to stimulate thus the taste for practical trials and tests."

19. Such is briefly the teaching-machinery in France for specialized instruction in agriculture. The Central Institut National Agronomique of Paris, the regional schools, the departmental practical schools, and the communal farm schools—these institutions, each complete in its equipment and strong in its teaching and controlling staff, provide a varied and graded training both theoretical and practical for every class of young men who desire to follow agricultural pursuits; and the departmental professors help to continue the course of instruction for the adult agriculturists, carrying it to their farms and homesteads in the communes and constitute a most interesting intermediate agency, connecting, in an unbroken line of continuity, the agricultural teaching of the schools and institutes and the agricultural life of rural France. The central aim of the organization is not only to supply sound and systematic training for the farmers, but also to maintain the entire agricultural system of the country on a high plane of efficiency and always in real, living touch with the general scientific and industrial advance of the times. No expense is grudged, no effort spared, to make farming as *scientific and intensive* as possible, and the marvellous progress of French agriculture during the last 20 to 30 years bears eloquent testimony to the beneficial influence exercised by these schools and institutes on the general course of the industry.

20. Coming to India, the first thing that painfully strikes the observer is the utter inadequacy of the existing provision for primary education. According to recent returns, the number of towns and villages in British India, excluding Upper Burma, is 575,458; while the total number of educational institutions, both public and private, is 138,054, so that the percentage of schools to number of towns and villages is 23.9, and 437,431 towns and villages in British territory (76.1 per cent.) are still absolutely without educational facilities of any kind! So, again the total number of scholars is 3,082,767, of whom 3,368,930 are boys and 318,777 girls. The children of school-going age, taken at 15 per cent. of the total population of the country, number over 38 millions, and we have barely 10 per cent. of the number at school. This means that close on 30 millions and more of our young children are at this moment growing up in ignorance—30 millions of our rising generation condemned by our defective organization of primary education to be brought up in darkness, and the mental servitude and the moral helplessness it implies and involves. What a waste—an appalling moral waste of talent and opportunity is here! As the Hon. Mr. Nolan, Secretary to the Government of Bengal, truly observes, "The fact is that the cultivators are illiterate and their children are growing up in ignorance, the exceptions being so rare and isolated as to be of no account for agricultural purposes. Now, if there is one principle on which modern statesmen in all countries are agreed, it is that popular education is the only means by which the condition of the masses can be permanently raised; and this truth has a special application to India, where these illiterate labourers are left to accomplish without superior guidance the great economic task of the country." This is a grave state of things, and every strenuous endeavour ought to be made to alter it. A large and substantial increase in the number of primary schools in all the Provinces is most urgently called for as a necessary foundation, without which any comprehensive scheme of specialized industrial education for the masses is a practical impossibility; and we would, most earnestly join with Dr. Voelcker and the Simla Committee in pressing upon the attention of Government the paramount importance of extending primary education all over the country.

21. Passing next to the existing arrangements for agricultural education, it is clear that in no Provinces have we yet got very far beyond the first preliminary beginnings of a practical

endeavour. In Bengal an Agricultural Primer is taught in the village schools, but no special institutions for the teaching of agriculture as yet exist. In the *N.-W. Provinces and Oudh*, a school of agriculture has just been established at Lucknow with a two years' curriculum divided into junior and senior, and including, among other subjects, the elements of agricultural chemistry, botany, and surveying. The admission test is the Middle English or Matriculation Standard, and the object of the school is to afford elementary practical agricultural instruction to (1) Kanungos and other revenue employes or candidates for revenue employment; (2) persons wishing to obtain agricultural certificates or diplomas, which might enable them to obtain posts as agricultural teachers or managers of experimental farms; (3) landowners and others wishing to learn something of the theory and the rational practices of agriculture for application to the management of their own properties. In the *Central Provinces*, as in Bengal, an Agricultural Primer is read in the village schools, and we have, besides, a good school of agriculture at Nagpur with a normal class composed of Vernacular teachers—two from each district. The course of study comprises agriculture, surveying, chemistry, botany, geology, elementary veterinary science, and drawing. The instruction is thoroughly practical in the field and laboratory.

22. To ensure that the students acquire a practical knowledge of agriculture, plots of land are allotted to them, which they are required to cultivate with their own hands. They are permitted to keep the produce. The students also maintain a labour journal and cultivation book for the experiments conducted on the experimental farm.

23. A small veterinary dispensary is attached to the class for practical instruction in the treatment of more common forms of cattle disease. There was also a travelling lecturer some time ago, but the place seems now to have been unfortunately abolished. In *Madras* we have an excellent Agricultural College at Saidapet founded in 1865, but it is yet an isolated institution without feeders and without much connection with the general scheme of Vernacular education in the Presidency. The instruction imparted is of a superior type, embracing a wide range of subjects. Agriculture is an optional subject for the Public Service Examinations, but owing, it is said, "to want of teachers, it is taught in very few schools, and even in them the instruction given is far from satisfactory." In our own Presidency there is no separate special machinery; but the Poona and Baroda Colleges have each a strong agricultural section organised under a special European Professor; and 8 agricultural classes attached to 8 High Schools in the mofussil. The University grants a diploma in agriculture to the successful pupils of the colleges, and the curriculum provides for a three years' course and comprises a wide range of subjects, among others, agriculture, botany, geology, chemistry, qualitative analysis, surveying, veterinary pathology, etc. The programme of studies for the High School agricultural classes is an elementary one and extends over two years; and agriculture is also an optional subject for the U. S. F. test recognised by the University. Little, however, is yet done to reach the cultivating classes through the village schools. The *Punjab* is about the only Province which is absolutely without means of imparting agricultural instruction of any kind.

24. Such are our existing arrangements. Larger developments are under contemplation in most Provinces, notably in *Madras*. In *Bengal* it is proposed to organize a strong Agricultural College at Sebpore, and measures are being adopted for introducing elementary instruction into the primary schools. In the *Central Provinces* the plan is to introduce a systematic course of agricultural training into the more important Vernacular schools of all the 18 Districts or Tahsils. In *Madras* a much broader scheme is under the consideration of the Local Government. There is already an admirable college at Saidapet, where superior instruction is given, and the Local Administration proposes to establish five farm schools, apparently on the French plan, in five representative districts, as feeders to the central college. Government further contemplates, in course of time, an agricultural school in each of the 21 Districts of the Presidency. Altogether the *Madras* scheme appears to us to be a comprehensive one.

25. With this hurried survey of the European system and the arrangements in India, existing and contemplated, for the education of the rural classes in agriculture, we would proceed to state briefly our own ideas on this important subject, confining our view to our own Presidency. The points for consideration are, among others, chiefly these—

- (1) What sort of special agricultural instruction is required?
- (2) For what classes is such instruction desired?
- (3) The question of the teaching agency. What existing institutions, if any, can be utilized for the purpose by modification or enlargement? And what new special institutions are needed?
- (4) The curricula of studies.
- (5) The question of management and control.
- (6) The question of funds.
- (7) Any special measures for the encouragement of the new studies.

26. On the first point, we would at once say that we want and desire a well-graded system of agricultural education complete in all its branches of higher, intermediate, and lower, as is contemplated in the *Madras* scheme. Technical instruction should be, as in the French systems, arranged on a thorough combination of *practice with science*; for, as Dr. Thaer, the founder of systematic agricultural education in Germany, would say, "agriculture cannot be learnt entirely by attending lectures delivered from the professorial chair." Besides, the

special course ought not to begin except on a broad basis of general education and culture ensured by adequate entrance tests, without which, and the logical, disciplined tone and habit of mind it gives, specialized instruction does not well succeed; and even in the pursuit of special studies we would desire that attention should be given as much to their disciplinary as to their scientific and technical value. *Agricultural education (Mr. Joshi)—contd.*

27. Next as to the classes for which such training is desired, they may be grouped as under:—

- (1) The large landed proprietors—the holders of Inams and Jagirs, the Talukdars, the Khots, the large Watandars, the Mehewasi holders, the Jamindars, etc.
- (2) Large capitalist farmers, whose holdings average between 100 to 500 acres.
- (3) The small landholders with holdings of 25 to 100 acres.
- (4) The smaller tenant-farmers in easy circumstances, etc.
- (5) Non-landowning classes—those who may wish to enter into agricultural pursuits, or who may wish to qualify themselves for posts of managers and superintendents on large estates, or, again, to go into the Revenue or Survey Departments of the public service, etc.

28. The following tables are appended as showing the status and position of our landed classes:—

TABLE A.

Tenure.	No of estates	No. of villages	No of holders and share-holders	Gross areas in acres
Ravavari	1,292,126	21,245	1,292,126	29,770,078
Inams and Jaghira	2,220	2,220	10,386	4,724,259
Talukdari	530	530	493	1,419,502
Mehewasi	62	62	93	120,402
Udhad Jamabandi	504	504	6,052	841,752
Khots	1,677	1,677	48,736	2,173,350
Izafat	7	7	13	3,609

TABLE B.

	Government.	Inam.	Total Number
Under and up to 5 acres	279,677	63,758	343,435
5 to 25 acres	434,028	83,942	517,970
25 to 100 "	268,986	32,778	301,764
100 to 500 "	30,904	5,886	36,790
And over 500 acres	1,449	622	2,071

29. On the question of machinery, Dr. Voelcker is strongly "in favour of attaching institutions for agricultural education to existing educational institutions in preference to isolating them," and Dr Cooke thinks "that this is the best and most economical method of securing to students the benefits of general as well as special education, as well as continuity in the system of instruction." And indeed the Simla Conference, agreeing with these distinguished Professors, deprecates the creation of special colleges and schools of agriculture. With all due deference, we venture entirely to dissent from this view and hold with the Madras Government that separate special institutions are absolutely necessary for specialized instruction, and that any attempt to graft on the general educational scheme such instruction, particularly in its higher branches, is doomed to failure and disappointment, there being always present the risk of the special studies being shadowed over and relegated to a secondary position in the general system. European experience supports this contention, and both the Madras and Bengal schemes contemplate an elaborate special machinery for the purpose. Accordingly we would also venture to recommend a similar special teaching agency for this Presidency. We would have—

- (a) *A Central Agricultural Institute*, to be located in Poona, as distinct and separate from the College of Science, organized on the plan of the celebrated Paris Institute Agronomique or the Berlin High School of Agriculture, well equipped and under a European (French or German) Specialist as Principal, assisted by a strong staff of qualified lecturers. The existing agricultural classes of the Poona College of Science to be transferred to the proposed Institute; the three years' course as at present arranged, leading up to the final test for the University Diploma, to be widened by the inclusion of (among other subjects) *comparative agriculture, agricultural technology, administrative law and land legislation*; the Institute to have a museum and a laboratory and an experimental farm as part of its necessary equipment; and finally the admission test to be sufficiently high to ensure an adequate basis of general culture. (We would not go below the U. S. F. or the Matriculation Standard, and would have by preference P. E. as the lowest test.) The Institute would

impart the highest type of instruction in scientific agriculture and would be mainly for sons of the large landed proprietors and science graduates and undergraduates of the University wishing to qualify themselves for higher appointments in the Revenue and Survey Departments and the Department of Agriculture.

- (b) Next, we would have five *Divisional Schools of Agriculture* corresponding to the "regional" schools of France or the Agricultural Institutes of Prussia, on the plan of "representative" district farm schools contemplated in the Madras scheme, but of a superior type. Our districts naturally fall into five groups, each with a distinctive and well-defined set of climate and cultural conditions, *viz.*, Sindh, Gujerat, Konkan, Deccan, and Carnatic; and we would propose that each of these divisions should have a superior school of agriculture located in a representative district. These divisional schools should be under competent native agricultural graduates as Head Masters, to be assisted each by a staff of four to five special lecturers. The entrance test to be the 2nd grade P. S. certificate as the minimum, the curriculum to be a sufficiently broad one, corresponding to the 1st and 2nd year courses of the Central Institute, and to comprise, besides the usual professional subjects, *comparative agriculture and land tenures*; the instruction imparted to be thoroughly practical and to have a special relation to the agricultural conditions and wants of the Divisions in which the schools are located, and excursions for observation and study to form an integral part of the course; each school to have a *model, not an experimental, farm*, intended for experimental illustration, exhibiting results of practices and processes shown by experiment to be advantageous, and the farm to be a model of successful cultivation to the whole Division. These schools are intended for sons of the large landed proprietors who might return to their ancestral estates and carry out agricultural improvements, as well as for other young men desiring to qualify themselves for posts in the Agricultural, Revenue or Survey Departments, or as managers of estates, and they will be either as feeders to the Central Institute or independent agricultural institutions, giving certificates of efficiency to their successful pupils at the termination of the course. We would also suggest that these divisional schools should have each a *normal class*, on the model of the one we have at Nagpur, to be composed of Vernacular teachers, say one from each Taluka, who, after they get certificates, might return to their schools and would form a valuable agency for the introduction of agricultural instruction into the village schools.
- (c) We would further have *agricultural classes* in all the High Schools of the Presidency—8 already existing. These classes to continue as at present teaching pupils for the U. S. F. course and also for the Central Institute and the Divisional schools. These classes further to have each a model farm where "apprentices," sons of poor farmers and labourers, might also be admitted for agricultural instructions; these apprentices to be stipendiary students (as till lately at Sholapore) and bound to work on the farms. The course of instruction for these apprentices to be as simple, elementary and practical as possible; the farms to be models of good and careful cultivation to the whole neighbourhood. The farm-schools so arranged under High School agricultural teachers, would correspond to the Departmental farm schools of France, and be our District schools, such as are proposed for the districts in the Madras Presidency.
- (d) We would at once introduce elementary instruction in agriculture into our village schools, an agricultural primer such as is taught in Bengal or the Central Provinces being read as a compulsory text-book. This would form a solid groundwork for the upper specialized courses.
- (e) Finally, we would earnestly recommend, as part of this teaching machinery, the appointment of *travelling agricultural lecturers*, corresponding to the Departmental professors of agriculture in France or the *wander-lehrer* of Germany, whose duty it would be to travel about the districts and deliver lectures to the assemblies of adult cultivators convened specially for the purpose in their own villages and under their own village headmen; elucidate to them in the most simple way and in their own homely idiom the more important principles of practical agriculture with direct reference to the features and conditions of the local farming; and suggest improvements in practices and processes and implements shown by experiment or found by experience advantageous elsewhere. These travelling lecturers should be certificated men of the Central Institute, who have gone through a systematic course of training and selected for their special practical knowledge, and should work under the immediate professional direction and control of the Director of Agriculture. They would also serve as advisers in agricultural matters to the district officers. Two for each "agricultural" division, or ten in all, would be enough for a practical beginning; the salaries should be sufficiently high, say, ranging from ₹150 to ₹200, to attract competent men for the posts. Altogether, to our thinking, these travelling lecturers would fulfil a most useful and important function in the general scheme of

agricultural education. They would form an admirable and effective agency—*Agricultural education (Mr. Joshi)*—contd. perhaps the only one that could be devised in our present condition of primary education—through which to reach the cultivating classes in the villages, disseminate among them sounder notions of practical agriculture, and, awakening their intelligent interest, enlist their active co-operation in the cause of agricultural improvement.

30. Such, briefly, is the machinery, and such are the institutions, we would recommend for the agricultural education of our rural classes. These institutions are—

- (1) A *Central Agricultural Institute* to be located in Poona under a European Principal.
- (2) *Five Divisional Schools of Agriculture* for the five agricultural divisions of the Presidency, each to be located in a representative district and with a Normal class for the training of Taluka Vernacular teachers.
- (3) *District High School classes and farm schools for apprentices* in all the districts of the Presidency.
- (4) *Elementary agricultural instruction* in the primary schools; and
- (5) *Ten travelling agricultural lecturers*—two for each Division.

31. With the exception of the Principal of the Central Institute and a few specialist professors who would have to be brought out from Europe, the requisite supply of teaching power for the proposed institutions could be easily obtained from the Poona, Baroda or Sardapat College, or the Nagpur Agricultural Class. There would be surely no lack of competent men for the work if sufficient attractions were held out. As for text-books, there would be some difficulty, and suitable hand-books would have to be specially prepared in the Translation Branch of the Educational Department for the purpose as they are required.

32. As to the question of *management and control*. All the institutions we have proposed should, we think, be under the administrative control of the Director of Public Instruction, as constituting an integral part of the general machinery of State education. In all professional matters relating to studies, lectures, text-books, tests, etc., we would have the Department of Agriculture exercise a directive supervision over them. At the local centres, besides, it would, in our opinion, be desirable to have small Boards composed of Revenue officials and non-official representative farmers, constituted and associated with the management of these institutions. The travelling agricultural lecturers would, of course, work, as stated before, under the immediate orders of the Director of Agriculture as do the Departmental professors in France under the Minister of Agriculture.

33. Lastly we come to the *vezata questio* of funds. The total charge of the machinery proposed would be, as far as we are at present able to estimate, about ₹1,00,000 at the most and on a liberal scale, or about $\frac{1}{4}$ per cent. on the total land-revenue collections of the Presidency (₹3,60,00,000), distributed as below:—

	Cost per annum.
	₹
The Central Institute	26,400
Per mensem.	
₹	
The Principal	1,000
The staff	1,000
Other expenses	200
The 5 Divisional schools of agriculture costing ₹500 each per mensem	30,000
The 28 District schools and classes costing ₹100 each per mensem	27,600
The travelling lecturers, ₹125, including pay and travelling allowance, each	15,000
Scholarships, prizes, etc.	2,000
TOTAL	1,01,000

34. The National Institute Agronomique, Paris, alone receives from the Central Government in France an annual grant of Fr. 251,450 (=£10,058, or over a lakh and a half). The small kingdom of Denmark devotes about £11,000 (=₹1,76,000) to the support of agricultural education. The additional expenditure, therefore, of a lakh of rupees or so per annum proposed for Bombay, with her vast agricultural interests, in support of agricultural education, may not be deemed too large or extravagant.

35. How is the new charge to be met? On this point we have two distinct suggestions to offer—

The total Provincial contribution to Local Funds by way of compensation for the loss sustained in consequence of the abolition of the one anna cess on abkari revenue is, as at present fixed, ₹1,55,068. The *excise revenue* of the Presidency comes up now to over 104 lacs net, on which the one-anna cess would amount to about ₹8,50,000,—i.e., nearly four times the present grant. In fairness and equity we submit that the grant should at least be doubled, and our suggestion is that the increase thus accruing to local resources might be utilised partly in aid of primary education and partly for the provision of agricultural instruction.

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education (Mr.
Joshi)—contd.*

Secondly, we would venture to suggest that the time is now come for considering whether the Local Boards might not be authorised, by amendment of the existing statutes, to spend half of the local cess proceeds instead of one-third, as at present, on the extension of primary education for the masses. Roads and bridges, dharmashalas and kaoharis, are, no doubt, most desirable things in themselves, but we have spent on these works of public convenience and utility very large amounts during past years, and it behoves us now to consider whether part of this expenditure might not be advantageously diverted to the extension of educational facilities for the people. General and technical education—it cannot be too often repeated—is essential to the well-being of the masses, even more so than the facilities of communication, and there is force and justice in the demand that every effort should be made to raise the poorer classes of the country “intellectually to the moderate level insisted on in regard to the humblest inhabitant of every civilised country.”

36. Should these two suggestions meet with favourable consideration, the financial difficulty can be easily got over and the scheme of agricultural education, as above outlined, might be launched out at once.

37. As for young men for the agricultural institutions; no doubt much difficulty would be experienced at the start in attracting students to the new courses. The field is a new and untried field, and special inducements would have to be offered, at least at the initial stages. The machinery of scholarships, rewards, and prizes would have to be employed, and we would also suggest, by way of special encouragement and in order that the scheme might receive a fair trial, that two or three high-class appointments (worth, say, ₹150 to ₹200) in the Revenue, Survey or Education Department, might be guaranteed to the successful students of the Central Institute, and two or three more in the subordinate branches of the public service set apart for the certificated men of the Divisional schools of agriculture. In the faculty of Civil Engineering, Government has given special encouragement to graduates of the University by the guarantee of certain appointments in the Public Works Department; and we know what a powerful attraction these guaranteed places have been to students of superior calibre and attainments. A similar privilege, if conceded to diplomaed men of the agricultural institute and certificated men of the agricultural schools, would assure their future in a way in which nothing else could. In course of time, as knowledge and enlightenment spread among the masses and the value of professional training comes to be seen, a fine field would open out before the trained men of these institutes. We have in our Presidency no fewer than 85,801 superior landholders—including Inamdars, Khots, Talukdars—besides many capitalist farmers, and there are close on 40,000 superior holdings, 38,300 averaging 100 to 500 acres, and 2,000 of over 500 acres in extent. And as agricultural education is more and more appreciated as a help to agricultural improvements, these trained men of the agricultural schools would be in great demand, and several would employ their professional knowledge for the improvement of their own properties and holdings. But this is a work of time, and in the meanwhile extraneous and artificial aids and inducements would be necessary to put the system into fair working order.

38. Such is our scheme, which we think might also be found suitable for the other Provinces of India. It is, no doubt, a large and comprehensive scheme, but we are convinced that no limited or restricted plans would meet the requirements of the case. The pressure of the economic position is severe—increasingly so,—and it does not seem to us to be in any view desirable that energy and funds should be frittered away on half measures and makeshift arrangements, which could yield no solid or lasting advantage. Let us make the effort, if an effort is to be made at all, on an adequate scale. The situation demands it, and considerations of future economic safety give emphasis to the demand.

39. The expenditure required would be a rather large addition to the Educational Budget of the Presidency. But looking to the magnitude of the interest at stake,—looking to the fact that now even the food supply of the people is imperilled and famines with starvation and suffering and an industrial paralysis in their train are threatening to be chronic in the land—the cost of the measures intended to bring some help and relief ought not to be deemed prohibitive. It should be cheerfully met and borne, whatever it may come to, if only for the sake of the future, even if necessary by resort to special taxation. There is also the Famine Insurance Fund, on which we might reasonably make a demand for this purpose.

40. The scheme is put forward in the confident hope that if properly given effect to it would be a lasting blessing to the country. Of course, we do not expect impossibilities; we are well aware that other measures of an equally comprehensive character, including a permanent limitation and settlement of the State demand upon the land, so as to bring into effective play the magic sense of property, which “turns sand into gold,” are required to restore the agricultural industry and life of the country to its healthy and normal tone. But education and the diffusion of technical scientific knowledge among the masses would have their effect, and would exercise a most salutary—revivifying and reinvigorating—influence on the entire economic life of the people. The Indian ryot with all his faults and shortcomings—and they are not few—is not the blind, obstinately conservative industrial worker he is painted to be. He is shrewd, keen-sighted and intelligent, always open to reason and argument, and ever ready to welcome light and new ideas, from whatever quarter they might come. He works in his old ways and sticks so lovingly and passionately to his own traditional methods, for he is yet untaught to understand and appreciate other and better ones. Let him be, for once, brought under the liberalising influences of education and knowledge, and no industrial worker could surpass him in boldness of initiative or vigour of enterprise. Education, wherever it has been tried, has

proved one of the most effective helps to moral, intellectual, and industrial upheaval and progress, and we submit there is nothing in the conditions of this country or in the national character and habits of its people to forbid the hope and anticipation that it would serve a similar end in India and work an analogous revolution. *Agricultural education (Mr. Tute)*—contd.

41. The scheme of agricultural education sketched out in the foregoing pages is submitted with great diffidence and as a tentative scheme, and whatever may be thought of its merits as a practical working plan, we feel sure that the educational problem, as regards the rural classes of the country, will receive the most careful consideration at the hands of the Conference, and we would content ourselves with observing that while the life-blood of the country is slowly ebbing away—the penalty of ignorance and mental degradation—the question of effective relief and cure with the aid of knowledge, Heaven's Light, may no longer be put aside. Our duty in this matter is a most solemn and sacred duty, and let us do it bravely, resolutely and cheerfully, come what might, and

" Learn, even in the darkest hour,
To trust the Almighty's care,
His eye beholds, His hand protects—
Oh, who would then despair ! "

(18)

Note on Agricultural Education prepared by MR. A. C. TUTE, Collector of Dinajpur, Bengal, and read before the Conference by MR. W. C. MACPHERSON, Director of Land Records and Agriculture, Bengal.

1. Few will dispute the main conclusion arrived at by Dr. Voelcker that our present system of education directly discourages anything like a study of agriculture. *Agricultural education (Mr. Tute)*.
2. It will also be clear to any one who has lived in the mufassal, as I have now for 22 years, that the one direction in which we can move with benefit to the country is improving and developing its natural resources.
3. The experiment of fostering every ideal thing has been tried for the last ten or fifteen years in Bengal. Boys have been taught everything under the sun save one, and that is to use the materials the Almighty has given them to the best advantage. We have tried to satisfy the cravings of a limited class of men for political power. We are all of us aware of the amount of real good that would oblige the country. Even in the jails we have taught peasants trades and industrial science, and if they had the inclination, they have not the means of pursuing after their leisure the trade of their choice.
4. We seem to have one thing needful, and that is, teaching people to make the best of the natural resources of the country.
5. I have been asked, not only by the Director of Agriculture in Bengal to furnish him with a note on the subject of agricultural education, and I gladly take the opportunity of giving my views for what they are worth on a subject which a constant mufassal service has rendered of paramount interest to me—the improvement of the resources of the country. We must start with two assumptions. They may seem unkind, but they are true. One is that the Bengali Babu will not take up any line of country from which he cannot see some near personal gain. By the Bengali Babu I mean the population under education at all schools above the rank of the village pathshala, in which the 3 R's alone are taught. The next is that the ordinary peasant views with distrust any new thing. At the same time when he sees by demonstration that a real gain can be had by the adoption of some simple method, he is eager to take it up. The popularity which has followed the introduction of the sugarcane crushing mills in this most backward district will illustrate my statement. How to combat these two drawbacks to the spread of agricultural education must be the first object in any scheme for the furtherance of the spread of that education. I have taken the line rightly adopted by Dr. Voelcker that we must begin simultaneously working from above downwards and from below upwards—from the student in the higher schools downwards: from the peasant who follows the plough upwards.
6. It is absolutely vain and idle to start anything like agriculture, whether theoretical or practical, in our schools and colleges as a voluntary or optional subject. I do not even think that the facility of obtaining a degree in agriculture, much as it would be prized, would in itself be enough to tempt those who go in for higher education to take up that subject. It would soon be known that a certain B.A. was but an agricultural B.A., and his value would be discounted amongst those who had taken their degree in the more cultivated subjects.
7. Added to this there is a contempt for anything like farming ingrained in those who call themselves "the enlightened." Education has not developed the physical side of their nature, and they would no more go in for the practical farming that commends itself to the young men at home, who go in for hard work to learn farming, than they would dream of attempting mountaineering on the Himalayas, or taking long walking tours for the pleasures of exercise and of enjoying the scenery of Eastern Bengal.
8. To make the study of agriculture a possibility amongst these people, it must be a *sine qua non* for the obtaining of a post. It must be made a compulsory subject in all competitive

*Agriculture's
education (Mr.
Tute)—contd.*

examinations for the Subordinate Executive service, and for the executive branches of the Provincial services. The question is—Is this desirable? I have no hesitation in answering, *yes*.

9. The knowledge of the principles of agriculture is invaluable to those who enter Government service. They must necessarily be few in number. Where I see the great advantage of the compulsory study of agriculture is *to the hundreds who must needs fail in getting those appointments*.

10. What is the result of our present system? Some hundreds of young men yearly fail in the attempt to get Government service. The next thing they go for is the Bar. That in the mufassal is already overcrowded. They cannot take to medicine, for they have not the training. The career of an engineer, either in Government or private employ, is equally closed. No man can become an engineer without a long and careful practical training.

11. They fall back therefore on newspaper-writing, politics (save the mark!), and annually swell the ranks of a discontented class who have received a cheap education and find that it is of no practical use. The whole array of mukhtars' touts, petition-writers, and outcherry loafers is the direct result of a system of education which has given men a certain acquaintance with the history and language of a foreign country, and has utterly failed to show them how to develop the resources of their own.

12. Land is cheap enough in all conscience in many parts of Bengal, and were the study of agriculture raised and dignified by being made a compulsory subject for Government service, many a man who now takes up pursuits of a more or less questionable respectability, would turn farmer, and benefit himself and his neighbours by farming on the principles which he learnt at school and college.

13. I am not sufficiently versed in the subject to lay down any methods by which agriculture should be taught in these higher schools. One thing would, to my mind, do much to further the study of the subject, and that is, to make Dr. Voelcker's own report a prescribed textbook in English. The style is as good, if not better, than many of those which students now read, and the subject-matter is certainly more useful than that of almost any one of them. I have tried to show why I think the study of agriculture should be made compulsory amongst students. I now come to consider how in the immediate future we could extend the knowledge of sound agricultural principles amongst the masses of the people. My first proposition in this direction may seem rather startling.

14. Over the gates of Kilmainham Jail in Dublin is inscribed the legend "Cease to do evil; learn to do well." Now, however much jail discipline in the *practical* may have made evil-doers to cease from evil practices, it has not taught them much of the *practical* art of doing well for themselves when they come out. There are, of *practical* knowledge, prisoners of the hardened criminal classes to whom jail must be made as distant *of time and place*. There is, however, a considerable jail population who are in casually, *temporary* lapse from the path of rectitude. Most of these men come from the *practical* classes. What could be easier than having every jail garden a practical school *of found suits* for such prisoners? A certain amount of task-work could be exacted daily from *each* *and it seems to me that* time would be better spent in showing a man, who had been brought up amidst agricultural surroundings, methods of carrying on his farming operations better than those to which he was accustomed, than in teaching the same man how to weave blankets or stoke an engine, as he is taught in the central jails, or breaking his spirit by the monotonous sound of the oil-mill or the dull tedium of the dhenki, as is done in the smaller prisons.

15. A man may learn to weave blankets in company with a number of others, but when he comes out of jail he would no more dream of carrying on the industry unless he were of weaver caste than he would for amusement call out, "Sirkar, salaam as you was," to which we are all accustomed. It is supposed, but I believe erroneously, that teaching men work on machinery fits them for employment in the Calcutta mills. It may *fit* them; but Calcutta employers, like the generality of men, look with disfavour on taking released convicts into their employ.

16. Teaching agriculture in the jails to prisoners, to whom it is not *absolutely necessary* to make life as unpleasant as possible, is therefore one of the means of spreading a knowledge of agriculture which commends itself to me. The more so, as my experience shows me that once a raiyat has seen *in his own case* that a certain method will give him a larger outturn, he will readily adopt it. From another point of view, too, it would be good, for it would send a man back to his home with some valuable information acquired, which he could use for his own advantage, and without getting the cold shoulder from the world in his efforts to lead an honest life.

17. I am puzzled how to suggest the teaching of agriculture in patahalas just at first. The kindergarten system of practical object lessons seems to me the best, and I am going to start five schools on the path of agricultural learning. I have selected these schools, as being situated either in Wards' estates, or estates which have recently come from under Wards' management, the proprietors of which are enlightened, and will be ready to help me. It is but an experiment, and I cannot prophesy its result. There is one thing certain, and that is, that if agriculture once gets popularized in the higher schools, its finding its way to the patahalas is a matter of but little time. Dr. Voelcker has given us the results of his enquiries. It is

necessary that those results should be widely known if they are to be of any practical good to the Empire. *Agricultural education (Mr. Tute) —contd.*

18. To ensure this a thoroughly sound system of agricultural education is necessary. This is impossible unless Government gives the subject a prominence which it has never yet enjoyed. If but half the trouble and energy which have been devoted to fostering Local Self-Government in town were devoted to inculcating local self-help in the mufassal, we should, in a very short time, have the Province of Bengal one of the wealthiest agricultural countries in the world.

(19)

Note by Mr. J. B. FULLER, Commissioner of Settlements and Agriculture, Central Provinces, on the need of simplifying the language of village school text books.

The artificial vocabulary of vernacular school text-books must have struck everyone who has examined a village school in these provinces. Even the First Reader, for children who have just got on terms with the alphabet, contains words which are never used by the people and which require translation before the pupils (and sometimes before their examiners) can comprehend their meaning. I take for instance Lesson 16 of the First Hindi Reader in which simple words have in the following cases been rejected for uncommon words of foreign origin :— *Language of village school text-books (Mr. Fuller).*

Svapna for "dream" (sapna).
 Varna for "caste" (jati).
 Nyāya for "justice" (insāf).
 Vastra for "clothes" (kapra).
 Ahār for "food" (khana).
 Avashya for "necessary" (zarur).
 Sahasra for "thousand" (hazar).
 Bhiama for "doubt" (sandeḥ).
 Jivadhām for "animal" (jānvar).
 Shreṣṭh for "best" (sab se utam).

The writer of this book himself appreciated the difficulty of many of the words and gives at the beginning of the Lesson equivalents for them in common speech.

2. I will now take as a sample of a more advanced text-book, the Hindi translation of the Agricultural Primer, and would observe to begin with that, as the primary object of this book is to instruct in elementary science and not in language, its vocabulary and style should be as simple as possible, and the translator should take as his model in this respect the admirable series of English Science Primers written by Huxley, Geikie, and others. But as a matter of fact the translation is so interlarded with Sanskrit words and phrases as to be absolutely unintelligible to an ordinary agriculturist if read out to him. I will pass over the Introduction, which is not perhaps an easy passage to translate, and will begin with Lesson I. Now, I do not object to the word *kriṣhividyā* for "agriculture," as a somewhat technical term is required and we may go to Sanskrit for it. Similarly, *kala* may be accepted for "art," which is a word having (so far as I am aware) no equivalent in use. But I object to *nyam* for "rules" or "principles," *varnan* for "relate," *visheṣh karke* for "especially," *sambandh* for "relation"—all in the very first sentence. Not one of these words is in ordinary use.

Going further I object to the use of *jantu* for "animal" (*jānvar*), and again of "*jivadhāri*" in this sense; of *praya* for "nearly," *vriksh* for "tree," (*ke*) *dwara* "by means of," *svata* for "themselves" (ap se ap), *virudh* for "opposite," *navin* for "young," *tantu* for "hairs," *sadaiv* for "always," *tebe* for "quick," *gati* for "motion," *bhakhya āraya* for "food" (khaneki chizen), *avashyak* for "necessary," *vastu* for "thing," *parambh* for "beginning," *sūdh* for "clear," *khadya* for "food," *asambhava* for "impossible."

Passing to Chapter II, amongst numerous instances of pedantic phraseology may be quoted :—

Sampurna for "whole."
Padārtha for "substance."
Yatharth for "in reality."
Adbhut for "countless" (be-shumat).
Sukshma for "fine."
Yadi for "if."
Drishti for "sight."
 (Ki) *Nai* for "like" (to).
Dinaru for "old."
Prani for "animal."

Now, the English words rendered as above are (with the possible exception of "substance", all simple terms, and having simple equivalents in everyday use. I am aware that the common language of the people is very deficient in abstract terms and that to translate such terms it may often be necessary to have recourse to the classical languages. [Perhaps the use of *gati* for "motion" may be justified on this ground.]

Language of village school text-books (Mr. Fuller) —contd.

Similarly, the use of classical words may be justified in translating purely scientific terms, though I think that in most cases it is better to boldly introduce the English term as it stands: "oxygen" is no more difficult for the schoolboy than "pran iakshak vayu"—its school-book translation. But I can see no justification whatever for the introduction of strange equivalents for words in everyday use—in the substitution of *prani* for *janwar*, of *vastu* for *chiz*, of *avashyak* for *sarur*, and of *khadya* for *khana*.

3. The introduction of Sanskrit words into our Hindi (and also into our Marathi and Urdu) school-books is apparently due to a desire on the part of the writers to exclude as contraband every word which is not of purely Hindu origin. It is not only in our schools that this desire for purism has made its mark. It has affected the court language also. For the familiar "Mudai" (plaintiff), "Mudalai" (defendant), and "gowah" (witness) our summonses bear the outlandish equivalents of *badi*, *pratibadi*, and *sakshya*,—words which are absolutely strange to the people. There is no length to which these purists will not go. A ban has ever been placed on the familiar word for "if" (*agar*) which is replaced by the unused word *yadi*.

4. The subject is one on which I addressed the Administration of these Provinces some time ago, and the question of reforming the text-books is now under the Chief Commissioner's consideration. I wrote—

"In stating that words directly taken from Sanskrit are not understood by ordinary pupils, I of course exclude those who have learnt them at school. Such persons, having acquired a knowledge of them with difficulty, are by no means disposed to underrate them, and one of the main difficulties in dealing with this subject is to ascertain whether words which have a strange look in text-books are understood by the people or not. It is by no means easy to cross-examine an uneducated man on the subject, and educated men have generally passed through the mill of the Education Department, and of course understand these words and are proud of understanding them. The real test is to enquire whether such words are used in ordinary conversation. It will be found that they are not. No ordinary man in his senses would for instance use "yadi" for *if*, "arambha" for *beginning*, "yatho chit" for *as far as* *chahye*. I am aware that objectors will argue that there is in English a vast difference between spoken and written language. But I submit that such difference as there is amounts to nothing compared to which we find here. There is not a word in an ordinary English text-book which could not be used in conversation with perfect propriety and without the very least reproach of pedantry. The difference between written and spoken English is one of style and syntax, not of vocabulary.

"Now, if it is true (as I venture to maintain) that our Hindi text-books are so framed as to introduce our schoolboys to a new language of highly artificial origin, instead of improving them in the use of their own language, the position is one open to very obvious criticism. So far as books are meant to teach a knowledge of things their object is in great measure defeated. The days are gone by when Latin was employed as a vehicle for teaching the rules of Latin grammar, and it is now universally recognized that a book which is to convey a knowledge apart from scholarship should be written in the simplest style possible. Education in the present time is becoming more and more directed to the expansion of the intelligence as opposed to the mere cramming of knowledge. But how imperfectly must such an object be attained when the wording of our books requires special study in itself? We now teach elementary science—a subject foreign to the ordinary run of indigenous studies and hence requiring special lucidity of treatment. Yet our science text-books are so written as to be unintelligible save to one who has first acquired a knowledge of their language. It would be more reasonable to employ the language of Chaucer as a medium for teaching Geography in English schools.

"Moreover, from the literary side of the question there appear to arise numerous not less weighty objections. I write with all diffidence on such a question as this, but I have always understood that the development of the English language in its present form dates from the admittance of the 'vulgar tongue' to our schools, courts and churches.

"It appears to me that the use of an esoteric tongue—quite distinct from the language of everyday speech—as the medium of instruction must powerfully obstruct the literary progress of the people. There is of course no scope for eloquence in such a language, for eloquence is only awakened by an audience. Books written in such a language would appeal to a very small class, and indeed little could be looked for but educational works—keys, manuals, and the like. The language being artificial and pedantic would always remain divorced from the thoughts of the people, and in teaching it we are raising a barrier between thought and language which must be prejudicial to both."

(20)

Note by Mr. E. C. OZANNE, Survey Commissioner and Director of Land Records and Agriculture, Bombay, on the progress of improved Dairying in Bombay and the necessity of improving Indian milk breeds.

Improved Dairying (Mr. Ozanne).

In 1890 Dr. Voelcker formed an opinion (Report, page 216) that in dairying there is but limited scope for improvement, but he still thought that "scientific study of dairying" in India was called for.

In the former opinion at the time I concurred, but there is now evidence that the scope for improved dairying is very large and that the need for scientific study is much needed, and that this study should be extended in the direction of improving the milk breeds of cattle.

Improved dairying in the Bombay Presidency is now far beyond the experimental stage. The first steps towards improvement began four years ago, as narrated in Dr. Voelcker's Report, with the introduction of improved dairy machinery and appliances and through the practical tuition afforded by dairy experts employed by Government. The initiative example of the Agricultural Department has encouraged progress. The extent of the progress may be fairly gauged by the value of dairy machinery and appliances already sold in India. Up to date the sales by the agent of the Dairy Supply Company alone aggregate about two lakhs of rupees. The machinery sold consists chiefly of cream separators and butter-making appliances. Cheese-making so far has not proved successful. Excepting perhaps in the north of India, climatic conditions are all against it. Elsewhere even moderate success in

cheese-making can hardly be expected. At out-stations some trouble is still experienced in profitably disposing of separated milk. In towns there is now no such difficulty. *Improved Dairying*
(Mr. Oranne).
—contd

The wide extension of improved methods is largely due to private enterprise. During the last year, this extension has been greater than in any previous years. It is certain that the manufacture of good dairy products will increase. As far as this industry is concerned no further fostering help is required from Government in some localities. Further progress in the Bombay Presidency is assured because dairymen find improved methods much the most remunerative. It is not only the consumer and dairyman who are benefited, the milk producer also, even in remote districts, participates in the better prices. In out-stations, where separators have been introduced, milk has risen appreciably in value, and buffalo-cows kept for milk have much increased. The reason is that butter properly made and cream properly separated can be railed to those important centres where market rates are high. In India there is hardly a limit to the distance to which well-made fresh butter can be sent. And as regards cream, during twenty-four hours' transport it will be ripening, so that, at destination, it will be in good condition for conversion into butter.

The far-reaching benefits of improved dairying prepare the way for what to my mind is a much more important undertaking. I refer to Government action towards the improvement of the milk-breeds of India and systematic enquiry by expert Government officers into the economic rearing and feeding of milch-cattle. I think it is clearly the duty of the Conference to lay down a definite line of action along which enquiry by each Provincial Government should be made.

The question is of the greatest importance, and has probably as great a bearing on the future agricultural prosperity of the country as any question. Milk and the many products from milk are to a greater extent the food of the people than in any other country in the world. Yet in no other country are the milch-cattle so unsatisfactory as they are in India. How poor in quantity, not quality, the milk yield is of the average Indian buffalo or cow is difficult to estimate; but it can be judged of by the difficulty of getting a good milch animal and the price that has to be paid for one. In the Bombay Presidency proper, I know of no tract excepting the Gir in Kathiawar and parts of Gujrat where even moderately good milch cattle are bred. In Lower Sind there is a fine milch breed. It is likely to be maintained in its pristine purity, because owners exercise the greatest care in mating their best milk cows. Many Sind stock-owners know the pedigrees for generations of their best milk animals. Elsewhere a haphazard system of breeding prevails, and it is an incontrovertible fact that the cattle are generally poor milch cattle and that their capacity to yield milk is apparently getting poorer year by year.

If we look to the history of any renowned milk breed of other countries, we find that through the efforts of specially qualified experts it has been bred up to its present high standard of excellence. There are good grounds to hope that the better class of Indian milk-breeds can be similarly improved. We have here and there throughout the country a remnant left of good material to begin upon. The work cannot be left to stock-owners. "Breeding specially for milk" is beyond the knowledge of the ordinary cattle-breeder. He undoubtedly knows how to breed good work-cattle. There is no reason, however, why a deep milking cow should not produce male offspring calculated to grow into good draft animals.

Improvement must be initiated in Government dairy and stock farms. If these are worked to supply Commissariat Departments with milk for sick soldiers in hospital they ought to be self-supporting. Such farms will be popularized if the military authorities find, as they have already done, that they can therefrom obtain a purer supply of milk than from the *gwalis*.

The establishment of Government dairy and stock farms would not only afford facilities for the primary object for which they would be instituted, *viz.*, the improvement of indigenous milk breeds of cattle, coincident with which would be the maintenance of milk registers and the systematic testing and analysis of milk, but would also afford the necessary opportunities for thoroughly investigating the comparative values of the numerous fodders and cattle foods which are in general use, but regarding the value of which we know next to nothing at present. Dairy farms would also form educational centres at which the more useful lessons to be taught would be the manipulation of dairy appliances and the practice of improved methods.

In breeding specially for milk, I think it is quite possible to improve our breed of buffaloes so that they become one of the best, if not the best, butter-producing breed of the world, and at the same time eliminate that irritableness of temper which is alike characteristic of most Indian breeds of cows and buffaloes, and which is all against free and full lactation. I think it is also possible that an unprofitable hereditary disposition to be irregular breeders may be in a like manner got rid of.

(21)

Note by Mr. J. WILSON, Deputy Commissioner, Shahpur, Punjab, on the use of Wards' Estates in Agricultural enquiries.

In Resolution of the Government of India, Revenue and Agricultural Department, No. 52G., dated 14th September 1887, paragraph 4, it is said that "much importance is attached *Wards' Estates in*
Agricultural
enquiries (Mr.
Wilson).

*Wards' Estates in
Agricultural
enquiries (Mr.
Wilson)—contd.*

by Her Majesty's Secretary of State, as well as by His Excellency in Council, to the manner in which estates under Government management are administered, and to the use made of the opportunities afforded by them for ascertaining the economic condition of the agricultural population." In estates under the Court of Wards, which are scattered all over the country, and managed by establishments thoroughly under Government control, we have ready to our hand an excellent means of observing existing modes of agriculture, the outturn of different crops, and other agricultural facts, which it is difficult to ascertain with accuracy except by systematised and continuous observation.

For instance, every Settlement Officer who has had to work out estimates of produce, such as those on which the land-revenue assessment of many districts in the Pánjab is based, must have felt that, owing to the want of a continuous system of observation on a sufficiently extensive scale, his estimates are, at the best, merely rough guesses. As regards the important factor of average outturn, they are generally founded on the results of observations made on small areas picked out here and there as representing average crops, checked by the very rough ideas agriculturists themselves have on the subject, and it is rarely possible to find them on trustworthy statistics of the actual outturn on large areas for a series of years. The need for such statistics is emphasized by the fact that it is a matter of common experience that observations conducted on small areas are apt to give too high results, and that the larger the area over which the observations are made, the smaller becomes the figure at which one is inclined to estimate the average outturn of a district or assessment circle.

As an example of the system I suggest, I may mention that in estimating the average produce of the Shahpur tahsil for purposes of assessment, I derived great assistance from the returns of the Natra estate which was under my own management as Court of Wards. As regards wheat on canal-irrigated lands, I found that the area harvested had, during the previous six years, varied from 2,195 to 4,032 acres, and the average outturn per acre from 5 to 11 maunds, the average for the six years being 7 maunds per acre on an average area of 2,028 acres. An average thus struck was obviously a much better basis for my estimates of average produce for the assessment circle than the statistics collected in the usual way by striking averages of the results of a number of observations on small areas of 2 acres or so, conducted in different places during three or four years.

What I would suggest is that the Director of Agriculture should be invited to lay down a system to be followed on all estates under Court of Wards, by which the areas under direct cultivation, or paying rent in kind by a share of the gross produce, should be carefully recorded with detail of soil and method of cultivation, together with the corresponding gross outturn of each kind of crop. These statistics should be tabulated year after year in such a form as would make it easy at any time to strike an average; and, say, every five years, averages might be struck and a note compiled by some one working under the Director's instructions showing the results of these observations and how far they might be taken as giving a true average of the outturn of different crops for the estate itself and for the whole tract in which it is situated.

Similarly, a system might be laid down under which the modes of cultivation practised on such estates, the amount and quality of the seed used, the quantity and kind of manure, the number of ploughings, waterings, etc., might be accurately recorded year after year for large areas. Observations thus continuously and systematically conducted would give us much more definite and accurate knowledge of existing agricultural practices than any number of desultory enquiries.

It will be noticed that in this note nothing by way of *experiment* is suggested, but only a systematised *observation* of existing practices and their results.

(22)

*Note by Mr. J. Wilson, Deputy Commissioner, Shahpur, Punjab, on the introduction of
Agriculture as a subject in Putwari's Examinations.*

*Agriculture in
Putwari's
examinations (Mr.
Wilson).*

In India, where such a large proportion of the pupils who attend the schools do so with the object of passing some examination which will qualify them for Government employment, the control of the development of education is in a familiar degree in the hands of the executive Government. All that it has to do is to prescribe the subjects in which candidates for the different posts are to be examined, and the whole system of education throughout the country will, following the law of demand and supply, speedily adjust itself to the requirements of the Government examinations. If, for instance, it is considered desirable that all grades of officials in the Revenue Branch of Administration should have a knowledge of agriculture, all that is necessary is that that subject should be given a prominent place in the examinations for all grades, and now that manuals of agriculture exist in most provinces, it would undoubtedly be a useful change if they were prescribed as subjects for all such examinations. More particularly, Dr. Voelcker's report on Indian Agriculture should be prescribed as a subject for all examinations for the post of tahsildar or any higher grade in the Revenue Branch.

As regards the post of putwari in the Punjab, the change could be very easily made. At present candidates for the post of putwari are examined in the three manuals, Arithmetic, Mensuration, Putwari and Kanungo Rules. There already is taught in most schools an excellent little manual on agriculture, giving a simple account of existing agricultural facts and processes, and this should be at once prescribed as a subject for examination. I should be

glad to see the examination made still more practical. Candidates might be made to yoke a pair of bullocks, plough and sow a field, work a well, and perform other agricultural operations with their own hands. Among other advantages this would help to serve men of the agricultural class for these posts, and would tend to disabuse the native mind of the prevalent idea that a man who can read and write is above labouring with his hands except as a mere scribe.

*Agriculture in
Futwara's
examinations (Mr.
Wilson)—contd*

(23)

Note by Mr. J. WILSON, Deputy Commissioner, Shahpur, Punjab, on the deputation of Junior Assistant Collectors for training in Agricultural work.

The importance of training young civilians in a practical knowledge of agriculture was pointed out by the Famine Commission, who suggested that with this object Assistant Collectors might be allowed and encouraged to take up small farms and work them themselves. The difficulty is that Assistant Collectors are so frequently transferred from one district to another that it would be seldom that any one of them would hold the same farm for any length of time. Still the system would certainly help to give each Assistant Collector, who took advantage of it, some practical knowledge of agricultural processes and a greater interest in agriculture generally. I would suggest that, near the head-quarters of each district, a small farm of, say, twenty acres should be set apart for this purpose, and the Assistant Collector for the time being should be required to take charge of it and allowed to make what profit he can out of it, and, on his transfer, to dispose of the stock, etc., to his successor or to others on terms to be approved by the Commissioner of the division; the only condition being that he shall make careful observations on a system to be laid down by the Director of Agriculture, report the results, and present for inspection accurate accounts of his income and expenditure on the farm. To enable him to stock the farm in the first instance, a takkavi advance on the usual terms might be granted.

*Training of Junior
Civilians in
Agricultural work
(Mr. Wilson).*

Each Assistant Collector should also, after he has been two years in the country, be required to select some particular crop or particular agricultural process as a subject of special study. He should be supplied with all available information on the subject, and should be given facilities for studying his special crop or process and making experiments with regard to it; and should be required to submit a note upon it every three years, embodying the results of his study. In short, each Assistant Collector, instead of having only a vague knowledge of agriculture generally, should be required to become a specialist as regards some particular branch of the subject.

(24)

Note by Mr. E. C. OZANNE, Survey Commissioner and Director of Land Records and Agriculture, Bombay, on the present system of training Junior Civilians in Settlement in Bombay, and recommendations.

In Bombay junior civilians are required to show that they have studied the system of settlement in force by passing at the Higher Standard Examination, a special paper, set by the Survey Commissioner on survey and settlement matters, the questions being confined to matters dealt with in the prescribed text-books.

*Training of Junior
Civilians in
Agricultural work
(Mr. Ozanne).*

Further, under standing orders, civilians employed in the Revenue Department are given an opportunity to learn the system of measurement and land valuation (classification) by being placed for six weeks under an Assistant Superintendent of Survey in charge of a field party. But this instruction is not necessarily or generally insisted on before the Higher Standard has been passed, and the paper referred to above does not test the practical knowledge gained in the field.

Thus, the course of study is less than the three months thought desirable in the orders of the Government of India (Circular 518 of 19th July 1883), and the training in the rudiments of surveying and settlement work is not made a condition in the departmental examination, as the opinion of that Government was that it should be. Yet it must be noted that the Circular referred to was addressed rather to other Governments than to Bombay.

Recommendations.

The training should precede the Higher Departmental Examination, and the paper should include questions on field work.

The course of study should be prolonged to three months, of which one month should be devoted to the study in the field of measurement and classification; one month should be devoted to the practical study of settlement; and one month allotted to a practical study of the duties of kaurungos in the field.

The measurement and classification could be better studied if it is possible to collect the candidates in one place under a competent instructor, whose sole duty it should be to give the maximum amount and variety of instruction in the allotted time. Hitherto more attention has been paid to classing than to measuring; but now that the classification done by the

*Training of Junior
Civilians in
Agricultural work
(Mr. Ozanne)*
—contd

Survey Department is final, the order of importance should be reversed, while measurement should include full study of the manner in which measurements are plotted in the field books, and the record made, and of the rules under which field demarcation has been carried out.

There is no reason why both measurement and classification should not be done at the same class and concurrently, but at all events the measurement training should precede the Lower Departmental Examination.

Training in settlement should be given in the monsoon after the training in classification has been passed. It should include a clear fortnight, either at one of the District Head-quarter Survey offices, or at one of the head-quarter offices of the Survey Department. The remainder of the time may best be utilised in the office of the Survey and Settlement Commissioner, who personally or through an assistant may give special instruction on settlement either in the form of lectures or otherwise, with special reference to the elucidation of important matters treated in the text-books prescribed.

For the present and as long as there is a Head-quarter Survey office of the department at Poona, the month for settlement training should be passed at Poona.

Kanungos' work.—There are printed rules under which the kanungos work; these rules, as far as they deal with correction and maintenance of the field record, should be studied practically. This may be done early in the service of a junior civilian, and preferably in the cold weather after arrival, even before the measurement course has been gone through; but, if possible, this course should be arranged for before the junior civilian attempts to go into the field. He may remain at the head-quarters of the district to which he is posted, and while studying his languages and other subjects for the Lower Departmental Examination be required to do the crop, waste and boundary mark inspection of, say, 50 survey numbers, acting under the rules for Circle Inspectors.

So far as regards the essential course for junior civilians prior to their being allowed to appear for the Higher Standard Examination. After they have passed that examination, they should be further trained in making crop experiments under the rules prescribed, in taking any opportunity offered to attend at the introduction of a revised settlement, in being placed for a time in supervision of any *pot patani* establishment which may be at work at a convenient distance, and, in the regular course of their duties in paying especial attention to the work of kanungos, and the District Survey offices for correction of the field record.

The course advised as essential before the departmental examination according to the Higher Standard will occupy a junior civilian six weeks before the Lower Standard and six weeks after that examination has been successfully passed. In the former period the study of languages will not be interfered with, but will be assisted.

It must be remembered that in Bombay the special Survey and Settlement Department has nearly completed its allotted task, and the duties for half a century performed by a special department will devolve wholly on the regular Revenue establishments.

(25)

*Note by Mr. J. B. FULLER, Commissioner of Settlements and Agriculture, Central Provinces,
on the training of young Civilians in Survey and Settlement.*

*Training of Junior
Civilians in
Agricultural work
(Mr. Fuller).*

In the Central Provinces it has, for some time past, been the practice to add practical instruction in settlement work to the course of survey which is prescribed by the Government of India.

The survey course includes traversing and the computation of traverses in addition to field plotting and area calculation. It occupies an officer from a fortnight to three weeks, giving his mornings only.

On its completion he is deputed for six weeks or two months to a district settlement, and there learns from the Settlement Officer the procedure in classing land and attesting records. For three weeks or a month he is given independent work in charge of an attesting party. The course is completed by some practical instruction in the determination of village rent rates and in assessment.

Under the sanctioned programme settlement work will always be in progress in at least three districts, and there will then be no difficulty in providing for instruction in settlement. Were this not so it would, I venture to think, be advisable to utilize as far as possible the Department of Land Records as a training school and to place two or three officers each camping season on special duty for a couple of months or so under the Director of this Department, to be employed by him in the inspection of village records, and in making any special enquiries which were required into the agricultural conditions of particular tracts. I am aware that junior officers are expected to test a certain number of village papers each camping season in the ordinary course of their district work. But their testing is generally regarded as merely supplementary to their case work and is not as a rule very detailed or searching. Districts which will shortly come under settlement would offer an excellent occasion for really thorough enquiries on which such officers could be employed to their own benefit as well as to the benefit of the Government.

Note by Mr. F. A. NICHOLSON, Collector of South Arcot, Madras, on the training of Junior Civilians in Agricultural work in the Madras Presidency

The rules for the training of newly-joined Assistant Collectors in the Madras Presidency contemplate and expressly direct that Survey and Settlement and Rural Economy shall form a part of their course. The rules in the Civil Service Manual run as follows:—

Training of Junior Civilians in Agricultural work (Mr. Nicholson)

"10. . . . They must also gain an intimate knowledge of the relations of landholders to Government and to their sub-tenants, and of the settlement of the revenue of their districts.

"11. One or more villages near the chief town will be placed under their charge, and they will be required to undertake their entire management and to keep the accounts of the same; their orders, until they pass by the first standard, being subject to the Collector's confirmation. After a time the condition of these villages, their tenures, statistics, etc., should be fully reported upon to the Collector.

"13. Assistant Collectors should also read the more important reports upon the original settlement of the revenue of the districts in which they are stationed.*

"14. As a means of enabling junior civilians to understand the idiosyncrasy of the native mind, Collectors have been requested to allow their assistants to accompany them, the Sub Collector and Head Assistant Collectors, in their tours through the districts, as, by the more direct and intimate intercourse and association with the people which they will thus have, they will acquire a more thorough knowledge of, and greater interest in, those with whom they have to deal than they could possibly obtain in the routine of daily office work at the head-quarters station."

2. *Survey and Settlement*.—For many years every junior civilian has been compelled to pass in these subjects, after spending about six months on ordinary work, he is obliged to spend one month in the field with a survey party and obtain a pass certificate. Until 1892 he was also required to spend two or three months in the field with a settlement party and obtain a similar certificate, one test subject being a complete specimen settlement of three or four villages. It is believed that the settlement field work has, since G. O. No. 104 of 3rd March 1892, been discontinued, but a complete knowledge of settlement principles and methods is still required, and, in particular, the history of the settlement of the district in which the Assistant is placed, must be mastered.

3. *Rural Economy*.—Junior (unpassed) Assistants are required, in common with other officers, to spend 2½ months in each half-year in district touring; one of the reasons is given in rule 14 quoted above; other reasons are the acquisition of a knowledge of rural conditions, crops and agriculture, village accounts, the annual settlement, etc.: in the words of Standing Order 235, para 9, the tours are to give them "as much practical and varied acquaintance with the people as possible."

But, in order that the Assistant may obtain an accurate knowledge of, and interest in, these matters, rule 11—a rule of immemorial standing, by which the Assistant is placed in complete charge of one or two villages—was passed. This rule is in general terms, but the following extract from a report by Mr. Le Fanu on one of his junior Assistants, shows one side of its practical working: "As soon as Mr. P. joined this district, he was placed in charge of the Karnam's office of Gandlapali (village in Chittoor taluq); he wrote up and kept all village accounts and transacted all Karnam's work in the village himself, with the Karnam's assistance, from 8 to 10 A. M. daily.....He learnt how the kist collections were received and accounted for in the several village accounts, and how money was remitted from the village to the taluq treasury. He inspected the fields for purposes of writing up cultivation and also inspected cultivation, checked the same with reference to the entries in Statement No. 1 (cultivation account) and in the Adangal (chief village record of cultivation and holdings). He wrote birth and death accounts and the cattle disease returns" (Board's Proceedings No. 69 of 16th February 1893.) Presumably he also had to send in the report mentioned at the end of rule 11 on the condition, etc., of the village.

The next extract, from Board's Proceedings, No. 835 of 26th September 1888, explains the points on which the Assistant Collector should report as required in the last sentence of rule 11.

"Order.—The important points to which the Assistant Collector's attention should be directed are:—

- (1) Economic condition of the villages, including prosperity or otherwise (with causes); tenures, including those of sub-tenants of Government and inam ryots; labourers; the state of agriculture, the use and treatment of manures and the manual substances and implements, and the ideas of the ryots on the subject, together with any current proverbs guiding or embodying their practice in general, cattle and their condition, with the method of stalling, treatment in disease, etc.; crops and their treatment and periods of cultivation, with varieties according as they are wet, dry or garden (s.e., irrigated from wells only); the division of lands, together with the effect of custom on such partition; transactions in land, and burdens (mortgages, etc.) upon it; rentals in kind and in

*Training of Junior
Civilians in
Agricultural work
(Mr. Nicholson)*
—contd.

money, both in their relation to the crops, and as regards the areas on which rentals are payable relative to the area under cultivation, the price per acre of various classes of land; other industries, etc., etc.

- (2) Nature of the soils.
- (3) Assessments, both absolute assessments, and in their relation to produce and outturn; demand for 20 years, with the causes of increase or decrease both in total amount and in the incidence of assessment per acre of each class of soil.
- (4) Collections.
- (5) System of village accounts and of the processes issued for collection purposes.
- (6) Irrigation works.
- (7) Vital statistics.
- (8) Vaccination.
- (9) Sanitation.
- (10) Education and other matters of administrative importance.
- (11) Demarcation and survey marks.

"2 The Assistant Collector should freely move amongst the people and fully acquaint himself with their wants."

4. The fact that every Assistant Collector in this Presidency is trained and occupied for many years as a Land Officer, renders it unnecessary to draft young men, on arrival, into the Department of Land Records and Agriculture. Every Revenue Officer in Madras is, in fact, a subordinate of the Land Records and Agricultural Department, since the Director is a Member of the Board of Revenue, and every officer is therefore continually engaged in much of the present work of the Department. What is necessary in regard to junior Assistants is to see that they get and take the full benefit of the rules mentioned above; that their early training is, as indicated in the rules, such as to interest them in the details and difficulties of the daily life and industries of the people, to explain the objects and methods of the various Departmental enquiries and operations (e.g., District Analysis, Land Improvement Act advances, crop-testing experiments, cattle census, etc.), which they daily work, and to suggest, as such training must suggest to most minds, the infinitely important and complex rural problems inviting and pressing for solution.

(27)

Note by Mr. W. C. Macpherson, Director of Land Records and Agriculture, Bengal, on the training of Junior Civilians in the work of the Department of Land Records and Agriculture.

*Training of Junior
Civilians in
Agricultural work
(Mr. Macpherson)*

The subject of instructing junior civilians in survey and settlement has received a good deal of attention in Bengal since 1885, and the Board of Revenue devote a paragraph of their Annual Report on the Land Revenue to telling what has been done during the year in this direction. It will be seen from paragraph 225 (page 64) of the Board's Report for 1892-93 that a number of young officers were employed in settlement work and were trained in survey during the year. I recently invited the attention of the Commissioners of Patna and Orissa to the opportunities afforded by the operations in Behar and Orissa for the training of young officers during the present field season.

From the point of view of my Department I should entirely agree with Mr. Fuller that every junior civilian should be required to go through a course of instruction either under a Settlement Officer or under the Director of Land Records.

(28)

Note by Mr. E. B. Francis, Director of Land Records and Agriculture, Punjab, on the deputation of Junior Civilians for training in Agricultural work.

*Training of Junior
Civilians in
Agricultural work
(Mr. Francis)*

Junior Assistant Commissioners are, so far as possible, deputed in turn for a course, usually of four to six months, of training under a Settlement Officer in survey and revenue record business. There are no means of giving training in agriculture, specially as the province possesses no agricultural institutions.

(29)

Note by Mr. H. Z. Darrab, Director of Land Records and Agriculture, Assam, on the deputation of Junior Civilians for training in Agricultural work.

*Training of Junior
Civilians in
Agricultural work
(Mr. Darrab)*

The present custom in Assam is that a certain number of junior civilians are sent for a few months in the cold weather to the survey camp to go through a course of practical training in surveying. This has been the rule during the last two seasons, because under recent arrangements, no junior civilian is entitled to promotion above the lowest grade until he has

obtained a certificate showing him to be a good practical surveyor. He is not placed in any way under the orders of the Director, nor do I think it practicable that he should be. *Training of Junior Civilians in Agriculture work (Mr. Dorrak)*

The staff at the disposal of the Chief Commissioner is too small to enable him to depute many men to settlement operations for a time sufficient to enable them to obtain much acquaintance with the work, and the consequence is that the Director is practically the Settlement Officer and works entirely through native subordinates. The revenue systems also of different districts differ too much to render the knowledge gained in one of much service in another. The tenures of the temporarily settled tracts of Sylhet and Cachar are entirely unlike those of the Biahmaputra Valley Districts, and a revenue officer thoroughly conversant with one would find himself altogether at sea for a long time if called upon to deal with the other. The area, too, in which settlements can be made is limited. *—contd.*

The five upper districts of the Assam Valley, Cachar, and about 600 square miles of Sylhet, comprise the whole, and until the recent resettlement of the first-named tract, the bulk of the settlement proceedings in even these areas consisted in the simple application of three fixed rates to varying areas, and was therefore settlement work only in name.

Nearly the whole of Goalpara and Sylhet are permanently settled, and in the three hill districts revenue is collected by a tax on each house or hoe. These make up the 11 districts of Assam, so it will be apparent that the opportunities for training in settlement work are neither numerous nor extensive. I do not think, therefore, that it would be practicable for the Assam Administration to draft junior civilians into the Land Records Department, or to give them any further technical training than the teaching in surveying now bestowed.

(30)

Note by Mr. H. F. CLOUSTON, Commissioner of Revenue Settlements and Director of Land Records and Agriculture, Madras, on the proposal to depute Assistant Collectors for training in Settlement, Land Record, or Agricultural work.

Up to about two years ago it had been the practice for a long time to depute Assistant Collectors for training in Survey and in Settlement. It is still the practice to give all Assistant Collectors a training in Survey, but the settlement training has recently been given up, for reasons which have not, it is believed, been published. The original settlement of all districts in the Madras Presidency will, however, be completed in a very few years, and it is not yet decided what principles shall be followed in the revision of settlement. If no revision of classification takes place and revision of rates is made to depend merely upon a change in prices, little could be gained by attaching a young civilian to a Settlement party. *Training of Junior Civilians in Agricultural work (Mr. Clouston).*

In the absence of any experimental farms in the Presidency, and the consequent want of experience as to the nature of the work to be conducted at these farms, it is not at present possible to say whether the deputation of Assistant Collectors to those farms for a short period may eventually become desirable.

A thorough knowledge of land records is essential to a revenue officer, but a young civilian in Madras is bound to pick up this knowledge in the ordinary course of his revenue work, and indeed in Madras there is no separate Land Records Department apart from the ordinary Revenue Department.

PROCEEDINGS
OF THE
BOARD OF AGRICULTURE IN INDIA
HELD AT
CAWNPORE
ON THE
18th February, 1907, and following days
WITH APPENDICES.



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No. C.—48, dated Camp Cawnpore, the 24th February 1907.

From—F. G. SLY, Esq., I.C.S., Offg. Inspector General of Agriculture in India,
To—The Secretary to the Government of India,

DEPARTMENT OF REVENUE AND AGRICULTURE.

I HAVE the honour to submit the Proceedings of the Meeting of the Board of Agriculture held at Cawnpore on the 18th February 1907, and succeeding days. These proceedings have been recorded by the Secretary, Dr. E. J. Butler, Imperial Mycologist, Pusa, and have been approved by the Board.

Proceedings of the 3rd Annual Meeting of the Board of Agriculture held at Cawnpore on the 18th February 1907, and succeeding days.

LIST OF MEMBERS.

1. F. G. SLY, I.C.S., *Offg. Inspector General of Agriculture in India, President of the Board.*
2. E. J. BUTLER, M.B., F.L.S., *Imperial Mycologist, Pusa, Secretary to the Board.*
3. COLONEL J. W. A. MORGAN, M.R.C.V.S., *Inspector General, Civil Veterinary Department.*
4. J. W. LEATHER, PH. D., F.I.C., F.C.S., *Imperial Agricultural Chemist, Pusa.*
5. H. M. LEFROY, M.A., F.E.S., F.Z.S., *Imperial Entomologist, Pusa.*
6. C. J. BRGTHEIL, *Imperial Bacteriologist, Pusa.*
7. E. SHEARER, M.A., B. SC., *Imperial Agriculturist, Pusa.*
8. A. HOWARD, M.A., A.R.C.S., F.C.S., F.L.S., *Imperial Economic Botanist, Pusa.*
9. W. ROBERTS, B. SC., *Supernumerary Agriculturist, Pusa.*
10. G. H. GARRAD, N.D.A., *Supernumerary Agriculturist, Pusa.*
11. T. F. MAIN, B. SC., *Assistant Inspector General of Agriculture in India.*
12. CAPTAIN A. T. GAGE, I.M.S., M.B., M.A., B. SC., F.L.S., *Director of the Botanical Survey of India.*
13. F. SMITH, B. SC., *Deputy Director of Agriculture, Bengal.*
14. H. H. CORBIN, B. SC., *Principal of the Agricultural College, Bengal.*
15. W. H. MORELAND, B.A., LL.B., C.I.E., I.C.S., *Director of Agriculture, United Provinces of Agra and Oudh.*
16. J. M. HAYMAN, D.V.S., *Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
17. H. M. LEAKE, M.A., F.L.S., *Economic Botanist, United Provinces of Agra and Oudh.*
18. A. W. FREMANTLE, *Principal, Agricultural College, United Provinces of Agra and Oudh.*
19. G. CLARKE, F.I.C., *Agricultural Chemist, United Provinces of Agra and Oudh.*
20. KHAN BAHADUR S. M. HADI, M.R.A.C., *Assistant Director of Agriculture, United Provinces of Agra and Oudh.*
21. W. C. RENOUF, I.C.S., *Director of Agriculture, Punjab.*
22. S. MILLIGAN, M.A., B. SC., *Deputy Director of Agriculture, Punjab.*
23. A. C. DOBBS, B.A., *Principal, Agricultural College, Punjab.*
24. J. H. BARNES, B. SC., A.I.C., F.C.S., *Agricultural Chemist, Punjab.*
25. P. J. MEAD, I.C.S., *Director of Agriculture, Bombay.*

26. F. FLETCHER, M.A., B. Sc., *Deputy Director of Agriculture, Bombay*
 27. J. B. KNIGHT, M. Sc., *Professor of Agriculture, Agricultural College, Bombay.*
 28. G. A. GAMMIE, F.L.S., *Economic Botanist, Bombay.*
 29. A. A. MEGGIT, B. Sc., *Agricultural Chemist, Bombay.*
 30. E. THOMPSTONE, *Assistant to the Deputy Director of Agriculture, Bombay.*
 31. M. E. COUCHMAN, I.C.S., *Director of Agriculture, Madras.*
 32. R. W. B. C. WOOD, B.A., *Deputy Director of Agriculture, Madras.*
 33. W. H. HARRISON, M. Sc., *Agricultural Chemist, Madras.*
 34. H. C. SAMPSON, B. Sc., F.H.A.S., F.B.S.E., *Second Deputy Director of Agriculture, Madras.*
 35. D. CLOUSTON, M.A., B. Sc., *Deputy Director of Agriculture, Central Provinces.*
 36. F. PLYMEN, A.C.G.I., *Agricultural Chemist, Central Provinces.*
 37. G. EVANS, B.A., *Principal, Agricultural College, Central Provinces.*
 38. J. MACKENNA, I.C.S., *Director of Agriculture, Burma.*
 39. F. J. WARTH, M. Sc., *Agricultural Chemist, Burma.*
 40. S. G. HART, I.C.S., *Director of Agriculture, Eastern Bengal and Assam.*
 41. RAI BAHADUR B. C. BASU, M.R.A.C., *Assistant to the Director of Agriculture, Eastern Bengal and Assam.*
 42. R. S. FINLOW, B. Sc., F.C.S., *Fibre Expert to the Government of Eastern Bengal and Assam.*
 43. H. H. MANN, D. Sc., *Scientific Officer to the Indian Tea Association.*
 44. A. LEHMANN, M.A., B.S.A., Ph. D., *Agricultural Chemist to the Government of Mysore.*
 45. RAOJIBHAI B. PATEL, M.R.A.C., *Director of Agriculture and Industries, Baroda.*
 46. L. C. SHARMA, M.R.A.C., P.A.S.I., *Bar-at-Law, Director of Agriculture, Kashmir.*

VISITORS.

47. SIR EDWARD BUCK, K.C.S.I., LL.D.
 48. MAJOR E. H. ATKINSON, B.E., *Principal, Thomason College, Boorkee.*

FIRST DAY.

CONFIRMATION OF THE MINUTES OF THE LAST MEETING.

1. A note was presented by the President showing the action taken on the proceedings of the last meeting of the Board (see Appendix B, page 21). The proceedings of the last meeting held at Pusa on the 15th January, 1906, and succeeding days were confirmed.

THE IMPROVEMENT OF THE INDIAN SUGARCANE INDUSTRY.

2. The main business before the Board being the framing of recommendations for the improvement of the sugarcane industry in India, it was decided to form a sub-committee to consider the reports received from the various provinces (see Appendix H, page 81) and to draft in outline a general scheme for future work. The following terms of reference were made to serve as a general guide to the sub-committee :—

A.—Cultivation.

The testing of varieties, including exotics, and especially the determination of the amount of variation in each variety as a preliminary to improvement by chemical selection. The trial of manures. Improvements in the

methods of cultivation. Improvements in irrigation and drainage. The improvement of ratoons by cultivation. The possibility of raising seedling canes in India. The investigation of disease and pests.

In particular the Committee should carefully consider the best methods for (1) laying out field experiments, (2) determining the quantitative yield of experimental plots, (3) testing on a planting scale the results of experimental station trials, and (4) the equipment necessary, and the maximum area that can be effectively dealt with by that equipment.

B.—*Manufacture.*

(1) The actual efficiency and the losses which occur at the various stages of the manufacture of *gur* or *jaggery*, and the methods of reducing these losses.

(2) The indigenous processes of sugar manufacture.

(3) The introduction of the small power factory system.

(4) The local conditions necessary for the successful working of the Central Factory System such as (a) minimum amount of cane required, (b) the radius from which it can be drawn, (c) number of cane cultivators to be dealt with, (d) supply of cane by cultivators, (e) the means of transporting cane to the mill, (f) the extension of the reaping period by the cultivation of early or late maturing canes, and (g) the supply of raw sugar for refining in Central Factories.

The following sub-committee was nominated :—

The President, Dr. Leather, Messrs. Howard, Smith, Moreland, Milligan, Knight, Couchman, Fremantle, Dr. Lehmann, Khan Bahadur Mohamed Hadi and Mr. Patel.

There was on view a large collection, made from all parts of India, of the different varieties of sugarcane, raw and refined sugars, samples of soils on which sugarcane is grown and the like. A most interesting demonstration was also given by Khan Bahadur S. M. Hadi of the improved indigenous processes of sugar manufacture followed in the United Provinces.

THE UNIFICATION OF METHODS EMPLOYED IN THE LABORATORIES OF AGRICULTURAL CHEMISTS.

The Board decided to form a sub-committee to deal with this subject the following being the terms of reference :—

- (1) whether it is desirable to prescribe official methods of analysis to be followed in the Chemical Laboratories of Agricultural Departments ;
- (2) if so, what methods should be prescribed ;
- (3) whether it is desirable to suggest methods of analysis for other substances as a guide for Agricultural Chemists ;
- (4) whether it is desirable to introduce a system of testing official methods by uniform samples analysed at each laboratory.
- (5) to make any further recommendations on this subject.

The following sub-committee was nominated :—

Dr. Leather, Messrs. Bergtheil, Clarke, Barnes, Meggitt, Harrison, Plymen, Warth, Finlow, Dr. Mann and Dr. Lehmann.

SECOND DAY.

PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

The programme of the Imperial Department was then considered. (Appendix C, page 25.)

The President remarked that certain of the programmes now submitted both of the Imperial and of Provincial Departments of Agriculture seem hardly to give sufficient information about the lines of work which it is proposed to follow, in order to enable the Board fully to exercise its advisory function. He suggested that, at least where it is proposed to

commence new work, a short statement should be given setting forth the lines on which it will be conducted.

8. In reply to the President, Mr. Howard gave a short account of the work which he proposed to undertake in the collection and investigation of fibre plants, mentioned in paragraph 2 of his programme. The first step will be to collect material for growing under uniform conditions, in order to determine whether the varieties of any particular fibre plant are true to type, and to isolate and examine the types. Then trials will be made to determine how far it is advisable to grow pure types or whether the mixtures so often found in the cultivated plant are advantageous in any way, or are unavoidable. *Hibiscus cannabinus* has been selected for immediate investigation.
9. Dr. Mann considered that the programme of the Imperial Department of Agriculture indicated a want of co-operation between the separate departments, and was lacking in inspiration. Certain of the experiments also appear to be typically local in character and should be relegated to provincial departments. He instanced the cultivation of sugarcane varieties mentioned in the programme of the Imperial Agriculturist. This is a local experiment; and in his opinion the work of Pusa should be of broader application. As an indication of the lines of sugarcane work which he thought Pusa might profitably undertake, he mentioned the following investigations: (1) the factors determining the proportion of sucrose and glucose in cane, (2) the factors determining the hardness of canes, (3) the factors determining the resistance of cane to disease, (4) the means of determining the time of ripeness of cane, other than by analysis, which is a method not generally applicable. In the discussion which followed, and in which Dr. Leather, Mr. Howard and Dr. Butler took part, it was pointed out that the varieties of sugarcane at Pusa are being maintained at Mr. Mollison's request and that until his return it is premature to speak of their rejection; that all the points mentioned by Dr. Mann for investigation are being or have been under study at Pusa or have been already the subject of research elsewhere, so that we have a considerable mass of information available. A high glucose content is known, for instance, to depend, amongst other conditions, on the immaturity of the cane, on its having lodged, on high manuring, on disease and on several other known conditions. Dr. Leather and Mr. Howard denied that there is any lack of co-operation at Pusa, and gave several instances of pieces of work carried out in co-operation.

PROGRAMMES OF PROVINCIAL DEPARTMENTS OF AGRICULTURE.

PROGRAMME OF THE BOMBAY DEPARTMENT OF AGRICULTURE.

[Appendix D, page 81.]

10. Mr. Fletcher stated, in reply to the President, that the experiments on land reclamation mentioned in paragraph 14 of his programme are being attempted under the following conditions:—
1. The reclamation of uncultivated coast lands flooded at high tides, and in which the problem is the removal of common salt. Previous work in this direction, which has been largely unsuccessful although considerable sums have been sunk, have been almost entirely carried out by embankments without drainage. It is proposed to introduce drainage on small plots taken up for the purpose.
 2. The removal of alkali salts, of which the chief are sodium carbonate and sodium sulphate, in uncultivated arid tracts in Sind where irrigation is available. Drainage in open drains and the application of lime and gypsum to the soil will be tested at a farm available for the purpose.
 3. The removal of alkali salts in areas with a small rainfall between twenty and thirty inches. An attempt will be made to wash out the salts without, if possible, any other assistance than that afforded by the rainfall. A farm is available on which this work can be carried out.
11. In reply to Dr. Leather, Mr. Fletcher explained that the survey of the cottons of the world, mentioned in paragraph 8 of his programme, is a broad

survey by countries in order to obtain the field characters of the types of cotton now cultivated in the cotton-growing countries. The aims of this survey are quite distinct from those of the survey of the Presidency cottons mentioned in paragraph 7, which is a detailed survey, taluka by taluka, or even village by village, so that accurate information may be obtained, not only regarding the main types, but also their varieties for every part of the Presidency, for purposes of seed distribution.

The recent severe outbreaks of boll-worm in cotton in Sind and in the Punjab were referred to. Mr. Fletcher and Mr. Main gave the results of their observations on the subject in Sind; Mr. Fletcher considered that the severe outbreak in the current season in Sind was due to favourable climatic conditions for boll-worm induced by floods, together with faulty methods of cultivation. Mr. Main stated that this year Egyptian cotton has been more severely attacked than the indigenous variety, and Mr. Fletcher added that this was probably due to the more branching habit of the Egyptian plant which had the effect of keeping the air moist between the plants. Mr. Renouf summarised the history of the outbreak in the Punjab, and the measures taken to check it. In the Punjab a distinct improvement was noticeable this year, which there is fair evidence to show was, at least in part, due to the measures taken, the most useful of which were the burning of the stalks and refuse of the cotton plants in the fields after the completion of the picking season, and the introduction of parasites.

It is recommended by the Board that the Bombay Department of Agriculture should undertake measures for the checking of the boll-worm pest in Sind, similar to those carried out recently in the Punjab. The Imperial Entomologist will depute an assistant to investigate the special conditions prevailing in Sind, and detailed suggestions for future action can then be drawn up.

Mr. MacKenna considered that the discussion has brought out the importance of expert assistance in checking the pests of cultivated plants. In the Punjab the loss from boll-worm alone in 1905-06 is estimated at £2,000,000 and even if a portion of the recovery was due to the action taken (which seems certain), the expenditure was overwhelmingly justified; in Sind the difficulty is largely a question of establishment. The Board records its sense of the importance of the facts brought before it with reference to the losses resulting in the Punjab and Sind from the prevalence of the cotton boll-worm and desires to point out the necessity of strengthening the Entomological staff both in the Imperial and in Provincial Departments of Agriculture.

Arising out of the proposal of the Bombay Department of Agriculture to conduct the manurial experiments at Manjri station with quantities of manure expressed by bulk and not, as hitherto, by chemical composition only, a prolonged discussion took place regarding the best method of measuring fertilizers employed in manurial experiments. It was held, on the one hand, by Mr. Howard and some other members, that in India, the dominant factor being the water-holding capacity of the soil, the effects of bulky manures in modifying the texture and improving the mechanical condition of the soil may outweigh considerations based on the supply of plant food only. On the other hand, Dr. Lehmann, Dr. Leather and other members held that in manurial experiments as such, the quantities used can only be tested, for purposes of comparison, in terms of the chemical composition. The aim of manurial experiments proper being to determine the effects of known quantities of plant food supplied in different forms, the introduction of a second variable factor, such as the mechanical effects of special manures, must lead to confusion and should be the object of separate experiment. The Board decided to refrain from making any definite recommendation for the adoption of a fixed standard of chemical composition for the measurement of quantities of manure employed in manurial experiments, the aims and conditions of such experiments in different localities being too diverse to permit of any general rule being laid down.

PROGRAMME OF THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE.

[Appendix D, page 38.]

At the request of several members, Mr. Moreland outlined the progress which has been made, during the past two years, in the system in force in the

United Provinces of distributing seed of certain crops, on credit. The main object at present is to broaden the basis of responsibility amongst cultivators receiving seed. Instead of distributing to individuals, groups of ten or fifteen men take up the seed and are jointly responsible for its return with interest. Owing to the advantages of this course, it has become possible to grant rebates of interest for punctual repayment at harvest time. The next step which it is proposed to attempt, at a favourable opportunity, is to develop these groups into co-operative societies so as to free the Department from much of its responsibility. In response to a general request, Mr. Moreland undertook to publish an account of the seed distribution work which has been carried out in the United Provinces.

17. The President suggested that it would be useful to obtain some definition of the responsibilities and functions of Agricultural Departments in this matter of seed supply. He did not consider that it is in any way the function of a Department to compete with private sources of seed supply. In the United Provinces the Department had a definite object in view—the introduction of a better variety of wheat into a tract where it was not previously known. Similarly in the seed distribution work in the Punjab, the Department had to deal with newly opened up country and new cultivators, in canal colonies, and the provision of seed became necessary.

The Board is of opinion that in regard to the supply of seed, the Agricultural Departments should not attempt to enter into permanent competition with existing sources, but should confine their efforts to showing the people how they can obtain seed from fresh sources, if necessary. The work of seed distribution should be limited to special cases, such as introducing new varieties by cultivating such on demonstration areas, providing seed of improved varieties of existing crops, or disease-free seed of certain crops.

PROGRAMME OF THE BENGAL DEPARTMENT OF AGRICULTURE.

[Appendix D, page 35.]

18. Mr. Smith gave a brief account of experiments in transplanting paddy at Burdwan. Transplanting single seedlings has given the best results. A discussion followed in which Mr. Sampson, Dr. Lehmann and other members took part, the general opinion being that the most advantageous system varied with local conditions, such as water-supply, soil and climate.
19. Mr. Smith stated in reply to enquiries that the extension of cotton cultivation in Bengal is now practically confined, so far as the Department is concerned, to the Chota Nagpur Division. The results elsewhere have not been encouraging. Tree cottons as a whole have proved disappointing. The experience with this class of cottons in Behar and elsewhere has not given any promise of ultimate success in their cultivation.

PROGRAMME OF THE MADRAS DEPARTMENT OF AGRICULTURE.

[Appendix D, page 36.]

20. The Board recommends that efforts to stamp out the disease of Palmyra and Coconut palms prevalent in the Godaveri delta should form a prominent feature of the work of the Madras Department of Agriculture in the coming year.

PROGRAMME OF THE PUNJAB DEPARTMENT OF AGRICULTURE.

[Appendix D, page 37.]

21. A discussion took place on the prevalence of alkali lands in the canal colonies of the Punjab. Mr. Milligan gave evidence to show that in certain districts the evil is increasing and that a grave danger threatens the colonies, if efforts to check it are not taken at an early period. The President and Mr. Renouf pointed out that it has been stated that the total extent of *reh* land in the colonies has, if anything, decreased, but Mr. Milligan said that in certain places it is undoubtedly increasing as a sequence to irrigation and that the matter is in urgent need of investigation.

The Board desires to emphasise the importance of an enquiry into the occurrence of alkali lands in the Punjab irrigation colonies, and recommends

that the enquiry should be prosecuted in co-operation with the Irrigation and Colonisation Departments.

PROGRAMME OF THE BURMA DEPARTMENT OF AGRICULTURE.

[Appendix D, page 37]

Mr. MacKenna gave a more detailed account of some of the main lines of work outlined in the programme of his Department. 22.

The Board is of opinion that, as the Imperial Entomologist is not in a position to give adequate assistance to Burma, owing to the very different conditions and pests in that Province, a separate Entomologist should be added to the staff of the Burma Department of Agriculture.

PROGRAMME OF THE CENTRAL PROVINCES AND BERAR DEPARTMENT OF AGRICULTURE.

[Appendix D, page 38]

Mr. Clouston gave an account of the manurial experiments with artificial fertilizers on cotton which are being carried out in the Central Provinces. The first year's results point to nitrate of soda as being most successful. 23.

The President described an enquiry which was made in Berar into the methods of seed supply of *Jari* cotton. It was found that practically the whole of the cultivators select their own seed from the crops after picking, and in doing so usually select the coarsest of the four types found in this cotton—the *Roseum* type. It is doubtful whether this is done deliberately to obtain a coarse, hardy and prolific variety, or is done because the *Roseum* bolls are usually larger and of better appearance than the others. The result, in all probability, accounts for the complaints received from the trade of the deterioration of staple in the past seven years, the counts of thread which can be spun from Berar *Jari* cotton having fallen from 16⁰ or even 20⁰ to 10⁰, whilst the percentage of lint to seed has in the same period risen from 33 to 40 per cent. The enquiry is being prosecuted. 24.

PROGRAMME OF THE EASTERN BENGAL AND ASSAM DEPARTMENT OF AGRICULTURE.

[Appendix D, page 41]

Dr. Mann enquired if the Department had taken any steps to supply jute seed to districts such as North Lakhimpur where there is a demand for seed. Mr. Finlow and Rai Bahadur Basu described the position of the seed supply at the present period, and stated that no difficulty was experienced in obtaining plenty of good seed in the open market; if a further demand arises, the Department is ready to provide any seed necessary to meet it. 25.

The Board recommends that arrangements should be made for the supply of jute seed to cultivators in districts where it is a new crop and locally unobtainable and where there is a demand for it.

PROGRAMME OF THE MYSORE DEPARTMENT OF AGRICULTURE.

[Appendix D, page 45.]

The Board has no remarks to offer on this programme. 26.

PROGRAMME OF THE BARODA DEPARTMENT OF AGRICULTURE.

[Appendix D, page 46.]

Mr. Patel explained that the difficulty in cheese-making consisted in the ripening of the cheese, which it was hoped to overcome by storing in cellars at a fairly even temperature. He invited suggestions for the utilization of skim milk, an important by-product of the large dairy industry of Guzerat, and some members promised to help him with such suggestions. 27.

THIRD DAY.

COMMERCIAL FERTILIZERS IN INDIA.

28. The President gave a short statement of the circumstances which led to the raising of this question, the early papers in connection with which are published in Appendix D of the Board's Proceedings for 1906. Further information has been collected during the past year and notes regarding the employment of fertilizers in Mysore and in Eastern Bengal and Assam, have been submitted by Dr. Lehmann and Dr. Mann respectively. These will be found in Appendix E, page 47, to the Proceedings. In the United Provinces and Central Provinces, enquiry has shown that absolutely no trade exists in artificial fertilizers.

Mr. Couchman stated that whatever demand exists in Southern India comes entirely from planters. The total area under planters' cultivation does not, however, exceed about 250,000 acres and only a few of the six or seven hundred planters of Southern India can afford to use fertilizers. Even amongst these the trade is contracting. The interests involved are, therefore, so small that legislation appears to be uncalled for. Nor is there any immediate prospect of the use of fertilizers spreading to the ryots. It has been said that the growing interest in the work of local agricultural societies and the increasing activity of Government in agricultural matters might be expected to result in the spread of artificials, but there is little real interest taken in these societies by the actual cultivators and as regards the Department of Agriculture other and more pressing lines of work must fully occupy its energies in the immediate future.

Dr. Mann stated that there is no demand for legislation in the tea planting districts, since fully guaranteed manures are available in sufficient quantity. Milled oil cakes are used by cultivators in the vicinity of Calcutta but there is little demand for any other class of fertilizer. In Bengal Mr. Smith considered that little hope appears to exist for any demand arising, since attempts by the Bengal Department to introduce bone meal and saltpetre have been quite unsuccessful.

Dr. Leather stated that there is a real awakening in recent years as to the value of oil cakes amongst the cultivators of India. Year by year prices have gone up in certain localities until they have reached a point at which they actually exceed the cost, per unit of nitrogen, of manures such as Chili saltpetre. Recent processes of obtaining nitrates from atmospheric nitrogen open up great possibilities, and we should be prepared for future developments. He considered that there is at least reason to watch this development carefully and to be prepared to legislate when occasion arises. In all other countries such legislation has become necessary.

Dr. Lehmann did not agree with Mr. Couchman's conclusions regarding the use of fertilizers by planters in Southern India. There is a considerable and increasing demand amongst coffee planters in Mysore, and in Coorg the trade in fertilizers was stated by the Coorg Planters' Association to be one of the reasons for the provision of railway facilities to that district. He has also received applications from ryots for advice in the use of fertilizers and is convinced that a demand is springing up which will almost inevitably lead to the necessity of legislative control to prevent adulteration. The machinery required for this is simple and its effects will be to guard against a check being given to an agricultural practice which is singularly necessary in India where the soil is generally so deficient in plant food.

29. The Board is of opinion that on the evidence submitted to it the time is not ripe for the introduction of legislation on commercial fertilizers, but recognises the desirability of maintaining a special watch over the developments which may occur in their use.

30. The Board also recommends (votes 15 to 8) that the Provincial Departments of Agriculture should be prepared to undertake analyses of artificial fertilizers for private individuals, at a nominal fee, and to advise on the rate charged for them. Such analyses should not be carried out for commercial firms or dealers.

The resulting risk of Agricultural Chemists being called as witnesses in civil suits to the prejudice of their work was recognised, but is at present small and these analysis can be stopped, if necessary, later on.

THE UTILIZATION OF RIVER SILT IN INDIA.

Sir Edward Buck presented before the Board a report on the control and utilization of rivers and drainage for the fertilization of land and mitigation of malaria. He gave an account of his investigations in Italy and India and suggested for the consideration of the Board the broad principles underlying the profitable utilization of fertilizing silt. (See Appendix F, page 71.)

31

The President welcomed Sir E. Buck in the name of the Board and expressed its thanks for the valuable explanation which he had given of his investigations in Italy and India. The enquiry has been taken up by the Government of India, and definite conclusions will doubtless be reached in due course.

Dr. Leather described the analyses which he has made in connection with this enquiry. (See Appendix F., page 73), and pointed out that the chemical characters of the silt do not show it to be a rich manure. It does not, in fact, differ materially from ordinary cultivated land, and in the case of hill streams may be considerably poorer. The quantity also is small. In most cases, from the ten streams analysed, the quantity was such that seven or eight feet of water would be required to obtain one inch of silt deposit. He did not wish to imply that silt is valueless as a fertilizer, but that its advantages must be sought in some other direction than chemical composition, possibly in its effects on the texture of the soil. With regard to the value of the dust washed down in the first monsoon rainfall, the quantity is so small that there is no possibility of its having any appreciable effect.

Mr. Howard was strongly of opinion that the fertilizing effect of silt due to its mechanical action on the soil. In large deltas such as those of the Indus and Ganges, the silt deposited all along the delta is of one and the same origin; in the upper deltaic areas, however, only the coarser particles are deposited and coarse sandy soils result; in the lower portion alluvial clay of fine particles is formed. This may in itself explain the increase of fertility along the course of such rivers as they approach the sea.

A large amount of evidence was given by different members of the Board in corroboration of Sir Edward Buck's remarks on the agricultural value of silt. The President described the measures in vogue in the Central Provinces in embanking rice and wheat lands. These embankments are sometimes for the definite purpose of catching surface wash and building up the soil of depressions; in other cases they appear to be primarily intended to hold water only.

Mr. Moreland stated that any form of silt deposited in the sub-Himalayan areas would probably prove beneficial. In Bundelkhand where the embanking of fields is not a usual practice, it has been found the best of the famine protective works introduced. It is intended to catch surface drainage only, and the lines of embankments have to be laid out with considerable engineering skill. Mr. Hayman pointed out that in some cases harm may result from embanking, as for instance in increasing *kans* grass in Bundelkhand, and that the work must be done with great care.

Mr. Fletcher described the systems of irrigation in Egypt. Two are largely employed. In the one case—the basin system—the flood water is caught in enormous basins up to twenty thousand acres in area and after settling for a month or two is again run off. In the other, canals are used, and the bulk of the silt is deposited in these and does not reach the fields. The agricultural advantages of the two systems differ greatly, for whereas in the former case there is a general rise in value of the lands so treated, in the latter there is often a depreciation. In this case part of the benefit of the silt is sometimes recovered by cleaning out the canals and putting the deposit on the fields. In some parts this is the chief manure employed and its value is well known, though from the point of view of chemical composition it is similar to the land to which it is applied. The effect is probably a mechanical rather than a purely chemical one. In Sind very much the same classes of silt deposit occur as in Egypt. There are catchment basins on a small scale into which the water is run from inundation canals and allowed to settle, and there are perennial canals which deposit silt in their own beds. In the former case the value is fully recognised. In the latter, of which the Jamrao system is an example,

the water is often not only useless for fertilizing purposes but complaints are sometimes made of its injurious effects. The crops on the Jamrao system are generally poor.

Mr. Wood described the application of tank silts in parts of the Madras Presidency where their value as fertilisers is well known. In river silts, good and bad qualities are known, the same river sometimes giving one or the other according as the rain to which its flooding is due arises in one or another formation of soil. Mr. Fremantle also mentioned the value of tank silts in villages which is fully realised by the cultivators.

Dr. Mann stated that the largest yield of tea per acre in the Assam valley is obtained on an estate which habitually employs only river silt from the Brahmaputra for fertilising purposes. He said that he has now come to believe that silt alone may be sufficient in many cases to account for the continued fertility of inundated paddy lands, a fact which at one time was a source of great wonder to him. While the chemical composition of the silt fails to explain this, its mechanical effects may do so. Mr. Sampson agreed with this view, as he has seen extremely good results in Tinnevely from carting silt on to paddy lands. As the silt appeared to be largely sand, the effect must be a mechanical one. A general opinion was expressed of the advantages of drainage maps of the nature described by Sir Edward Buck.

Sir Edward Buck was glad to hear such a considerable body of evidence in India in support of the views which he had put forward. The extension of the employment of silt in agricultural practice in India can only be done by strong Government assistance, as the areas available for private enterprise are individually too small and the private capital insufficient. It seems clear that there is a strong need for each province to obtain sufficient information to enable it to take up the matter on a definite plan.

32 The Board agrees that it is a grave error not to utilize fertilizing silt, wherever it may be profitably used.

That it is advisable to continue the analyses of the silt contained in our rivers and streams and of surface drainage, and wherever there is promise of success to carry out more detailed analyses, particularly as regards the first falls of rain. These analyses should include the mechanical characters of the silt.

That the co-operation of the Irrigation and the Agricultural Departments should be fully secured for these purposes.

THE IMPROVEMENT AND EXTENSION OF COTTON CULTIVATION IN INDIA.

33 The President said that the Government of India desired to receive the advice of the Board regarding the best plan for assisting cultivators in disposing of small quantities of any new fine stapled cotton tried on a small scale. (See Appendix G, page 77.)

Mr. Mead described the system which has been adopted in Sind in dealing with Egyptian cotton. This system has been fully detailed in a report to the Bombay Government. Arrangements were made by some zamindars direct with private firms, but the bulk was put on the market through Government agencies in public auctions. These were attended by the mill owners of Ahmedabad, and the greater part of the crop was taken, the first two auctions realising a high price. No considerable difficulties were experienced in carrying this out.

Mr. Fletcher held that whether in introducing exotics or in providing an improved type of local cotton, arrangements must be made to get full prices. Where the area is small, as in the first stages of introduction, Government must deal direct with the cultivators. Later on it is preferable to get private firms to take it up. In the beginning it is necessary to recover the seed for purposes of distribution and this can only be done by buying back direct from the cultivators. Once the advantages are realised, distribution will occur of itself and the recovery of seed be no longer necessary.

Mr. Renouf stated that the Dharwar-American cotton introduced in the Punjab was all sold in the first year to a local firm. Difficulties were

experienced in adjusting the accounts. The second year local mills bought the cotton at a premium of Rs. 1-8-0 per maund above indigenous cotton. This year about fifteen hundred acres were grown. To deal with this, a sum of £500 was asked for from the grant made by the British Cotton Growing Association, to be utilised in getting a broker to act as agent. No broker could, however, be got to take it up. A local firm was then approached and it agreed to take the crop at Rs. 1-6-0 premium, Government guaranteeing the brokers' expenses. At the same time a local broker in Lyallpur, after independent enquiries, came forward and took up a proportion of the crop at from Rs. 1-8-0 to Rs. 1-13-0 premium, and the success of this enterprise will lead to its continuance in the future. The intervention of Government is not as a rule advisable, for their agency is not always favourably regarded by the cultivators, and they are not in a position to know the true value of the crop.

Mr. Hayman stated that the acclimatised American cotton introduced in the United Provinces has not extended sufficiently for private intervention. All is bought by the Department. He doubted if a demand will arise for this cotton, unless it is found to mix with southern cotton, a point now being tested by the mills.

The Board is of opinion that the purchase by Government of the produce of newly introduced cotton should be restricted to the earlier stages when the area to be dealt with is small. When the area commences to expand, the assistance of private firms may usefully be sought, the firms acting either as agents for Government or as principals under a guarantee against loss. When the area is somewhat larger the system of Government auctions introduced in dealing with the Egyptian cotton in Sind is a suitable one. The concentration of trials in a compact tract rather than their distribution over a wide area would greatly facilitate the disposal of the produce.

FOURTH DAY.

THE IMPROVEMENT OF THE INDIAN SUGARCANE INDUSTRY.

The report of the sub-committee appointed to draft a memorandum on this subject was considered.

A discussion took place on the question of specifying certain localities in which the conduct of sugarcane experiments is advisable. The Agricultural Department of Eastern Bengal and Assam invited the opinion of the Board on the suitability of the Jorhat Experimental Station for this purpose, but the Board does not consider itself in a position to specify the localities in which sugar stations should be established.

On the question of the conduct of field experiments in sugarcane, Dr. Mann advocated the constant supervision of a competent observer in order to obtain a more accurate determination of the characters of the crop than can be gained by weighing only in the hands of assistants untrained in methods of precision. He referred to the conclusions arrived at by Mr. Barber at the Samalkota Station which bear out his contention. Dr. Lehmann did not believe that observation can ever compare with the balance in testing the yield of a crop. Whilst admitting the necessity for such observations, the results should be judged chiefly by the balance. The assistants in charge of sugar stations should be sufficiently reliable to be able to carry out weighing tests in a trustworthy manner. Mr. Couchman pointed out that, though the results obtained at Samalkota had been largely arrived at by the methods suggested by Dr. Mann, frequent analyses and weighments had been made and the figures preserved on record at the station.

In planning plots for sugarcane experiments, Mr. Sampson and Mr. Fletcher drew attention to the danger of allowing seepage from one plot to another to interfere with the results. This danger may be avoided by surrounding each plot with two or three lines of sugarcane which are not included in the consideration of the results, as is done at the Manjri station in Bombay.

Dr. Mann believed that it is unnecessary for several stations to conduct experiments to determine the requirements of cane in plant food. This can be

done once for all. What each station should aim at determining by its manurial experiments is the best manure to provide for a particular set of conditions of soil and climate.

Dr. Mann and Mr. Howard considered that it is of importance to experiment, with the object of ascertaining whether any accurate means of determining the time of ripeness of cane, other than by analysis, can be discovered. No other method than this is apparently known, and several members remarked that cane growers in India are often obliged to carry out experimental boilings to find the proper period for cutting. Dr. Mann also suggested that experiments should be conducted to aim at the provision of some form of raw sugar other than *gur* for supplying refineries. The great losses in handling *gur* and the limited period of the year during which it can be worked are obvious disadvantages.

Mr. Moreland suggested that Government should be prepared to consider the desirability of granting assistance to pioneer central factories when suitable localities for such factories have been found. The difficulties which pioneers in an industry such as this have to contend with are often considerable, and may in some cases be lightened by fuel concessions, assistance in acquiring land or other similar means. Dr. Leather agreed with Mr. Moreland that the early stages of central factories are beset with difficulties, the chief of which is a want of confidence between the factory and the cultivator. The former cannot rely on getting his full promised supply of cane; the cultivator is unwilling to abandon his own methods for a procedure which he has no certitude will continue or repay him in the long run.

The Board suggests that Local Governments may consider the advisability of granting concessions to pioneer central factories when suitable tracts for the establishment of such factories shall have been found.

The Board adopts the report of the sub-committee on the improvement of the sugarcane industry as modified below :—

Scheme for the improvement of the sugarcane industry of India. Sugarcane experiments on the scale contemplated by the terms of reference should only be started in tracts where the crop is at present of *commercial* importance or likely to become so. In tracts where sugarcane is grown only for domestic consumption, the trials (if any) should be on a much more limited scale.

2. The information given in the provincial reports as to the increase or decrease of sugarcane cultivation in each province is not complete, but it does not tend to show that there has been any important change except in a few isolated cases. The fluctuations in area, which sometimes extend over short periods of years, appear to be due mostly to seasonal variations in the rainfall, particularly at the planting season, and to the economic condition of the people. Thus the decrease in recent years in the Bombay Presidency appears to be due to bad seasons, and the reduction in the resources of the cultivators owing to the effects of famines. In the United Provinces (which account for practically half of the total area under cane in India) the cultivation has been fairly constant, and as the result of a favourable planting season this year's area is very nearly the highest on record. The Bengal statistics show a large reduction from 755,000 acres in 1890 to 423,500 acres in the present year, but these statistics have to be received with caution, while in recent years the reduced prices of sugar and the profits on jute cultivation are believed to have resulted in a contraction of the cane area. The large reduction in the Central Provinces from 96,000 acres in the early sixties to 18,000 acres last year is believed to be principally due to the extension of railways; in early years the cultivators were obliged to grow home supplies, but they have been unable to compete with the more favourable cane tracts of the United Provinces and Bombay, and have substituted other more profitable crops, such as cotton. Before undertaking any important scheme of sugarcane experiments in a tract, it is recommended that the past history of sugarcane cultivation should be thoroughly inquired into.

3. *The objects of a sugarcane experiment station* are some or all of the following :—

- (a) Cultivation Experiments (including preparation of the land, methods and times of planting, supply of canes for sowing, distance apart of the canes, methods of after cultivation, mulching, trashing, irrigation, drainage, and the like).
- (b) The investigation of the manurial requirements of the cane, and the available supplies of manures.
- (c) The testing of varieties with a view of introducing a better cane.
- (d) The improvement of existing canes by chemical selection.
- (e) Attempts to raise seedling canes.
- (f) The methods for preventing the ravages of pests and diseases.
- (g) Improvements in the manufacture of the product.

(A) *Cultivation.*

4. In conducting the field experiments, the plots should be if possible one-fifth of an acre or at the very least one-tenth of an acre in area. They should be oblong in shape and laid out as long as practicable, at least 2×1. Oblong plots ensure greater uniformity in soil conditions and greater ease in cultivation. Land should be chosen as uniform as possible, and if necessary the soil of each experimental area should, in the first place, be carefully tested by growing crops until sufficient uniformity is secured. In cases where danger of seepage exists, a sufficient margin should be left round each plot to counteract this factor, such margins being also cropped. The number of sets in each plot of a series should be the same and should be examined for freedom from disease, and great care should be taken to check pests at the outset. Great care should also be taken to replace vacancies. The irrigation water for each plot should be carefully measured.

5. To enable the experiments to be made year after year provision must be made for rotation. This requires that the total area available for experiments should be at least twice that under cane in any given year. To ensure accuracy it is desirable to duplicate all the plots.

6. *The area required.*—At sugar stations throughout India care should be taken not to undertake experiments at several stations which can be equally well done at one. An area of about 12 acres under cane is a suitable standard of area for a sugar station, sufficient allowance being made in addition for rotations.

7. *Equipment.*—In providing equipment at sugar stations, efficient work should be aimed at, irrespective of cost, and the question of working stations at a profit should not be taken into consideration. The equipment is a matter of importance at all sugar experiment stations including the Poona (Manjri) Farm. As it is essential that there should be no delay in crushing the experimental canes as soon as they are ripe, a power mill is necessary, capable of dealing with about 2½ to 3 tons of canes per hour or 30 tons per working day. The mill should be sufficiently large to crush each plot as soon as it is ripe. The estimated cost of this equipment is about Rs. 7,500 (including shed).

8. *Ripening of the cane.*—In conducting field experiments with sugarcane, it is essential to determine when the cane is ripe and at its best. The only safe method is to analyse the cane as it approaches ripeness once a week or once a fortnight. The appearance of the cane is not a sufficient index to determine whether it is ripe. The analyses can be conducted by a reliable trained Indian assistant. When the plots are large, trial boilings can also be conducted in conjunction with the analytical work. Investigations of other methods of testing the ripeness of cane should, if possible, be undertaken.

9. *The determination of the yield.*—As neither the weight of canes nor the amount of *gur* is a reliable index of the yield, it is necessary to weigh the canes, to crush them, and to determine the amount of sucrose in the juice and that left in the bagasse. The results of an experiment should be expressed in

tons of sucrose in the cane per acre, and the purity of the juice should also be recorded. A calculation of the results from the weight of the canes and the analysis of a sample is not desirable. The determination recommended is the most reliable test, but, if desired, the juice can be made into *gur* and the weight stated, for the information of cultivators.

(B) *Manufacture.*

10. *The manufacture of gur or jaggery.*—A careful inquiry should be made into the actual efficiency and the losses that occur at the various stages of the indigenous processes for the manufacture of *gur* or *jaggery*, with a view to ascertain the best methods of lessening such losses.

11. *Milling.*—The following information concerning milling tests was supplied. In the United Provinces with thin canes, the best of the iron mills in ordinary use gives about 65 per cent. of extraction, whilst the inferior mills give about 45 per cent. In Mysore, with thick canes, the local 3-roller iron vertical mill gives 67½ per cent. of extraction, whilst a small power mill gives 76 per cent.; these mills were working at their highest efficiency. In Bombay, the local Poona mill with thick canes gives an extraction of 68 to 72 per cent. The improvement of the local mills is, therefore, one of the most important branches in which advance seems possible.

12. *Receptacles for collecting juice.*—Experiments in Mysore show that losses from fermentation due to the use of dirty receptacles amount to about 10 per cent. of the sugar in the juice. The discarding of earthenware pots, and the use of iron or copper receptacles, combined with cleanliness would prevent a considerable proportion of this loss.

13. *Liming.*—In the United Provinces liming is not practised, *sājjī* (carbonate of soda) being used, which results in great losses of sugar. In Mysore experiments have shown that the average loss of sucrose from imperfect liming amounts to 18½ per cent. A careful investigation should be made into the liming processes, in which attention should also be given to its effects on the colour and the keeping qualities of the *gur*.

14. *Methods of straining and skimming.*—Inquiry should be made into the possibility of improving the existing methods by the use of filter clothes and the like.

15. *Boiling.*—Inquiry should be made into the losses that occur through delay in boiling, charring, burning and the like. The possibility of introducing boiling pans of improved shape should be considered.

16. *Indigenous processes of sugar-making.*—A careful investigation of indigenous processes of sugar-making should be made with a view to improvement on the lines followed in the United Provinces. It also recommends an investigation of the Hadi processes to determine the actual losses that occur at each stage and the possibility of avoiding them. The Hadi equipment, consisting of three boiling plants, centrifugal and engine with boiler, costs about Rs. 4,650, exclusive of mill, which may either be worked by engine power or by bullock), which deals with 40 maunds of *rab* a day giving 20 maunds of sugar = 1½ acres of cane a day or 100 acres of cane in a season.

17. *Small power factory system.*—The type of equipment depends on the class of sugar to be produced; the production of *white* sugar postulates the use of vacuum pans, which involve a substantial area of cane (100 acres or more) for their efficient use, whilst sugar of a lower grade needs only open pans and steam boiling. The type of equipment usually employed on small factories in the West Indies for the production of 'muscovado' sugar, consists of a 3-roller mill, clarifier, settling tank, filter press, sulphur apparatus, open train of evaporators, pug-mill, centrifugal, engine and boiler. It is roughly estimated that a plant of this description, dealing with 2 tons of cane per hour in a working day of 12 hours, or 1,500 tons of cane over a working season of 63 days (=about 50 acres of cane in the Poona district or 100 acres of cane in the United Provinces) would cost about Rs. 20,000 or including necessary buildings, etc., Rs. 25,000. This amounts to a heavy outlay per acre of cane, but from the information available, it would seem that the losses avoided by using such a plant, including an estimated saving of 9 per cent. of

juice in milling, 10 per cent. of sugar outturn from avoidance of inversion, and allowing for loss on the molasses and for the cost of working, would, apparently, give a fair prospect for its introduction into suitable tracts, provided that local conditions are favourable. The Board recommends that, if further inquiries verify this forecast, such a small power factory might be tried as an experiment at a suitable sugar experiment station.

18. *Central Factory System.*—The information before the Board was not sufficient to enable them to state the conditions necessary to the successful working of a large central factory, including the supply of cane or raw sugar required. It is recommended that these conditions should be ascertained, that Departments of Agriculture should make local inquiries as to the tracts where these conditions are most nearly approached and publish the results for general information. The causes of failures of this system in certain cases should be inquired into.

19. *Imports.*—The imports of all classes of sugar, which have increased from 168,000 tons in 1894-95 to 347,000 tons in 1905, amounting to 2½ lbs. per head of the population of India, show the great demand for sugar in India. The attached letter from the Bombay Chamber of Commerce gives some interesting information as to the class of import trade at that port. (See Appendix H, page 81.)

20. It is desirable that a conspectus should be made of the results of previous experimental work on sugarcane in India, including a critical examination of the results.

VETERINARY MATTERS.

1.—THE CURTAILMENT OF GRAZING GROUNDS.

Colonel Morgan stated that this question was raised at the last meeting of the Board of Agriculture and its full consideration postponed for the collection of information from Local Governments. The papers received in connection with the enquiry are laid before the Board (Appendix I, page 231). From these it would appear that few definite suggestions have been offered, and the only point remaining for the Board to decide is whether a further and more detailed enquiry is called for. In the Punjab canal colonies and in Sind, it has been reported that the extension of cultivation is resulting in a serious contraction of the large breeding herds that supply the work cattle of many districts.

The President briefly recounted the enquiries which have been made in the past into this question, and the instructions issued by Government from time to time. Practically none of the recommendations which have been made have fully secured the objects aimed at. Grass and fodder reserves have only led to the increase of local cattle up to the limit of supply in good years and consequently great mortality when scarcity arose.

Mr. Sampson and Mr. MacKenna mentioned specific instances in Ongole and in Burma where this difficulty does not exist, but the conditions in the latter Province are not applicable to other parts of India.

The Board is of opinion that the evidence before it is not sufficient to justify any further enquiry on the subject of the improved provision of grazing grounds in the large cattle-breeding districts, as no further information appears to be available on the subject, and it would not be likely to lead to any practical result.

2. THE PROVISION OF FODDER IN TIMES OF FAMINE.

The President stated that this matter has also been before Government for years; he gave a summary of the past history and of the recommendations to be found in the Famine Commission Report of 1901. In Bombay the chief recommendations were (a) to stimulate the growth of fodder by the grant of loans and other assistance, (b) to import fodder from other parts, (c) to deport the cattle from distressed districts to forests or other available better areas, and (d) the provision of Government cattle camps. The first of these has been found by experience to do much good in suitable tracts, and the importation of fodder is preferable, generally speaking, to the deportation of the cattle. The Famine

Codes of the Provinces in general adopt these recommendations, which form the basis for action in time of famine.

The Indian Famine Union recommend in addition the introduction of drought-resisting plants, such as salt bushes, into famine liable tracts. In practically every case, however, in which this has been tried, it has proved a failure.

The storage of fodder, which has also been recommended has not been found practically successful as deterioration is rapid. This Board recommended in 1906 the botanical investigation of fodder grasses, and this is already in progress in some provinces.

Other members of the Board discussed the advantages of ensilage, the improvement of pasture grounds and the systems of grazing, which questions have been successfully taken up in some parts of India. The Board considers that Departments of Agriculture should, where possible, take up these lines of work.

3. THE BEST METHODS OF UTILIZING THE SERVICES OF VETERINARY ASSISTANTS, I.E., BY STATIONARY WORK IN DISPENSARIES OR BY ITINERATING WORK IN VILLAGES.

41. The Board is of opinion that this is an administrative matter which can be more profitably dealt with by the contemplated Board of Veterinary Science.

FIFTH DAY.

AGRICULTURAL ENGINEERS.

42. Sir Edward Buck presented a note on the training of Agricultural Engineers, which is printed as Appendix J, page 240 of these Proceedings. He referred to the valuable work which was begun at Cawnpore by Messrs. Wilson and Clibborn at the time when he was Director of the Department. He wished the opinion of the Board on the following points :—

1. Whether it is desirable to have a corps of agricultural engineers attached to the Agricultural Departments in India.
2. Whether a survey of each province should not be undertaken to determine the directions in which agricultural engineers could be profitably employed.
3. How best the competent experts required for this work should be obtained.

Mr. Moreland supported Sir Edward Buck's opinion of the value of the work carried out by the professional engineers who had been at one time attached to the Department. Their length of service was too short to permit of many problems being solved, but they laid the foundation of practically all that is known regarding the construction of spring wells in these Provinces. The Irrigation Department is not in a position to deal with the provision of wells, and small works of this sort must be in the hands of cultivators and landholders. It must be the duty of the Agricultural Department to ascertain where there is room for increasing the number of wells. It must also determine what difficulties in well construction exist in specific places, and it must endeavour to overcome these difficulties. Records of the localities requiring more permanent wells are now available for these Provinces. Similarly it is now known where temporary wells may be required in times of distress, and details of their cost, time required for construction, etc., have been obtained. This information will be referred to in the United Provinces Famine Code. The Board of Revenue now undertakes to provide any advances required where the survey has shown that wells are needed, and further than this, Collectors are instructed to let it be known that Government is anxious to encourage the making of wells and ready to advance the capital required. In some cases the cultivators themselves are not certain that wells can be made and if so how far they will prove useful. In these cases assistance will be given them by sending down a staff to determine whether wells can be

made and what precautions should be taken in their construction. The additional staff employed for this purpose is a trained man who makes and looks after the tools and three overseers who are in charge of the boring parties. Part of the staff has had to be obtained from Engineering Colleges, and the Agricultural Colleges would not be competent to provide such men.

The President said that during the famine of 1899-1900 in the Central Provinces temporary wells were constructed in the Chattisgarh rice districts. Many of these were successful but some were failures. This depended on the fact which was apparently brought out, that there is a flow of underground water along the slopes in this area which can successfully be reached by temporary wells for a short period after the cessation of the monsoon rainfall. The Agricultural Department was inadequate to carry out a survey of this underground water. Another question in which assistance is required in the Central Provinces is in the case of wells bored in the districts where rock is near the surface. A substantial proportion of these are failures. Trial borings are called for where it is proposed to make these, but no provision has yet been made for a boring staff, pending the publication of the results of the work in the United Provinces. The diversity of the work in which an engineer can assist Agricultural Departments is so great that there is ground to doubt whether a single man could be obtained capable of dealing adequately with all branches of it.

Mr. Mead said that the Bombay Department has begun to assist in well construction, and with success in alluvial soils though not to any extent in rocky localities. It is proposed to organise the staff required through the Public Works Department. In Guzerat local expert assistance is available to the Department and trial work is being carried on in this area. Work in checking erosion in parts of the Deccan is also being taken up on a small scale.

Mr. Renouf stated that measures are being prepared by the Punjab Department of Agriculture to carry out minor irrigation works on the lines recommended by the Irrigation Commission. A survey is being made of suitable localities and a scheme is under consideration in conjunction with the Chief Engineer of the Irrigation Department, somewhat on the lines of that of the United Provinces. As regards the staff he was of opinion that skilled engineering advice is essential in minor irrigation works, and would prefer trained Public Works Department subordinates to agriculturally trained men with a smattering of engineering for the subordinate staff.

Mr. Couchman referred to the useful work carried out by Mr. Chatterton in raising well water by power. Mr. Chatterton's staff inspects wells in which there is a prospect of increasing the water supply by providing engines, and advances are given in suitable cases to provide the plant, which is erected by the Department.

Dr. Leather referred to the assistance which can be given by engineers in agricultural machinery. He considered that a full engineering training is essential for agricultural engineers. Mr. Fremantle, while admitting the importance of the engineering aspect of work such as Mr. Chatterton's, considered that for the main subjects of minor irrigation works referred to in Sir Edward Buck's note, agricultural knowledge is all important and for the subordinate staff at least he considered that the main training should be agricultural, an engineering course, preferably at an engineering college, being added.

Dr. Lehmann said that as regards implements the best assistance can be obtained from a trained agricultural staff rather than from professional engineers.

Major Atkinson considered that the discussion has shown that a highly skilled engineer to advise on schemes of minor irrigation works, checking erosion and improving land by silting, seems to be required. He should also have a special knowledge of mechanical engineering to enable him to advise on implements, power systems of raising water and similar matters. The existing specialists in irrigation and hydraulics in the country probably are unable to devote sufficient time to more specially agricultural matters. The ordinary training of Public Works Department subordinates does not appear to be quite

suitable for the staff required to deal with questions such as those discussed. In addition to one skilled engineer attached to each Department, a small number of subordinates specially trained would be required, one to deal with machinery, one for well-boring and so on. This would still leave a certain number of smaller aspects of agricultural engineering in which the trained agriculturists could profitably advise. Mr. Fremantle's suggestion of a special course of engineering in engineering colleges for agricultural students required to deal with these questions is impracticable, unless much more time can be given than is likely to be available.

43. The Board is of opinion that skilled engineering assistance is desirable in Agricultural Departments of Provinces where this aspect of agricultural improvement is important, and that this matter should receive consideration by Local Departments. The training to be provided for the staff is also a matter for further consideration in view of local requirements.

THE UNIFICATION OF METHODS EMPLOYED IN THE LABORATORIES OF AGRICULTURAL CHEMISTS.

44. The following report of the Committee appointed to consider this question is adopted by the Board.

Report of the sub-committee for the unification of the methods of analyses in Chemical Laboratories of Agricultural Departments.

The points of reference which the sub-committee considered were as follows:—

- (1) whether it is desirable to prescribe official methods of analysis to be followed in the Chemical Laboratories of Agricultural Departments;
- (2) if so, what methods should be prescribed;
- (3) whether it is desirable to suggest methods of analysis for other substances as a guide for Agricultural Chemists;
- (4) whether it is desirable to introduce a system of testing official methods by uniform samples analysed at each laboratory;
- (5) to make any further recommendations on this subject.

Item 1.—It was recommended that the principle be adopted of having official methods, the use of which will be binding on the Chemists of the Agricultural Departments.

Item 2.—Methods for the analysis of the following classes of substances were considered:—Soils, Feeding-stuffs, Manures, Waters, and it was decided to make the following methods official.

A. Soils. (a) Sampling.—That in all ordinary cases and unless special circumstances interfere, the surface soil shall be defined as the first 20 cms.

(b) Definition of fine earth, and the sieve to be employed.—Fine earth to be that portion of the soil which will pass a sieve with round holes 1 m.m. in diameter.

(c) Chemical Analysis.—Available phosphate and potash. Dyer's method.

B. Feeding stuffs.—Woody fibre.—The strength of the acid and alkali used to be 1½ per cent. and the period of digestion to be ½ hr. in each case.

C. Manures.—Methods for the extraction of soluble and insoluble phosphates.

D. Waters. (a) Albuminoid Ammonia.—Wanklyn's method.

(b) Oxygen absorbed.—Method of Clowes and Coleman.

Item 3.—The Committee consider that it is desirable to recommend methods for use in Agricultural Laboratories, and the details of such methods should be revised annually.

Item 4.—It is desirable to test official methods but the necessity for testing such methods must be considered separately in each case.

Item 5.—The full details of the methods should be published with such illustrations as may be necessary, and revised annually. For the present 100 copies will be a suitable number to print.

APPENDIX A.

PROGRAMME FOR THE THIRD MEETING OF THE BOARD OF AGRICULTURE.

SUBJECT I.—*The confirmation of the Proceedings of the last meeting.*

A note is attached (see Appendix B, page 21) showing the action taken on the recommendations of the Board.

SUBJECT II.—*The Programme of work of the Imperial Department of Agriculture.*

A consideration of the programmes of—

- (1) The Director, Pusa Research Station;
- (2) The Imperial Agricultural Chemist;
- (3) The Imperial Economic Botanist;
- (4) The Imperial Mycologist;
- (5) The Imperial Entomologist;
- (6) The Imperial Agriculturist.

2. Provincial Directors should examine them to see whether they meet the requirements of their own Provinces; Imperial experts should examine them to see whether the programmes of branches, other than their own, meet their requirements.

SUBJECT III.—*The Programmes of work of the Provincial Departments of Agriculture.*

A consideration of the programmes submitted by—

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| <ol style="list-style-type: none"> (a) Bombay. (b) United Provinces. (c) Bengal. (d) Madras. (e) Punjab. | | <ol style="list-style-type: none"> (f) Burma. (g) Central Provinces and Berar. (h) Eastern Bengal and Assam. (i) Mysore State. (j) Baroda State. |
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2. The Imperial experts should consider whether the programmes meet their requirements, and whether they can suggest improvements. The Provincial Directors should consider whether the programmes of other Provinces can be improved so as to meet any special requirement of their Province or to ordinate the work.

SUBJECT IV.—*The Improvement of the Indian Sugarcane Industry.*

A consideration of the notes submitted by the Provincial Departments and a discussion as to the best lines for future experimental work.

SUBJECT V.—*Veterinary matters.*

A discussion of the notes submitted to the Board, dealing with the following matters:—

- (a) The curtailment of grazing grounds;
- (b) The provision of fodder in times of famine;
- (c) The best methods of utilizing the services of Veterinary Assistants, *i.e.*, by stationary work in dispensaries or by itinerating work in villages.

SUBJECT VI.—*The unification of methods employed in the laboratories of Agricultural Chemists.*

* Distributed to Chemists only.

A consideration of the note* submitted by the Imperial Agricultural Chemist on laboratory methods.

SUBJECT VII.—*Commercial Fertilizers in India.*

A consideration of the notes submitted by certain members of the Board.

SUBJECT VIII.—*The utilization of river silt in India.*

Sir Edward Buck will present a note on the above subject and will explain to the Board the results of his recent enquiries in Italy.

SUBJECT IX.—*The improvement and Extension of cotton cultivation in India.*

The consideration of the methods which should be adopted for the utilization of the grant made by the British Cotton Growing Association for the improvement of Indian Cotton.

SUBJECT X.—*Agricultural Engineers.*

The consideration of a note presented by Sir Edward Buck. (See Appendix J, page 240.)

F. G. SLY,

*Offg. Inspector General of Agriculture in India and
President, Board of Agriculture in India.*

APPENDIX B.

Note showing the action taken on the Proceedings of the second meeting of the Board of Agriculture in India.

This note has been prepared for the information of the members of the Board of Agriculture, to show the action taken on the recommendations made at the second meeting of the Board of Agriculture. The references are to the numbered paragraphs of the proceedings of that meeting, those in which no action was necessary being omitted.

Item 3.—Supply of European Stores.—The Inspector General of Agriculture again brought to the notice of the Government of India difficulties that at present exist regarding the supply of European Stores required for experimental purposes in the laboratories of the Departments of Agriculture, both Imperial and Provincial. At the instance of the Secretary of State, the Government of India have again asked the Inspector General of Agriculture to submit a report on the actual experience of the Imperial officers, which report has been submitted.

Item 4.—The Government of India (Department of Revenue and Agriculture) in their letter No. 188—12-16, dated the 26th January 1906, to the Inspector General of Agriculture, have laid down, for the guidance of the Imperial experts, the principles of inter-communication between Provincial experts of the Agricultural Departments and themselves.

Items 5 to 11 and 74.—Agricultural Education.—The Government of India have invited the attention of all Local Governments to the standard curriculum of studies in Agricultural Colleges recommended by the Board, and have asked the Local Governments to make use of it in drawing up the curriculum of the Agricultural Colleges in their respective provinces.

Items 12, 13 and 66.—Programme of Research Work of the Pusa Institute.—The general principles laid down by the Board as regards the research work of the Pusa Institute have been borne in mind in the framing of the programmes for the coming year.

Items 14 to 22.—Programmes of the Imperial Experts.—The remarks of the Board have been communicated to the officers concerned for their information.

Item 14.—The Government of India agree with the Board's recommendation that the publication of the results of analyses must be left to the officers concerned.

Item 15.—Dr. Leather has arranged at Pusa to carry out analyses of sugarcane during different stages of their growth so as to test the period of actual ripening. He and Mr. Shearer have also drawn up a note on the prospective sugarcane experiments which is appended for the information of the Board.

In February last the Imperial Agricultural Chemist deputed one of his assistants to the Central Provinces for analysing sugarcane juice in the field. The assistant visited Lanji in the Balaghat District in order to check the results of the previous year's analyses, but the seasonal conditions of the year were unfavourable to the experiments. Bad weather also intervened, and some of the canes intended for analyses were found to have been cut for 8 days. The analyses nevertheless indicated it a very good cane, though not of the same quality as in the previous year.

Dr. Butler continued the work of selecting sugarcane grown at Pusa with a view to eliminating disease, and Dr. Leather tested the canes both with regard to the percentage of juice and the percentage of sugar.

Item 17.—The experimental work on indigo at Pusa has been abandoned because more important work occupies the attention of the Imperial Economic Botanist, and because it seems desirable to concentrate all the work at Sirseah Research Station of the Indigo Planters' Association.

Item 18.—Experiments for resisting the pigeon pea wilt disease have shown a considerable promise in the Bombay Presidency. The selected seed from the disease infected plots at Kirkee Farm has this year given a crop with at least 75 per cent. less diseased plants than last year's crop. The work will be continued.

Similar experiments at Pusa were lost owing to the floods so that no infections were carried out.

Item 19.—The Pusa Institute has published a bulletin by Mr. Lefroy, on the cotton boll worm of the Punjab which describes the measures to be adopted against boll worm. The Imperial Entomologist visited the Punjab several times during the year and suggested means to check the ravages of the boll worm to the cotton crop of the year. The results of the introduction of parasites are encouraging and justify the continuance of the work on these lines.

Item 21.—The Imperial Entomologist visited United Provinces during November 1906.

Items 23 and 24.—*Programmes of Provincial Departments.*—The Government of India have invited the attention of the various Local Governments to the general principles recommended by the Board.

Item 25.—*Bombay. Alkali Lands in Sind.*—In July 1906, the Bombay Government submitted proposals to the Government of India for the appointment of a specialist for five years to investigate the alkali problem in Sind. Before submitting the proposals to the Secretary of State, the Government of India have asked the Bombay Government to furnish them with some facts as to the nature and magnitude of the alkali evil, the time from which it dates, the rapidity with which it is spreading and the factors to which it is apparently due. The question is still under consideration.

Item 26.—*Experiments in the introduction of Egyptian cotton in Sind.*—The Director of Agriculture, Bombay, has fully described the results of the experiments with Egyptian cotton in Sind obtained during the season 1906, in Appendix B to the Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1905-06. It was decided to restrict the cultivation to such area as could be effectively supervised in order to introduce a knowledge of the Egyptian methods of cultivation. Fifty tons of seed were imported from Egypt and 5,000 acres are reported to be under this cotton during the season.

Item 27.—*Investigation of the ground-nut tikka disease.*—Is promising well and will be continued during the year. It has been suggested that the disease might be checked by introducing new and early ripening varieties. The Bombay Department of Agriculture has arranged to obtain from America, Japan and Pondicherry 5 tons of seed from each for distribution before May 1907.

Items 28 to 31.—*United Provinces.*—The Government of India have invited the attention of the Local Government to these items.

Item 32.—*Bengal.*—The Government of India have invited the attention of the Local Government to this item.

Items 33 and 34.—*Madras.*—The attention of the Local Government has been invited to these items. Mr. Finlow's bulletin on the extension of jute cultivation describes the proposals for extending this crop.

Item 35.—*Punjab.*—The Government of India have invited the attention of the Punjab Government to this item.

Items 37 and 38.—*Central Provinces.*—The Government of India have invited the attention of the Central Provinces Administration to these items.

Items 39, 40 and 41.—*Eastern Bengal and Assam.*—The Government of India have invited the attention of the Local Government to these items.

Items 43 to 50.—*The Improvement of Indian Wheat.*—The Government of India have again addressed the Secretary of State regarding the appointment of a Wheat Expert. They have also suggested to the Local Governments the desirability of completing, as far as possible, an agricultural survey of the varieties of wheats grown in their respective provinces.

Items 51 to 55.—*The Improvement of Indian Tobacco.*—The Government of India have again recommended to the Secretary of State the appointment of a Tobacco Expert without whom it is not possible to adopt the Board's suggestions on the subject.

Items 56 to 60.—*Veterinary.*—The matters included in these recommendations are still under the consideration of the Government of India. It is also under consideration whether a separate Board of Veterinary Science in India should be established.

Items 61 to 65.—Commercial Fertilizers.—The Government of India negatived the proposals of the Board of Agriculture for the appointment of a Committee to collect information concerning the use of Commercial fertilizers in India, for the purpose of considering the possibility of introducing a system of inspection and control by legislation or otherwise. This decision has been communicated to the members of the Board with the permission of the Government of India in order to enable those who are specially interested in the subject to collect further information for further consideration by the Board.

At its last annual meeting held on the 13th August 1906, the United Planters' Association of Southern India discussed at considerable length the subject of the need of Government control over the sale of artificial fertilizers. The meeting was attended by the Inspector-General of Agriculture, Drs. Leather and Lehmann. The Association has submitted a resolution urging earnestly a reconsideration of the recent decision of the Government of India in this matter and requesting that a searching inquiry may be instituted with a view to the early introduction of some system of control on the lines existing in the United States.

Items 67 to 71.—Procedure at the Board Meetings.—The Government of India have generally approved the proposals put forward by the Board and have left the practical methods of the procedure to be followed at the meetings of the Board to the experience of the Board.

As regards the inquiry into sugarcane which forms the principal subject for the discussion at this meeting of the Board, Mr. Barber kindly prepared a scheme for Provincial inquiry. The notes submitted by the Provincial Departments on the subject are appended (see Appendix H, page 81).

Items 72 and 73.—Place of Meeting.—The Government of India have approved the recommendation of the Board that its meeting should be held in alternate years at Pusa and in the Provinces.

Item 75.—The form of degree or diploma.—The question of the form of the degree or diploma to be conferred by provincial Agricultural Colleges is still under the consideration of the Government of India. They have promised to address Local Governments separately, if necessary.

F. G. SLY,

*Offg. Inspector General of Agriculture in India and
President, Board of Agriculture in India.*

*Note on the prospective sugarcane experiments by Messrs. J. W. Leather,
and E. Shearer.*

The cultivation of varieties of cane at Pusa has led to the following as being the more important question which we should try to answer—

(a) *Date of Planting.*—The cane was planted in March of the current year and we think two dates, approximately October and February, should be tried with a thin variety and a thick variety in order to note any advantages which might accrue from the one or the other. Judging by the present crop, it seems likely that some cane can be obtained mature from the end of October and it is of importance to ascertain over how long a period cane can be brought to maturity.

(b) *The depth at which sets should be planted* should probably depend on the moisture conditions of the soil. Where the sets are put into freshly irrigated land, as in black cotton soil tracts, there can be no object in putting the sets deep. But where the cane is planted without irrigation, as in Behar, it is an open question whether sets should not be covered with several inches of loose earth. It is proposed to plant several varieties with two distinctly different amounts of earth over them.

A similar question is whether the present Behar plan of preparing a trench beforehand is the most desirable. A great part of the moisture which was in the removed earth and some of that from the bed of the trench is lost. We therefore propose to plant some two or three varieties in pits, made *at the time of planting*, as a means of testing the question. An irrigation channel will be

made afterwards along the line of pits. The whole of the earth dug out of the pit will be replaced together with the manure.

In this connection also it seems possible to do all the cultivation required for cane by bullock power only. With the implements at present at our command we can cultivate to a depth of 9 inches and if necessary subsoil stirring could be done in addition. The question of bullock power for cultivation is important because of the cost of manual labour and also the difficulty of getting the requisite amount of labour at a busy season. We therefore propose to plant an area of not less than $\frac{1}{4}$ acre to 1 acre by bullock power only.

(c) *The distance between rows of cane* has been 5 feet up to the present. Mr. Barber has found 4 feet sufficient and we propose to plant two or three varieties at this latter distance between rows and two or three varieties of thin canes at 3 feet 6 inches. In the experiments with pits these will be 4 feet by 3 feet apart.

(d) Some of the canes this year have been unable to support their own weight and have fallen. In the coming year some varieties will be bound by the lower leaves as soon as these commence to fade and this binding will be continued upwards; finally, when the later stages of growth have been reached, three or four stools will be bound together at the upper part.

APPENDIX C.

PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE FOR 1907-08.

PROGRAMME OF THE AGRICULTURAL RESEARCH INSTITUTE, PUSA.

The scientific work of this Institute for the coming year is indicated in the programmes submitted under the different sections.

The construction of the buildings sanctioned by the Government of India has practically been finished with the exception of the Phipps' Laboratories. The stone and brick work in this building will continue for some months longer. The furnishings and fittings, as well as the erection of electric and gas installations, will also take to the end of the year, so that it is calculated this important building should be ready for occupation in January 1908.

Probationers from the provinces to the number of 17 have been taken for training during the past year, and now that the hostel is finished this number can be increased if it is necessary.

The curriculum of studies will be prepared by the Inspector General of Agriculture in India and the staff.

Books to the value of ₹22,000 have been purchased for the Library and Reading-room. A catalogue is in preparation and will be issued shortly.

The publications from this Institute during the past year, besides the usual annual report, have consisted of a quarterly Agricultural Journal of India and Memoirs on various scientific subjects. It is intended to continue this work.

B. COVENTRY,

*Director of the Agricultural Research Institute and
Principal of the Agricultural College, Pusa.*

I.—AGRICULTURAL CHEMISTRY.

1. *Available plant food in soils.*—The programmes of 1905 and 1906 contained references to a series of experiments on the determination of readily available plant food in soils. The subject has been limited mainly to a test of the value of Dyer's method for the estimation of available phosphates and potash, and for the most part only one natural order of plants has been so far included. The experiments have consisted in (a) the testing of soils by Dyer's method in the laboratory, and (b) the growth of plants in the same soils both with and without additions of fertilisers in the pot-culture house. The work was much handicapped at Dehra because the shed in which the pot-cultures were made was unsuited to such work, and insects and rats and fungi spoiled some of the cultures. A very well equipped house has been constructed at Pusa, and the work is under good control.

Altogether nine soils from various parts of India have been included, and the several years' work has resulted in a very good confirmation of the value of Dyer's method for the estimation of available phosphate, so far as the growth of cereals is concerned. The data for potash was not so certain. The more definite results are about to issue as a Memoir.

Future experiments will include natural orders of plants other than the gramineæ. I intend also to apply the information which we have obtained to a certain area of Behar, which judging by analyses of odd samples, is a fairly well defined and large area deficient in phosphates, but how soon this can be taken up must depend on other calls of my time and my staff. It is obvious, however, that if areas of land exist which possess special features, their geographical limits and properties should follow as a practical outcome of such experiments as those referred to.

2. *Rain and dew.*—As mentioned in my two previous programmes, the amount of nitrogen compounds has been determined in rain water (collected at Dehra Dun and at Cawnpore) and in dew (collected at Cawnpore) over one year in each case. The data obtained were published as a Memoir of the Department this year. The result was to show that Indian rain does not

contain any inordinate quantity of such compounds; in fact the series of specimens which were examined contained no more than has been found in England. The amount of nitrate was relatively higher and that of ammonium relatively lower at Dehra, and this may perhaps be due to electric phenomena, but the popular notion that our rainfall forms an important supply of such plant food is clearly negatived.

A similar series of records is being kept at Pusa, but if any novelty is met with, it will lie in other directions.

3. *Drainage*.—The subject of drainage was also referred to in my previous programmes. During the past year four rain gauges, two of 3 feet and two of 6 feet thick and 1/1,000 acres in area, have been constructed at Pusa, and I wish here to mention that we are under obligation to Mr. M. H. Arnott, the Superintending Engineer in charge of the works, for the interest which he took in their construction. If these gauges are to yield really satisfactory data, they must contain only undisturbed soil, and Mr. Arnott constructed those at Pusa quite successfully, the earth being not only undisturbed land but also quite free from cracks. They were completed before the commencement of the rains, but the measuring apparatus was only fitted up later, and imperfect records were all that could be maintained this year. The drainage water was tested for nitrate and it was found to be almost free of this constituent. This was anticipated from a previous examination of the soil. In this respect our gauges are very different from those at Cawnpore. Two of them carry *dub* grass (*Cynodon dactylon*) and two are maintained fallow, and for the coming year they will be kept in this state.

The similar gauges at Cawnpore continue to yield most interesting drainage water. Through the kindness of Messrs. Moreland and Hayman I have been supplied with samples throughout three monsoons, and the concentration of the nitrate in water continues undiminished. Moreover the total quantity of nitrate this year (one of heavy rainfall) has been greater than even that of 1904. This quantity is naturally not to be confused with the concentration. It varies like the quantity of drainage, with the rainfall.

4. *Water in soils*.—As mentioned in my last programme, a record of the amount of moisture in the soil throughout the year was to be maintained. This has been done since February down to a depth of 5 feet from the surface.

The apparatus employed has not been publicly described. I intend to do this during the coming year, but it may be briefly stated that a specimen of the undisturbed soil is obtained and weighed without any such loss of moisture as would affect the required accuracy of the experiments. The soil is then dried and the moisture estimated by difference. From the first borings it became perfectly evident that accurate as this information is, other data would be necessary. The percentage of water was found to vary in a quite unexpected degree, and this could only be referable to differences in the physical nature of the different strata. Accordingly it was necessary to add to the foregoing "percentage determination" of the amount of water, a careful physical examination of the different strata. This is a most tedious and time-absorbing matter and has delayed the work in a measure. But one result has been clearly defined, which is that, after percolation has ceased, the quantity of water present in any volume of soil is dependent primarily on the physical character of the soil, and that, within a few inches there can be a variation from 8 or 10 per cent. up to as much as 20 per cent. of water. This is in full agreement with the opinions on the subject of soil moisture which Mr. Lyman Briggs of the United States Agriculture Department expressed several years ago. It also shows the futility of expressing the quantity of water in soil simply as a "percentage." There is every reason to expect that it will be possible to publish some very interesting data during the year.

5. *Soil gases*.—During the last few months I have perfected an apparatus which enables one readily to determine the quantity and nature of the gases contained in soils at various depths. It is a subject which has occupied my thoughts for several years, but which for technical reasons I was unable to submit to experiment until I came to Pusa. At present there is no very precise information on this matter in any country.

6. *Cyanogenetic glucosides*.—It has been decided that the work at Pusa on this subject shall be restricted to an enquiry into the conditions under which

these glucosides are formed in plants. So far no success has attended the experiment. I have failed to grow sorghum containing any material proportion of dhurrin, but further experiments will be conducted during the coming season. Linseed, another plant in which a cyanogenetic glucoside is formed, is now growing at Pusa, and it contains very considerable quantities, but the conditions of the formation are still unknown.

7. *Manures: Calcium Cyanamide and Calcium nitrate.*—These are the two substances which have during very recent years been prepared by bringing atmospheric nitrogen into combination with lime and carbon or oxygen respectively. Their nature has been sufficiently made known in various agricultural journals. Both have been employed in my pot-culture experiments, and I hope to see them used in field experiments very shortly. The question of cost is naturally a very important one, but judging by figures published in Europe, their nitrogen is already as cheap per pound as that in either Chili saltpetre or sulphate of ammonia. I need only add that I have found no deleterious effects to follow the use of the cyanamide.

8. *Field experiments.*—A separate note on some field experiments, which will extend over a series of years, will be submitted by Mr. Shearer and myself in January.

9. *General analytical work.*—Owing to the appointment of Chemists to the Provincial Agricultural Departments, the number of odd specimens sent for general analysis is likely to decrease, and indeed it has done so in a measure already. As a result there is not only more opportunity for the prosecution of various investigations but it is also possible to organize the work more perfectly. Hitherto it has been almost essential to give preference in a great measure to analyses of provincial samples, and this has not enabled me to detail one assistant to any one specific work. But with the decrease of such odd analyses, this more perfect organization will become possible.

10. *Probationers.*—Three probationers from provinces have been accommodated in the Pusa Laboratory during the past year. During the current year several of the newly appointed Chemists to provinces are to spend some months at Pusa, and the small temporary laboratory will be very fully occupied.

J. WALTER LEATHER, PH. D.,

Imperial Agricultural Chemist.

II.—ECONOMIC BOTANY.

1. *Plant breeding and plant improvement.*—During 1907, the following crops will be studied: wheat, tobacco and barley. The determination of the varieties of Indian wheat, tobacco and barley will be continued.

2. *Fibre plants.*—The collection and investigation of fibre-yielding plants will be continued.

3. *Fruit experiments.*—The permanent experiments on the culture of Indian fruits will be continued on the lines laid down in the first report.

4. *Minor investigations.*—The study of the varieties and cultivation of cassava. The Imperial Agricultural Chemist will determine the amount of glucoside and starch. The economic importance of the male plant in *ganja* cultivation.

5. *Publications.*—The monograph on Indian wheat will be completed.

A. HOWARD, M.A.,

Imperial Economic Botanist.

III.—MYCOLOGY.

1. *Training.*—The training of provincial probationers in Mycology will be continued. The probationers from Bengal and the Central Provinces will finish their course, and new men will be received from Madras, the United Provinces, and possibly another province. A period of about 18 months will be required in each case.

2. *Research and experimental work* (a) *Soil fungi in relation to plant life.*—A number of the commoner fungi found in decomposing organic matter in Pusa have been isolated. Fresh collections are made from selected localities so as to ascertain the relative frequency at different seasons of the different species. This must be continued over some years. The effect of these in pure culture on dead vegetable tissue will be tested, as soon as a sufficient number of constantly recurring forms have been obtained. The work on Mycorrhizas or the association of fungi with living plants will be continued.

(b) *Wilt diseases.*—The efforts to obtain a resistant strain of pigeon pea (*arhar* or *tur*) are showing considerable promise at Bombay. The selected seed from the disease-infested plot at Kirkee Farm has this year given a crop with at least 75 per cent less diseased plants than last year's crop. This work will be continued. The similar experiments at Pusa were lost owing to the floods. No infections were carried out at Pusa for the same reason, but fresh arrangements will be made for the coming season.

(c) *Surgarcane diseases.*—The plots at Pusa were flooded in August and the experiments lost. Sufficient growth had, however, occurred to illustrate the good effects of seed selection. This work will be repeated and fresh experiments started.

(d) *Crop rusts.*—The work at Cawnpore, in conjunction with Mr. Hayman, to ascertain the origin of wheat rust each season will be continued. About 100 plants in all have been grown under protection from outside infection without developing rust. A considerable number will again be grown in the cases under varying and better controlled conditions. It is proposed to repeat at Pusa some of Dr. Erikason's cytological work, which is in want of confirmation. The investigation of other crop rusts may be taken up if occasion arises.

(e) *Smuts.*—The life history of some Indian smuts is being investigated and work on these will be continued.

(f) The identification and study of other fungus diseases of crops will occupy, as usual, a large amount of time.

3. *Systematic work.*—Arrangements have been completed for the identification of most of the species of fungi which have been collected during the last five years. The necessity for this work, which cannot be satisfactorily done in India, is apparent from the first large collection dealt with, that of the rusts and smuts. Though these parasites have had more attention paid to them by previous workers in India than any of the other groups of fungi, one new genus and forty-two new species were contained in a first collection of one hundred and forty-three specimens recently worked out in conjunction with Herr Sydow at Berlin. Other groups will be taken up in turn.

E. J. BUTLER, M.B.,
Imperial Mycologist.

IV.—ENTOMOLOGY.

The work of the past year in studying and advising on insect pests will be continued; assistance will be given in directing the work of provincial assistants until the appointment of Entomologists to provincial departments. This work will occupy the major part of the time and no new investigations of an extensive nature are proposed. The enquiry into insecticides, non-poisonous to cattle, will be continued. The results gained with the re-introduction of parasites of the cotton bollworm to the Punjab justify a continuance of this work which will probably restore normal conditions. The value of trap crops will be studied as opportunities permit on the Pusa Experimental Farm. Some progress has been made with the investigation of biting flies, and it is proposed to continue this and to publish the preliminary results. It will be necessary to continue the work of the insect survey of the plains of India with a view to the identification of common insect pests and their allies. Should the appointment of provincial Entomologists lessen the mass of routine work, it may be possible to commence the study of the parasitic enemies of pests with a view to an extension of this method to pests other than the bollworm of cotton in the

Punjab. In co-operation with the Madras Agricultural Department, it is hoped that it may be possible to investigate the insect pests peculiar to Southern India. A method of checking the migratory locusts will be tested in co-operation with the Punjab Agricultural Department; should there be any extensive occurrence of this pest, other work will be dropped in favour of the more careful study of this important insect.

H. MAXWELL-LEFROY, M.A.,
Imperial Entomologist.

V.—AGRICULTURAL BACTERIOLOGY.

As this officer will be on deputation during the coming year, no programme is submitted.

VI.—AGRICULTURE.

1. The initiation of a series of permanent field experiments in conjunction with the Imperial Agricultural Chemist, a note on which will be submitted separately.
2. *Sugarcane*.—The cultivation of the selected varieties will be continued.
3. *A systematic trial of the efficiency of field agricultural implements—native and foreign in use in India*.—An attempt will be made to estimate the co-efficient of friction in each case and to work out the draught in foot-pounds.
4. *Experiments with cotton, annual and perennial*.—These were initiated by the Inspector General of Agriculture in 1904. In the case of the annual cotton, the design was to discover or produce a superior cotton, indigenous or exotic, suitable for cultivation in Behar. Many tree cottons were collected and grown with the same end in view. The work has, up to the present, been largely a failure, but will be continued on the lines originally laid down.
5. *Training of probationers*.—Will be continued as at present.

E. SHEARER, M. A.,
Imperial Agriculturist.

APPENDIX D.

PROGRAMMES OF PROVINCIAL DEPARTMENTS OF AGRICULTURE FOR
1907-08.

BOMBAY.

I.—AGRICULTURAL STATIONS IN CHARGE OF THE DEPUTY DIRECTOR OF
AGRICULTURE.

Serial No.	Name of Station.	SITUATION.		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea level.	Average rain fall inches.	TEMPERATURE.	
		North Lat- tude.	East Long- tude.							Maxi- mum.	Mini- mum.
1	Surat	21°12'	72°52'	South Guja- rat.	172 (88 newly acquir- ed in 1906).	Black Cotton.	1896	about sea level.	39	103°	47°
2	Nadiád	22°44'	73°0'	North Guja- rat.	44	Sandy (Goradu).	1903	Do.	33	114°	60°
3	Dhãrwãr	15°27'	75°08'	Karnatak	74	(a) Black Clay (b) Red Sandy.	1904	2580 ft.	32	100°	61°
4	Dhulia	21°10'	75°20'	North Deccan.	28	Medium black.	1905	944 ft.	22	112°	37°
5	Mirpur- khas.	25°32'	69°2'	Sind	47	Sandy alluvial loam.	1904	about sea level.	6	120°	40°
6	Muvãlia	22°50'	70°18'	Panoh mahãls.	58	Part reds Part black.	1906	...	30	108°	44°

In addition land has been acquired (66 acres) for a farm to be irrigated from the Gokák Canal (Belgaum District).

2. *Continuous investigations* are being conducted on the manurial and cultural practices of the cultivators in the several districts of which the conditions on the above stations are typical. New methods and artificial manures are being tried in comparison.

3. *Selection* of following crops is a part of the work of all stations on which they are grown, *viz.*,—Cotton, Jowãr, Bãjri, Wheat, Tuer, Til, Groundnut, etc.

4. *Foreign varieties* of these crops are being tried.

5. *Cotton breeding* is being extended.

6. *Wheat breeding* is being initiated.

7. *The Cotton survey* of the Presidency is being continued and where mixtures are grown, these are analysed.

8. The survey of the *cottons of the world* is almost complete.

9. *A wheat survey* is similarly being initiated.

10. *Groundnut disease* (Tikka) is now being taken up.

11. *Disease proof potatoes* are being sought for (Dhãrwãr).

12. *Tobacco cultivation and curing* are being investigated (Nadiád.)

13. *The spice gardens* of Kanara are being experimented on with regard to the question of leaf mould.

14. *Land Reclamation* is being attempted under 3 sets of conditions.

15. *Irrigation* on several of the stations is a subject of experiment both as regards quantity of water to be applied and method of raising it.

16. *Insect Pests* are being investigated.

17. *European ploughs* are being indented for by cultivators and are supplied at cost price.

II.—AGRICULTURAL STATIONS IN CHARGE OF THE PROFESSOR OF AGRICULTURE.

Serial No.	Name of Station.	SITUATION.		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea level.	Average rain fall inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maximum.	Minimum.
1	Manjri. (near Poona.)	18°30'	73°59'	South Deccan.	63	Medium black.	1894	1850	27	108°	40°
2	Poona. (Kirkee)	18°30'	73°50'	Do.	66	Do	1879	1850	80	108°	40°
3	Lonavala	18°45'	73°27'	West Deccan.	25	Light.	1904	2039	186		
4	Poona Agricultural College.	18°30'	73°50'	South Deccan.	130	Light and medium black.	1905	1850	80	108°	40°
5	Poona Dairy and Farm.	18°30'	73°50'	Do.	+	Medium black.	1892	1850	80	108°	40°

+ Included under No. 2

MANJRI STATION.

Manjri station is a Sugarcane Farm. A comprehensive series of experiments has been drawn up by a Committee composed of the expert officers of the Department and the Director.

Rotations suitable for the block system of irrigation, manurial tests, including fallowing, green manuring, application of farmyard manure and castor cake, farmyard manure and fish manure, farmyard manure and safflower cake, in varying proportions; farmyard manure, farmyard manure and sulphate of potash, farmyard manure and ammonium sulphate, farmyard manure and crude nitre.

In all cases, the quantity of manure is to be measured by bulk as well as in terms of its chemical constituents instead of solely in such terms as in previous experiments.

Cotton and jute under irrigation are to be tried. Irrigation experiments will be continued.

POONA STATION.

Poona Station is small and irregular. Dr. Butler has a series of experiments with groundnut Tikka disease, and one with Tur wilt which will be continued.

Trial of new varieties and growing of fodder for the Dairy complete the work of the Station.

LONAVLA STATION.

Lonavla rice experiments are to be continued. The principal line of work is to investigate the principles upon which the efficiency of *rab* depends, and to find a suitable substitute.

Some work in making a survey of the rice varieties has been begun.

POONA AGRICULTURAL COLLEGE STATION.

College Farm is purely for demonstration.

POONA DAIRY STATION.

The Dairy is run on commercial lines.

III.—AGRICULTURAL STATIONS IN CHARGE OF THE ECONOMIC BOTANIST.

Serial No.	Name of Station.	STATION		Tract represented.	Area in acres	Types of soil	Date when established	Height over sea level.	Average rainfall inches.	TEMPERATURE	
		North Latitude.	East Longitude.							Maximum.	Minimum.
1	Ganeshkhind gardens.	16° 30'	73° 50'	South Deccan	80	Medium black and light murum.	1904	ft. 1800	30	106°	40°
2	Bassein gardens.	19° 20'	72° 51'	North Konkan	90	Sandy alluvial loam.	1906	About sea level	88	92°	56°

GANESH KHIND GARDENS.

1. A systematic collection of indigenous trees and shrubs to determine (among others) the following facts:—

- (I) The most satisfactory methods of reproduction, transplanting and treatment during growth.
- (II) The periodical increment of growth.
- (III) Periods of leafing, flowering, fruiting and ripening of seed.
- (IV) Age at maturity.
- (V) Special investigations regarding the quality of timber, yield of the other economic products, etc.

2. Experimental introduction of rubber, fibre, medicinal plants, etc.

3. Experimental tests on exotic plants on the same lines as (1) and (2).

4. Endeavours to increase and to improve the yield of fruit trees, indigenous and also exotic, if found suitable for the Deccan.

5. Botanical research, in special natural orders, the first three to be undertaken being Malvaceæ, Leguminosæ and Cucurbitaceæ.

6. To continue the cultivation of cottons for purposes of botanical classification, also of wheat and rice.

7. To attempt the improvement of a selected number of our finest wild flowering plants so that they can be used as garden plants.

BASSEIN GARDENS.

Programme of work as in the Ganesh Khind Botanical Gardens with special reference to conditions in the Konkan. While the Fort is being cleaned advantage is being taken to study the best local methods,

UNITED PROVINCES OF AGRA AND OUDH.

The following are the principal subjects of investigation at the different agricultural stations:—

1.—CAWNPORE.

A.—Manurial experiments.

1. The permanent series with wheat and maize.
2. Trial of artificial manures on cotton.
3. Comparison of neem-cake, cotton refuse, and poudrette on the yield and quality of potatoes.
4. Long-term experiment with green-manuring.

B.—Variety experiments.

5. Varieties of early ripening arhur (*Cajanus indicus*) as a protection against frost.
6. Trial of a variety of maize as a fodder crop.

C.—Study, improvement and selection of crops.

7. *Wheat*.—Completing the provincial collection and record of local information as to relations of varieties to soils, resistance to rust and drought, baking

qualities, comparative prices, export demand, and local estimation in which each variety is held. Hybridization.

8. *Cotton* :—

- (i) *Indigenous*.—Botanical study of the local varieties; examination of the relative proportions of different types as commonly sown together. Extent of variation in these types. Their selection and trial from an economic point of view.
- (ii) *American*.—Introduction of the longer-stapled American variety (*G. hirsutum*, Mill.) with arrangements for securing to the cultivator its full market value.
- (iii) *Indian*.—Study of the changes which take place in certain types of Indian cotton when brought to this Province and grown under conditions to prevent any possibility of cross-fertilization.
- (iv) Hybridization.

9. *Poppy*.—Selection.

10. *Rice*.—Cross fertilization of two varieties, to meet the ravages of the rice-sapper (*Leptocorisa acuta*) and obtain a rice of good quality with the protective qualities of a coarser variety, in which the head remains in the sheaf until maturity.

D.—*Other investigations.*

11. Nitrogen investigations, including examination of drainage-waters and a set of rotations designed to indicate the effect on the fertility of the soil of different forms of cropping customary to the province, and to ascertain how far the benefits following a gram crop are due to nitrogen collection and how far to crop variation.

12. *Rust*.—Joint work with the Imperial Mycologist in an enquiry as to the origin of rust, its earliest appearance, possibility of the disease being carried over by volunteer crops, and selection of rust-resisting varieties carried out under conditions conducive to rust.

13. *Seed inoculation*—Pot experiments carried out as a check on the field experiments at Orai Station.

14. *Irrigation*.—Arrangements for determining the seepage of water in field channels, and the average quality of water required at different seasons of the year for different crops in the *duab* soils.

15. Trial of fodder crops for growth in seasons of scarcity.

16. Entomological records.

17. Incidental investigations such as testing plots for experiment, determining residual capacity of old manurial plots, etc.

II—*ORAI*

1. *Cotton*.—Botanical examination of cotton collected from different parts of Bundelkhand, examination of the relative proportions of different types as commonly sown together: selection and trial from an economic point of view.

2. *Wheat*.—(i) Attempt to select a rust-resisting wheat conducted under special conditions conducive to rust, and with seed obtained from all parts of the Province.

(ii) Trial of wheats bred at Cawnpore as to suitability to the locality and resistance to rust.

3. *Linseed*.—Work as in connection with selection of wheat, Russian, Dutch, Australian and country varieties under trial.

4. *Juar*.—Classification of Bundelkhand juars and enquiry into the local varieties most suitable for distribution locally in times of need.

5. *Ground-nuts*.—Trial of Japanese, American, Spanish and Bombay varieties on light land under irrigation.

6. *Kans*.—Trials of methods of eradication.

7. *Fodder-supply*.—Propagation of spineless cactus and other plants on waste land.

8. *Seed inoculation*.—Inoculation of gram on poor soils.

9. *Tillage*.—Study of implements for Bundelkhand soils.

III.—ALIGARH.

This station lies in the centre of the cotton tract and is designed mainly for improvement of this crop. The station was only opened in June 1906 and this year's programme of cultivation is preliminary. The lines of work proposed are:—

- (1) Study and selection of the local cotton, and enquiry as to the local trade demand.
- (2) Methods of sowing and interculture.
- (3) Introduction of an improved cotton, if possible American Upland with arrangements to secure for cultivators the value of the quality.
- (4) Trials of implements and water-lifts.

IV.—PARTABGARH.

This station, too, was opened only in June 1906. Its specialities will be rice and sugarcane, but for the present the cultivation is designed only to get a knowledge of the soil and conditions.

The distribution of seed on credit and the demonstration of methods of sugar manufacture are conducted from this station.

Other lines of work which are being taken up are:—

- (1) Introduction of maize in the locality.
- (2) Improvement of the ravine-systems as grazing grounds.
- (3) Preliminary trials of ammonium sulphate on sugarcane.

V.—RECLAMATION STATIONS.

The arrival of the Agricultural Chemist is awaited before revising the present programme. The railways having quoted a low special rate for gypsum an experiment is being undertaken with an area which is at present just too alkaline for cultivation.

VI.—WELL INVESTIGATIONS.

The well survey continues. The facts of each village in the Province are now on record, except in a few districts, and the villages where irrigation is defective are being classified according to their needs.

Borers have been placed under Collectors in the majority of districts to assist in locating sites for wells. The investigations still in progress relate to:—

- (1) The best form of percolation well for fine sand in localities where springs do not exist.
- (2) The most practicable way of increasing the supply in the rock-wells in the south of the Provinces.
- (3) The safe employment of oil-engines or other power lifts in spring wells in the alluvium.

BENGAL.

1. The experiments on (a) paddy, (b) jute and (c) potatoes that are being carried on at the Burdwan Agricultural Station will be continued.
2. The experiments on (a) aman paddy, (b) aus paddy, (c) jute, (d) potatoes and (e) groundnuts that are being carried on at the Cuttack Agricultural Station will be continued.
3. The experiments on (a) sugarcane, (b) wheat, (c) mustard and (d) paddy will also be continued at the Dumraon Agricultural Station.
4. The two agricultural stations newly started at Bankipur and at Sabaur, near Bhagalpur, will be brought into working order.
5. Another new agricultural station will be started during the year.
6. The production of jute seed at Furnea, Chinsurah and perhaps Berhampur will be continued.
7. The work in connection with the cultivation of *Buri* cotton in the Chota Nagpur Division will be extended. A special farm will possibly be opened for this purpose, in addition to encouraging the cultivation of this variety among private cultivators.
8. The working of the Tasar Silk Farm which was started in April last at Chaibassa will be continued.

MADRAS.

The general programme sketched in Board's Proceedings No. 6857 *Miscellaneous of 20th November 1905, will be followed during the year 1907.

The following brief note is forwarded on the work proposed for 1907.

1. The attention of the Government Botanist was mainly engaged in the investigation of the haustoria of the sandal-wood tree, on which subject two papers have been issued.

The wild peppers of Southern India are still being studied, and a collection has been made of the flora of the Government pepper farm at Taliparamba (Malabar). A collection of lemon grass was made and some plants sent to the Director of Botanical Survey, Calcutta. An attempt was made to send some lemon grass plants in wardian cases to Barbados through Kew, but the plants died before reaching Gibraltar. Seeds are now being collected on the Taliparamba farm and will be sent by post direct to the West Indies.

2. The study of the root parasites of the sandal has been finished, and the haustoria of *Cansjera*, *Olaa*, *Ximenia* and *Opilia* are now being studied by the Government Botanist. A collection of other root parasites such as *Strigas*, *Eginetia peanunculata Nicotiana*, etc., is also being made. A special Agricultural Inspector is now engaged in collecting material for a report on the sugarcane cultivation of the Presidency. This will be completed during the current year.

3. The Mycological Assistant is on special duty in connection with the experiment which is now being made to arrest the spread of the palmyra disease in the Godavari District.

4. The Imperial Entomologist paid a short visit to Madras in December last, and has kindly undertaken to frame a definite programme of work for the Entomological Assistants during the coming year. It is also hoped that Mr. Lefroy may be able to spend a portion of the current year in the Madras Presidency in investigating the Entomology of Southern India.

5. The tillage and manurial experiments described in last year's note will be continued, and in the case of cotton an attempt will be made to extend the cultivation of the pure Karunganni cotton in Tinnevely by the selection of a quantity of pure seed, which will be distributed to the ryots under agreements. The addition of a black soil area to the Koilpatti farm will also permit an increased supply of pure seed to be raised for distribution to the ryots who showed much appreciation of the selected seed distributed to them last season. It is at present intended to concentrate the efforts of the Agricultural Department in Tinnevely on extending the growth of pure Karunganni.

6. Experiments in long-staple cottons will be continued at Attur and Taliparamba, and at the new farm at Nandyal in the Kurnool District the "northern" cottons will be investigated. Simultaneously, the sorghums usually grown in Kurnool in rotation with cotton will be specially studied and attempts made to improve them by seed selection and introducing a leguminous crop into the rotation. Indigo will be tried in the first instance, as this crop is still extensively grown near Nandyal.

7. *Sugarcane*.—The Mauritius canes found most satisfactory at Samalkota have been introduced into the Chingleput and South Arcot Districts at Melrosapuram and Palur, and a considerable number of canes will be distributed to the ryots of the neighbourhood for the approaching season. A nursery on dry land will be opened at Samalkota in the coming season for the supply of seed canes to the ryots of that district. Some additions have been made to the collection of canes at Samalkota which now comprises 38 varieties.

8. *Jute*.—Serajgunj and Howrah jute were introduced during the year at Samalkota and *sun* hemp and *gogu* are being tested along with them. The fibres have been sent to Calcutta for valuation. The same three fibre crops were also attempted on the Taliparamba farm in Malabar. The jute and *sun* hemp in Malabar is poor, but the *gogu* promises well. All these experiments will be continued during the current year.

9. *Ground nut*.—The Palur farm has been put on a permanent footing and a regular series of experiments has been laid down to test the different varieties against the local Mauritius which now holds the field. One plot of permanent ground nut will be laid down with a view to test the effect on the soil of continuous cropping with ground nut without manure.

10. The Hagari Experimental station is being laid out for the irrigation experiments on black cotton soil. Cotton and paddy are the two crops selected for experiment at first, and it is hoped that most of the area will be brought under irrigation in the course of the year.

11. *Tobacco*—The curing experiments undertaken by Messrs. Spencer and Company at Diadigul will be continued. In September last a small quantity of light wrapper Sumatra tobacco seed was obtained from Borneo and is being grown near Oocanada and some American varieties are being grown for seed on the Koilpatti farm.

12. *Paaspalum dilatatum*.—Is being tried at several stations, and is doing well at Hagari in black cotton soil on the outer slopes of irrigation channels. Experiments are being made by the Forest and Revenue Departments and it is hoped to summarize the results of these early next year.

PUNJAB.

1. The measures to be adopted for the prosecution of the campaign against cotton boll-worm in 1907, are under consideration at the time of writing. The operations for the improvement of indigenous cotton will be persevered with. They have not met with any particular success up to the present, but adverse seasons and paucity of staff may be partly accountable for this. A scheme has been submitted to the Local Government for a systematic survey of the Province with reference to the possibility of extending irrigation by means of embankments, water-channels and wells, and also for rendering scientific assistance to cultivators in carrying out minor works of irrigation. It is probable that a start will be made next winter. Entomological work will be continued, the chief subjects being locusts, and sugarcane, cotton and oilseed pests.

2. The equipment of the Lyallpur College and Research Institute, the framing of a curriculum and prospectus, and the recruitment and training of the members of the native staff, will claim the attention of the Principal and of the Agricultural Chemist. The Chemical Laboratories should be ready by the autumn, and by that time a considerable amount of work should be ready in connection with the "reh" investigation referred to in the next paragraph.

3. The Deputy Director of Agriculture will be occupied with the distribution and improvement of acclimatised American cotton in the Jhelum and Chenab Colonies; 1,500 acres were sown in 1906, and a substantial increase is expected in 1907. There will be further trials of Egyptian cottons in the South-West Punjab (the Dera Ghazi Khan and Muzaffargarh District). The results obtained in 1906 were inconclusive. An experimental farm will be established and organised at Jullundur. An enquiry into "reh" has been undertaken in the Chenab and Jhelum Colonies with a view to the reclamation of "usar" soils. Miscellaneous work includes the introduction and trials of new varieties of crops, e.g., Java indigo, small demonstrations of machines, and so forth.

4. The Lyallpur Agricultural Stations will be extended to 500 acres, the extension being for seed growing and demonstration. Owing to the inconclusive nature of many of the results hitherto obtained, special attention is being given to testing as large an area as can be spared by weighing the produce of the same crop and variety grown under uniform cultivation without manure on each plot. The comparative experiments will be slightly curtailed for the present, and the hydraulic experiments are temporarily unavoidably discontinued. Experiments will be made in growing cotton on ridges so as to facilitate interculture and prevent water-logging—a system which has been very successful on a small scale in the past year. The experiments and operations with wheat and cotton and other crops will be on the same lines as before. Selected varieties of wheat and cotton will be grown for seed distribution. A trial will be made with jute.

5. The Sargodha Seed Farm is now well stocked, and will have large quantities of good wheat and cotton seed for sale.

BURMA.

The Department in Burma has hardly as yet taken shape. I returned from leave and assumed charge as Director on the 15th of October 1906. Prior

to this Mr. K. D. Shroff, B.A., had been appointed Assistant to the Entomologist and had been devoting his time up till the date of my arrival to collection and classification of insects and to the study of Burmese. Without efficient equipment and supervision, but little progress has been made. The Agricultural Chemist—Mr F. J. Warth, B.Sc., arrived on the 29th October. None of our laboratories have as yet been begun and I had great difficulty in getting him accommodation. The Principal of the Rangoon College has kindly offered some help and Mr. Warth has had an opportunity of seeing how Chemistry is taught there. As he has already done some work on laterite, I put him on to an examination of the laterite belt of Lower Burma with special reference to the surface soil, and the question of its manurial treatment. At this stage (early in November), it is proposed that Mr. Warth should be sent to Pusa for a time. On his return I propose to put him on to an examination and analysis of the soils of the selected Farms. He will also draw up elementary textbooks on the lines of the syllabus suggested by last year's Conference.

Up to the time of writing an Agriculturist and Botanist have not arrived nor is it known when they may be expected.

It may be added that excepting for the acquisition of land for Experimental Farms at Mandalay and at Hmawbi (near Rangoon) nothing further has been done. No buildings have been erected and further work awaits the receipt of orders on the whole scheme.

In these circumstances nothing has been done up to date and it can hardly be expected that much in the way of definite work will be possible during the coming year. Assuming, however, that I shall shortly have a full staff, I shall employ them as follows:—

The Agriculturist will be as much out on tour as possible, studying local crops and local methods of cultivation. I shall endeavour to accompany him as often as possible. For this year the crops which he might especially take up would be rice, tobacco, cotton and wheat (with a view to the survey of existing varieties suggested by the last Board of Agriculture, both in the case of tobacco and wheat).

The Botanist would also be out as much as possible, making collections of the various plants of the country and would work with the Agriculturist on the survey of wheat and tobacco.

The Chemist will, as above indicated, complete his work on the laterite tract which forms a large and important one and would then take up an analysis of the soils of the two Experimental Farms: all with reference to manurial experiments.

The Assistant to the Entomologist.—I should be obliged if Mr. Maxwell Lefroy would kindly work out a scheme of research for this officer. I would suggest a study of the rice, tobacco and cotton pests.

The Director.—As far as I can see my work for the next year will principally be concerned with organization of establishment and plans and specifications of buildings. I propose, however, to look into one or two matters. The existing Experimental Gardens want attention. Some have served their purpose; some, I fear, have few results to show. I propose to go round as many of them as I can and advise on the desirability of their continuance or abandonment. The question of cattle-shows and the best methods of conducting them requires careful consideration. The Rice-crop of Akyab is causing a certain amount of alarm amongst merchants and I propose to discuss this matter along with the millers. Rangoon, Bassein and Moulmein will also be visited during the milling season and various questions in connection with the quality and milling properties of the paddy will be investigated.

Next monsoon, even if, as is likely, the buildings are not ready and we have not our complete staff, I propose to work the Farms with hired temporary labour simply on the indigenous methods of the country. This will be better than leasing the land for another year and will also give the staff an opportunity of carefully studying local methods and considering possible improvements.

CENTRAL PROVINCES AND BEHAR.

1. There are now four Experimental Farms in these Provinces—one at Nagpur, one at Labandih near Raipur, one at Powarkhera near Hoshangabad, and one

Farms.

near Akola in Berar. The total area of arable land on the four farms is about 1,100 acres. In addition to this there is a grazing area of about 900 acres in all. These farms serve a double purpose—(1) as Experimental stations at which the general agricultural problems of the Provinces are investigated, and (2) as Central depôts from which selected seed, good bulls and improved agricultural machinery are issued. The Raipur Station is situated in the rice tract, Akola in the cotton tract and Hoshangabad in the wheat tract. The experiments at these stations are devised to solve problems relating to the staple crop or crops grown in the tracts in which they are situated. The crops experimented with at the Nagpur Station are of a more varied type, as are also the crops of the surrounding country. This station, moreover, serves as a College Farm on which the students of the Agricultural College get a general knowledge of all the important crops grown in the Provinces. The experimental work on which the Department will be engaged during the year will fall under the following heads.

2. The chief experiments with cotton will be conducted at Akola. The most promising of the hybrids already bred will be grown on a larger scale and seed

Cotton.

selected from the best types of each hybrid. The four different varieties of cotton commonly grown under the name of *jari* or *varadi* will be grown separately and the values of the outturns compared *inter se*, and with the other local varieties. Experiments will also be undertaken to ascertain how far these can be improved in the quality and quantity of their lint by seed selection. Extended experiments will be undertaken to ascertain the yield of long staple and short staple cottons. In the last 30 years coarse cottons have been rapidly displacing long staple cottons, and it is open to question whether the cultivation of coarse cottons is not really the more profitable to the ryot. Other experiments will be devised to decide as to the best spacing distances for cotton plants, the most profitable rotations, the advantages or otherwise of topping the young plants to produce increased branching, and of deep *versus* shallow cultivation. Egyptian and Upland Georgian will be sown under irrigation about a month before the rains, as it is believed that, if thus given a longer period of growth, they will mature before the drought and cold nights of the winter, which seem to check their growth, set in. If the experiment proves successful in the experimental stage, it may be possible to grow these on a practical scale under tank irrigation in parts of the Central Provinces.

3. Some preliminary work will be done in classifying the wheats of the Central Provinces. Crossing will be

Wheat.

carried out on scientific lines with a view to produce a hybrid that will be immune to disease and possess at the same time good milling qualities. The pure varieties and crosses that have already been experimented with will be tested still further for rust resistance. Questions relating to depth of tillage and spacing will also be investigated. This experimental work will be mostly confined to the Powarkhera Station.

4. Experiments in rice cultivation are confined to the Labandih Station. The four different methods of cultivation are compared, *viz*, transplantation sowing by previous germination, sowing *in situ* and cross-ploughing (*biasi*), and simple sowing *in situ*. Experiments are also being conducted to ascertain what is the most economical quantity of water for rice on different classes of soil and whether light waterings at frequent intervals are not more economical for the less retentive soils than heavy waterings at longer intervals. The double-cropping tests will also be continued so as to find what are the most profitable crops grow after rice.

5. The rotation experiments with *juar*, linseed, tur, gram, sesamum and other minor crops will be continued.

Miscellaneous crops.

Some new sorghums will be tried and their outturns as fodder crops compared with those already grown. The cultivation of *jute*, *ambari* and *sunu* hemp will be continued at the Raipur Station and their fibre-yielding powers compared. At the Hoshangabad Station Russian linseed is being tried as a fibre crop. Experiments are being undertaken with sugarcane and sweet potatoes at Raipur. It is believed that in the black soil of this Division sugarcane especially can be grown at a very handsome profit wherever irrigation is possible. The best canes of the Central Provinces will be tried and others will be introduced from Bombay and Madras.

6. The various series of continuous experiments with locally obtainable manures and imported fertilizers will be continued. An experiment has also been devised to ascertain the best method of saving and conserving cattle-dung and urine. In the manurial experiments with cotton nitrate of soda has this year given splendid results; but it is believed that an application of cattle-dung before sowing followed by a small quantity of this fertilizer as a top dressing immediately after the plants are thinned out would prove to be even more profitable for the cotton crop on black cotton soil. This will be tested during the coming year.

Manurial experiments.

7. The advantages of deep *versus* shallow cultivation for wheat and cotton will be compared. The eradication of *kans* (*Saccharum spontaneum*) will be again experimented on. New implements will be purchased and tried from time to time.

Tillage experiments.

8. The study of wilt in *tur* and rust in wheat will be continued. Thirty-two samples of *tur*, received from the different districts of the Central Provinces and Berar, and 12 obtained from Bombay Presidency, are being tested for their wilt-resisting qualities. Seed will be selected from those varieties that prove the fittest to withstand the disease, and that seed again sown on a wilt-infested area.

Plant diseases and insect pests.

The two Entomological Assistants have their head-quarters at Nagpur. The senior Assistant spends most of his time on tour so as to investigate the important crop pests of the Provinces. Experiments are made at head-quarters with insecticides especially on pests infesting garden crops.

The demonstration work of the Department will fall under the following heads.

Small farms will be worked by the Department in the more backward agricultural districts with the object of demonstrating better methods of cultivating certain crops, or of introducing new ones.

Demonstration farms.

The three cotton-seed farms will be continued under the supervision and management of the Department as usual.

Cotton-seed farms.

In future these farms will be supplied each year with specially selected seed from the experimental stations, so that no selection on the farms themselves will be necessary, and all the seed grown thereon will be issued to cultivators.

The use of saltpetre as a manure for irrigated wheat is being demonstrated in connection with tank irrigation. At certain centres practical demonstrations will also be given of the working of the Meagher system of sewage disposal.

Manures.

The method of treating *juar* seed with sulphate of copper to prevent smut will be taught to all the Revenue Inspectors of *juar* tracts; they in turn will demonstrate the practice on a large scale to the actual cultivators.

Prevention of smut in juar.

There has been a very great demand for fodder-cutters, winnowers, corn-shellers and improved ploughs of late consequent on their advantages becoming more widely known. Agricultural Assistants will tour in as many different districts as possible with these machines and give practical demonstrations of their advantages.

Improved implements.

The varieties of cane grown, diseases prevalent and methods of cultivation in vogue are being studied with a view to try the best canes as an experimental crop at the Raipur Station. The Assistant Director will tour through some of the sugarcane tracts so as to demonstrate the improved Poona Mill and evaporating pan.

Sugarcane cultivation and preparation of gur.

The Agricultural Gazette published monthly gives the results of experimental works and such other information as is likely to be of some practical utility to its readers. In publishing these results a comparative statement is made of the profits to be gained from the particular practice of farming recommended.

Agricultural Gazette.

The meetings of the Agricultural Associations will be used as another means by which useful knowledge and advice can be disseminated among the cultivators of the Provinces. These meetings will be attended when possible by one of the officers of the Department.

EASTERN BENGAL AND ASSAM.

The programme of work for the ensuing year falls under the following heads:—

- I. Reorganisation of the Agricultural Department.
- II. Equipment of Agricultural stations.
- III. Experimental work at the Agricultural stations.
- IV. Experimental work outside the Agricultural stations.
- V. Special work of the Fibre Expert.
- VI. Organisation of the Provincial Veterinary Department.

The work to be done under each of these heads is briefly noted below.

I.—REORGANISATION OF THE AGRICULTURAL DEPARTMENT.

A separate Director of Agriculture will be appointed for this Province in time to attend the meeting of the Agricultural Board at Cawnpore in February 1907. The Department will now be organised on the lines laid down in Sir Bamfylde Fuller's minute dated the 16th February 1906, of which a copy* is attached for easy reference. The superior staff at present consists of an Assistant Director of Agriculture and a Fibre Expert. A Superintendent of the Civil Veterinary Department is in training at Belgachia and will join after a few months. An Agricultural Chemist and an Economic Botanist are expected from England next cold weather. Three students have recently been sent by this Government for special training at Poona and Pusa with a view to their ultimate appointment as Agricultural Supervisors. They will go through a five years' course of study. The arrangements for carrying on the work until these students are trained are now under consideration.

II.—EQUIPMENT OF AGRICULTURAL STATIONS.

The Department has in its direct charge the following Agricultural stations:—

- (i) The Central Station at Dacca.
- (ii) The Rajshahi station.
- (iii) The Rangpur station for tobacco.
- (iv) The Jorhat station for sugarcane.
- (v) The Upper Shillong Farm and the Shillong Fruit Garden, which are worked as a single concern.
- (vi) The Wahjain Tropical Plantation.

A few brief notes regarding the equipment of each of the above stations are given below:—

- (i) The Dacca Central Station came into being only a few months ago. The land has just been acquired. It has yet to be fenced in and provided with the necessary buildings. The work of construction has begun and is not expected to be completed before a year; it may take longer. Roads and paths will have to be made. A considerable portion of the land which will be devoted to experimental work will have to be reclaimed from jungle, levelled and plotted out. The work of reclamation has begun, but the land will not be in a suitable condition for experimental purposes before some two years. The Farm remains to be provided also with working cattle and implements. The Dacca Central Station will be the head-quarters for the Expert Staff of the Department. Buildings are in course of construction for the accommodation of these officers and their subordinate staff. Laboratories are also about to be constructed.

*Not printed in these Proceedings.

- (ii) The Rajshahi station which was established in the latter part of 1904 still remains to be provided with the necessary farm buildings. Although Government has been in possession of the land since 1904, the ownership of the land has been in an undetermined state, and it has been thought unwise to expend money upon permanent buildings. Steps will now be taken to acquire the land under the Land Acquisition Act and to erect the necessary farm buildings.
- (iii) The site of the existing Rangpur station having been pronounced unsuitable for tobacco research by Mr. Sly, it has been decided to open a new tobacco farm at Burirhat, a place five miles from the Rangpur civil stations. It is proposed to make over the existing farm to the Rangpur Agricultural Association which was instrumental in establishing the farm. The site of the new farm has been selected. If funds permit, the site will now be acquired and as much progress as possible will be made in 1907-08 towards erecting buildings and bringing the land under tobacco cultivation. The land is at present fallow.
- (iv) The Jorhat station which is a little over a year old remains to be provided with permanent buildings. These will be constructed in the ensuing year.
- (v) & (vi) The equipment of these stations is fairly complete. The Inspection Bungalow at Wahjain may need to be rebuilt.

III.—EXPERIMENTAL WORK AT THE AGRICULTURAL STATIONS.

No programme of work has yet been prepared for the Dacca Central Station or for the new Tobacco Station at Rangpur. The programmes of the other stations for the year 1907-08 will be practically the same as for the current year. They are reproduced below with a few modifications.

THE RAJSHAHI AGRICULTURAL STATION.

I.—NEW CROPS—

1. *Potato*.—Nainital and Patna (red skinned round, from Shillong). There is no means of irrigation, but a small area of light loamy soil will be planted to ascertain if potato can be grown without irrigation, as at Rangpur and in Assam Valley generally.

2. *Malancha*.—*Malachra capitata*—a new fibre.

II.—VARIETY EXPERIMENTS—

1. Coarse winter rice—
Hatisal of Assam.
Common local variety.
2. Fine winter rice—
Bansmati (Burdwan).
Dadkani (Dinajpur).
Kataribhog (Dinajpur).
Badsabhog (Burdwan).
Maniki Madhuri (Assam).
Black Joha (ditto).
3. Autumn rice (Aus)—
Local variety.
Central Provinces fine.
4. Sugarcane—
Local (Khagra or Khari).
Dacca Gandari (and one or two more kinds).
5. Wheat—
Local white.
Local red.
Mazaffarnagar white.

III.—MANURE EXPERIMENTS—

1. Winter rice (local variety)—
Try (1) Bonemeal, 6 maunds per acre *versus* no manure.

(2) Green manure with cowpea *versus* no manure.

2. Sugarcane (local variety)—

Try (1) Cowdung, 150 maunds per acre *versus* cowdung plus castor cake 24 maunds per acre.

(2) Similar experiments with super 6 maunds per acre and saltpetre 2 maunds per acre *versus* castor cake 24 maunds per acre.

IV.—SEED SELECTION—

Try (1) Common local coarse variety of winter rice.

(2) Ditto fine ditto.

V.—JUTE—

A programme for jute experiments is being drawn up by Mr. Finlow. He will work in co-operation with the officers of the Bengal Government who are experimenting at Burdwan.

VI.—MULBERRY—

This is a very important crop in the Rajshahi Division. Experiments will be made in manuring the crop as a substitute for the local custom of banking up with new earth.

THE EXISTING RANGPUR AGRICULTURAL STATION.

I.—Tobacco for wrappers—

(1) Sumatra under shade.

(2) Do. without shade.

(3) Between rose of tallgrowing annual plants, such as rahar or castor-oil.

II.—Cigar-leaf tobacco for fillers, with American and selected indigenous varieties.

III.—Cigarette tobacco—

Cavalla, Isabelli, Sari and Scented leaf.

IV.—Ginger—

Local,

Jamaica,

Cochin, and

Calicut.

V.—Potato—improved varieties grown without irrigation.

VI.—Varieties of fine rice.

THE JORRHAT AGRICULTURAL STATION.

This farm is to be devoted mainly to experiments in sugarcane. Under the advice of Mr. Sly, the greater part of the land is being cropped with cereals with a view to bring the soil, as far as possible, to a condition of uniform fertility in order to render it fit for comparative experiments. The sugarcane work in the farm will be restricted for a year or two longer to the propagation of indigenous and exotic varieties with a view to the supply of seed-cuttings for future experimental work.

Carayonica cotton and potato are being grown as minor experimental crops. It is proposed to continue their cultivation in the coming year.

THE UPPER SHILLONG FARM AND THE SHILLONG FRUIT GARDEN.

1. Potatoes—

(a) Trial of varieties.

(b) Trial of Bordeaux mixture as a fungicide.

(c) Trial of manures. It is proposed only to try green-manuring.

(d) Distribution of seed potatoes of the varieties that have been found successful.

2. *Introduction of European fruits and fruits of the semi-temperate climate.*—These include apple, pear, cherry, plum, apricot, peach, grape, gooseberry, raspberry, curraut, strawberry, fig, walnut, almond, loquat, treetometo cherimoyer and mountain pappaya.

3. *Distribution of trees and seeds* of such new fruits and vegetables as have proved successful. These include Australian pear, strawberry, fig, Spanish chestnut, rhubarb, asparagus and a large fruited variety of squash (*Sechium edule*).

4. *Trial of new crops.*—Three varieties of American sweet potatoes (New Jersey, Virginia, Nonsimmond) and Jerusalem artichoke.

5. *Preservation of fodder in silos.*—Efforts are being made to introduce silo-making among the Khasias.

6. *Silk.*—The cultivation of mulberry will be continued, as well as experiments in silk-worms.

7. *Cattle-breeding.*—The dairy farm will be continued, and efforts will be made to improve local breeds of cattle, by the distribution of stock from the farm.

THE WHAJAIN TROPICAL PLANTATION.

The plantation is used as the trial ground for various species of tropical spices, drugs and fruits. These are as follows:—

A. Spices.—Cinnamon.

Lesser Cardamom.

Greater "

Nutmeg.

Olove.

B. Drugs.—Cocoo.

Coffee.

Camphor.

C. Fruits.—Oranges and other citrus fruit.

Kew and Ceylon Pineapple.

Bangalore pappaya.

Grafted Mango.

" Litchi.

Sapota.

Banana.

Breadfruit.

Rambutan.

Soursop.

Oherimoyer.

D. Lemongrass for essential oil.

IV.—EXPERIMENTAL WORK OUTSIDE THE AGRICULTURAL STATIONS.

The programme of work outside the Agricultural Stations of the Department includes measures taken to encourage the spread of jute cultivation in Upper Assam, experiments in wheat cultivation in the Assam Valley, distribution of seeds and manures to private persons and Government officials, the maintenance of the Sericultural School at Rajahahi and the introduction of improved hand-looms for the benefit of the weaving community. Numerous experiments are also being made in Government and Wards' Estates throughout the Province. The "Model Farm" maintained by the Khas Mahal Department at Chittagong will not be altogether abandoned as was at one time feared. The local officers proposed to lease it to a gentleman who will continue to conduct agricultural experiments. There are several private experimental farms in the Province which are doing creditable work—particularly the farm of Babu Brojendra Kishore Acharjya at Gouripur in Mymensingh, the farm of Babu Baikuntha Kumar Nandi at Itakhola in Sylhet, and the farm of Babu Man Gobind De Chowdhury at Krishnapur in Cachar. The two last-named farms are making very hopeful experiments in tree cotton. The Department will help these private farms by inspection, advice and facilities for obtaining seed and manure.

V.—SPECIAL WORK OF THE FIBRE EXPERT.

Mr. Finlow's present head-quarters are at Pusa, but when his house has been constructed, he will come to Dacca. His laboratory will not be ready as soon as his house, but a temporary arrangement will be made until the regular laboratory is complete. Mr. Finlow has been making elaborate experiments on the absorption of moisture by jute. As the Government of this Province has recently decided not to embark on legislation regarding wet jute, it is probable that Mr. Finlow's experiments on this subject may now be abandoned. This will set Mr. Finlow's laboratory free for experiments which he desires to conduct regarding the chemical composition of jute fibre under various conditions. In out-door work Mr. Finlow will continue "selective" experiments in jute and will also make experiments regarding the best conditions under which retting can be conducted. He will also investigate fibre plants other than jute. At Rajshahi Farm he will make manure and other experiments in the cultivation of jute. In this work he will, as already pointed out, co-operate with the Bengal officers who are making similar experiments at Burdwan. Mr. Finlow will give help and advice to those who are extending jute cultivation in new tracts, particularly in the Assam portion of the Province. I may mention here that the authorities of the Assam-Bengal Railway desire to conduct jute experiments through their station masters all along the line. The Department will give them help in the matter of seed and instructions, and Mr. Finlow will tour along the line to give professional advice. This is a hopeful departure and the process may be extended to crops other than jute. Passengers waiting at railway stations have plenty of time to study experimental cultivation in plots of railway land adjoining the station.

VI.—ORGANISATION OF THE PROVINCIAL VETERINARY DEPARTMENT.

A scheme for the organisation of the Department has been submitted to the Government of India by this Government. Under this scheme the ultimate strength of the Veterinary Establishment is to consist of a Superintendent, who would be a member of the Imperial Veterinary Service, two Deputy Superintendents, eight Inspectors, and 120 Assistants. Each of the 57 sub-divisions in the plains districts is to be provided with one Stationary and one Itinerating Veterinary Assistant. There will be besides six Veterinary Assistants for employment in Hill districts and on special work. It is thought that the immediate needs of the province can be met by appointing three Inspectors and 46 Assistants in addition to one Inspector and 14 Assistants now employed. The Province will continue to depend on the Belgachia College in Bengal for the training of its subordinate Veterinary staff, and the Local Government will contribute a certain sum annually towards the up-keep of the College.

Mr. Harris, the newly appointed Superintendent of the Department, will join in April and the Department will be gradually organised as qualified Veterinary Assistants are forthcoming.

There has been a virulent epidemic of cattle disease in the Surma Valley, and it is proposed to take special steps to deal with it through non-official agency pending the organisation of the Department.

MYSORE.

The work proposed to be done by the Mysore Department of Agriculture is:—

- (a) To continue the study of soil moisture, especially with a view of determining in how far the capillary action of the Mysore soil is able to lift water to the surface and what effect cultivation and growing crops have on soil moisture.
- (b) To make preliminary pot-culture experiments with potash fertilizers, especially noting their effect on the mechanical condition of Mysore soils.
- (c) To continue pot-culture experiments with bone-meal with a view of getting some information regarding the factors which affect its availability.

- (d) To continue the standardization of the plots on the Experimental Farm at Hebbal and try to reduce the experimental error due to accidental differences other than soil. This error amounted in one case to 27½ per cent. and on the average to about 8 per cent. of the total yield of the crop. The differences in crop due to differences in the soil of adjoining plots has amounted to 100 per cent. in one instance.
- (e) The establishment of a Mycological and Entomological Laboratory and, as far as circumstances will permit, a preliminary study of one or more of the plant diseases or insect pests of Mysore.
- (f) Continuation of the routine work of the Department, such as the analyses of fertilizers, soils, a series of coffee samples, "famine foods," etc. Also, if the time permits, a series of tests to study the absorption of plant food by Mysore soils out of solutions percolating through them, especially phosphates.

BARODA.

I.—Experimental work at the Baroda Model Farm to be continued on the following points :—

- (1) Sowing Egyptian cotton in March and April.
- (2) Manuring of cotton.
- (3) Artificial manures in sugarcane and tobacco.
- (4) Preservation of sugarcane seed and planting of stool.
- (5) Groundnut in dry rotation.
- (6) Cheese-making and utilization of skim milk.

II.—Seed selection and distribution of ordinary crops.

III.—Introduction of groundnut.

Entomology :—

- Study and combating of cotton pests.
- Investigation of wheat and rape-seed pest.

Education :—

Introduction of revised course in the school of Agriculture.

Travelling Instructors :—Increasing the number of instructors as men become available.

Demonstration Farms.—Developing the demonstration farms in Kadi and Amreli.

APPENDIX E.

PAPERS ON COMMERCIAL FERTILIZERS IN INDIA.

MEMORANDUM ON THE USE OF, AND TRADE IN, ARTIFICIAL MANURES IN BENGAL, EASTERN BENGAL AND ASSAM, BY HAROLD H. MANN, D.Sc., SCIENTIFIC OFFICER TO THE INDIAN TEA ASSOCIATION.

In the inquiry which was discussed and proposed at the last meeting of the Board of Agriculture relative to the question of the advisability of introducing a system of control over the sale of commercial fertilizers in India, I was asked to undertake to find out the present conditions of the manufacture and trade in Bengal and Eastern Bengal and Assam. At an early stage of the investigation Mr. Coventry was kind enough to tell me that he would collect such data as related to Behar and the indigo districts and this limited the field which my inquiries have to cover.

It was suggested that the class of substances which should be included in the scope of the inquiry should be limited to the following:—

1. Imported fertilizers, such as superphosphates, Chili saltpetre, sulphate of ammonia and the like.
2. All mixed fertilizers.
3. Ground phosphates of every kind.
4. Ground bone and bone char.
5. Guano.
6. Milled or ground oilcake.
7. Blood manure.
8. Milled fish.
9. Refined Indian saltpetre.

To these I have ventured to add 10, sulphur, as although this is not properly a fertilizer, yet its use for agricultural purposes has enormously increased in recent years, and it stands on much the same basis as to possible adulteration as the others.

Before proceeding to consider such of the above manures as have, or are likely to have, any importance, it may be well to eliminate the remainder. I can find no trace of any import of, or commerce in, two of the above substances, namely, guano and blood manure. It is extremely unlikely that either of these will be imported or used in the future, and in view of this fact nothing more need be said about them.

Of the remainder, some seem to be entirely imported as such, and some to be partly imported and partly manufactured from the raw material here, and some to be entirely country products. To the first of these classes belong Chili saltpetre, ground phosphates, dissolved bones and sulphur, to the second belong superphosphates, sulphate of ammonia and the various mixed fertilizers, while the remainder are entirely made in India itself so far as I can make out. It may be well to consider these various classes of material in this order.

Chili saltpetre or nitrate of soda is imported into Bengal for agricultural purposes in exceedingly small quantities. In the year 1905-06, I can only trace the import of 20 cwts. of this material valued at the port at Rs226. I can find no trace of any having been sold, except by one firm, who in the last three years inform me that they have disposed of only 5 cwts., 5 cwts. and 34 cwts., respectively, practically the whole of which has been used for experimental purposes on Government or other experimental stations. Though there is evidence to show that the action of nitrate of soda is not precisely the same as that of saltpetre, yet, in view of the large amount of the latter available here, it is not likely that a large market for nitrate of soda is likely to arise.

Ground phosphates are in a similar position, except for the fact that they furnish the raw material for the manufacture of superphosphate. Considered as manures in themselves, their present use is purely an experimental one, and so far as I can make out only about ten tons were sold for this purpose during

last year. I am informed that the whole of this is of Indian origin, presumably from Trichinopoly, but my informants give no details.

Dissolved bones also prove, rather to my surprise, to be entirely imported as such. The total demand seems to be for 'Indigo factories and Government experimental farms' and, including a small quantity for tea estates, only amounts to a very few tons, the largest dealers only stating a sale of 3 tons during the last year.

Of these three materials, as a result of all the information I have collected, there seems a general impression that there is no room for nitrate of soda, that ground phosphates are only to be considered as a raw material for superphosphate manufacture, and that no extended use of dissolved bones is likely to take place until they can be manufactured locally, which involves cheap sulphuric acid. Only, therefore, the third of these is really within the scope of our investigation, and its extended use is so distant and so problematical that it can hardly be considered a question of practical politics.

Included in this class, however, is the very important material sulphur, whose import has been increasing by enormous strides in the last five years, chiefly for blight destruction (red spider, pink mite, thread blight, etc.) on tea estates. During the last few years the amount imported into Bengal has been as follows:—

	Amount Cwts.	Value ₹
1901-02	22,814	1,85,351
1902-03	28,318	1,49,228
1903-04	34,309	1,78,441
1904-05	40,974	1,90,977
1905-06	48,536	2,39,624

Most of this comes from Sicily, but I had a sample sent to me some time ago as from Japan which was available in Calcutta at ₹83 per ton, whereas the price of the Sicilian sulphur is nearer ₹100 per ton. I have had a very large number of samples of sulphur through my hands, and they have been, every one, exceedingly pure, and preference between several samples has practically always to be made as a result of determination of *fineness*, the finest being naturally the best for blight destruction. Most of that used is finely ground sulphur, and not in the form of 'flowers,' but the grinding is usually done before importation. This material is rarely purchased through local dealers, usually it is obtained either from the importers or a large Calcutta firm.

Turning to the second class of fertilizers, namely, those partly imported as such and partly manufactured from the raw material in India, I have found very great difficulty in ascertaining the relative amounts imported and manufactured. If we take the whole of the material classified as 'Manure' by the Customs at Calcutta as belonging to this class, the total amount received in 1905-06 amounted to a value of ₹4,146 only, of which ₹1,718 belong to one single consignment of 'manure for sugar.' This shows the very small extent of the trade. I know three importing houses in Calcutta who have taken up agencies for European manure firms in the last five or six years; of these, one has abandoned the trade altogether, another supplies its few orders locally from another firm, and a third has barely commenced. It may practically be said that Messrs. D. Waldie & Co., of Konnagar, are the only firm in Bengal proper (excluding Behar) who do a serious business in directly imported artificial manures.

The business done in commercial manures of the kinds specified (superphosphates, sulphate of ammonia, mixed fertilizers) which are manufactured or made up from raw materials in India is somewhat greater. Once again with regard to the first and third of these, Messrs. D. Waldie & Co. are, so far as I can tell, the only manufacturers in the districts now under discussion.

As regards superphosphate, the whole amount locally made is only about 40 tons per annum, and shows no tendency to increase at present. The likelihood of future increase under present conditions is not great at least in the tea areas. Much would, probably, be used if the price were reasonable, but it costs in Calcutta ₹60 to ₹65 per ton, or, say, ₹80 per ton or thereabouts on a tea estate. This is at least two-and-a-half times as much as in England, and though the benefit derived, even in tea culture, is quite considerable, yet it will certainly (judged by my results at Heeleaka) barely pay the cost of

application. The use of larger quantities of superphosphates is therefore intimately connected with a reduction in the price of sulphuric acid. Till this takes place, it will only in rare cases pay for application; if it is once effected, it is quite likely that a slow increase in the demand would arise, but it would be very slow.

The distribution, such as it is, is entirely in the hands of large firms in Calcutta. No local dealer in my districts deals in it. The superphosphate is made and ground by machinery entirely. I have not succeeded in getting to know whether it is prepared chiefly from ground mineral phosphates or from bone ash. Judging by samples which have come into my hands, I should judge it is principally the former. In any case I am informed that such ground phosphates as are used for preparing it are indigenous.

Mixed manures are used in exceedingly small quantities and are of the usual character. "Special tea manure," "special potato manure," and so on are on the market, but the demand is practically nil. I am informed that tea-gardens are the principal customers for these, and the demand from them is certainly not more than, say, ten tons per annum and the trade shows no tendency to increase. They are principally composed of fine ground bones, with superphosphate, and sulphate of ammonia so far as I can tell.

Sulphate of ammonia shows signs of increasing demand in a greater measure than these other materials. It is not, however, for tea, for jute, or for country crops, but almost entirely for sugar and indigo. I may say that *none* is used in the tea industry. Up to quite recently this has also been a monopoly in Bengal of one firm, and they inform me that their sales have hitherto amounted to under 100 tons per annum.

Now it seems that the manufacture is to be taken up on an extended scale in the coal districts, and no doubt if it can be produced at a reasonable rate, it will be quickly in demand for the abovementioned purposes. Among the purely artificial manures, there is more immediate prospect of the extended use of this material than of any other. It is not likely, however, to extend into native agriculture for a long time, and meanwhile it will be bought in large quantities from the makers.

We have now dealt with all those of the manures about which inquiry was made which are imported either in the form of raw material, or as ready-made fertilizers. There remain those produced in the country, which are really the only ones extensively used. These are—

- (1) Oilcake.
- (2) Refined Indian saltpetre.
- (3) Bones, bone char, and bone ash.
- (5) Fish.

Of these, the use* of the last-named is exceedingly small. One of my informants states that "Fish manure has come to be used in recent years in small quantities by tobacco growers in parts of the Rungpur District. This manure is not imported as such, but is simply the dry dusty refuse that has been left over from dried fish, which is extensively consumed in Eastern Bengal." I was approached myself some time ago by a Chittagong firm as to what demand there would be from the tea industry if they set up a mill at that part to prepare fish manure, but nothing came of it. Fish may be at present used near the coast or near the rivers, but there is no prospect of any production of fish manure on a large scale.*

There are quite a number of bone-crushing mills in Bengal, but nearly all their production is exported. The following are, I believe, all the bone-crushing firms in the Provinces :—

- (a) *Agricultural Phosphate Company, Limited.*—Agents, Messrs. Macmillan & Co., Calcutta, Works at Ultadanga. These mills crush bones only and *steam* so far as is necessary for export purposes to New Zealand and elsewhere.
- (b) *Bally Khal Bone Mills.*
- (c) *Bengal Bone Mills.*—Works at Ballighata.
- (d) *Chingrihatta Bone Mill.*—Works at Chingrihatta, Calcutta.

* Since writing the above, I have been approached by a Calcutta firm, who offer me five hundred ton per annum of 'animal meal' (chiefly fish, I think) containing 7 to 8 per cent. nitrogen and 12 per cent. phosphoric acid at Rs105 per ton.

- (e) *Ganges Valley Bone Mill Company*.—A Glasgow firm. Agents, Messrs. Graham & Co. Mills at Uttarpara, Hooghly.
- (f) *Standard Bone Mills*.—Chingrihatta, Calcutta.

In addition to these, there has been a gradually increasing number of tea-gardens who put up their own bone disintegrator, collect bones from the district, crush them, and apply to their own land. The machine used for this purpose is the so-called 'Devil Disintegrator.' One of the planters in Assam, who has the installation longest, writes me relative to his bone supply as follows: 'I pay ₹1-4-0 per maund (80 lb.) delivered at the factory, and it costs me, including labour, ₹1-12-9 ready to put on the land. I could now, I think, get the bones for ₹1 or ₹1-2-0. I did not care to reduce the price as I was afraid of frightening the collectors away, as I had a good deal of difficulty in getting them to bring any at first.' Another local planter quite close to the above only pays ₹1 per maund. The manager of a large tea estate in the Duars, where bones have been crushed for a long time, writes me that the local price of bones is ₹1 per maund, but most are collected on their own property and in their own bazaars. One planter takes, or did take, all the bones, I believe, from the Darjeeling bazaar.

This is not, however, commercial production. And in considering the possibility of an extended trade in bone meal to the tea districts, it must not be forgotten that these very districts are the sources from which the bone mills themselves draw a large amount of their supply of raw material. Considering that every tea estate has steam or equivalent power on the spot, and bones are to be had locally, it is not at all likely that there will be a large trade in ground bones or bone meal from Calcutta. In fact, the actual use of bought bone meal is getting less rather than increasing.

Apart from the tea industry, bones are not used at all in the area I am considering. Mr. Basu (Assistant Director of Agriculture for the new Province) writes me—"The use of bones is absolutely unknown to the native agriculturist in this Province." This appears also true for Bengal proper. The results of the experiments with bone meal and saltpetre for paddy have, however, been so striking that it is just possible that their use may take a very gradual extension for this crop. It would be absurd, however, to suppose that this can take place with anything but the greatest slowness. For sugar and indigo, bone meal will not take great extension, and, as before stated, the conversion into dissolved bones, or bone ash superphosphate, depends on the presence of cheap sulphuric acid. Bone char is produced in some quantity, but I have only once heard of its proposed use in these districts for manure, and this was for tea.

Summing up all the information available with regard to bones, it may be said that bones are not likely to become a favourite manure for tea, and if they do, it is most probable they will be ground locally on the gardens which use them. For sugar and indigo little is used, and little is likely to be used. For country crops, no bones are used at present, though there is a possibility that, following the experiments at Burdwan, etc., they may take a very gradual extension for paddy. The use of dissolved bones and bone ash superphosphate must await, at least, cheap sulphuric acid.

It may be interesting to give the actual export of bones from Bengal (including Assam) for the last five years, which will indicate the amount available. The largest purchaser is New Zealand, then the United Kingdom, and then Japan.

Year.	Quantity.	Value.
	Tons.	₹
1900-01	19,645	7,89,487
1901-02	18,212	9,74,985
1902-03	23,684	12,74,712
1903-04	29,229	15,51,940
1904-05	24,141	13,21,990
1905-06	27,056	15,84,037

During the past year the value of bone meal in Calcutta has been remarkably constant, and it has been quoted with a guarantee of $4\frac{1}{2}$ per cent. ammonia and 52 per cent. tribasic phosphate of lime at R59-8-0 per ton in the last three months of 1905 to R61-0-0 per ton from July to September 1906. It has, however, risen to R65 per ton at the end of the year.

I may say that in the bones and bone meal which have come before me I have found no trace of adulteration or of selling boiled bones as genuine bone meal.

It remains now to discuss the production and use of refined saltpetre and oilcakes, probably the only two artificial manures of present importance and of probable importance in the near future. First, as to refined saltpetre. An enormous number of data on the manufacture and composition of Indian saltpetre have been recently brought together by Mr. D. Hooper (Agricultural Ledger, 1905, No. 3). According to him the principal centres of saltpetre refining are Farukhabad, Cawnpore, Sitapur and Shahjahanpur in the United Provinces, Hissar, Ferozapore and Montgomery in the Punjab and Saran, Muzaffarpur and Darbhanga in Behar. In Calcutta I may say that in the trade the best class of "refined" saltpetre is almost invariably spoken of as "Farukhabad refined." There are, however, quite a number of small refineries at Narcaidanga near Calcutta, but the price they obtain is never equal to that for the so-called Farukhabad refined saltpetre.

In Calcutta saltpetre is usually sold on a basis of 5 per cent., 10 per cent., or 15 per cent "refraction," that is to say, the impurities are guaranteed to amount to not more than 5, 10 or 15 per cent., as the case may be. In my experience the samples so sold rarely reach the guarantee if moisture be included as an impurity, as it always is by the trade. But in our climate this item is very uncertain and I have found the amount vary from .47 to 2.85 per cent. The following are ordinary commercial analyses done by me during the past year of samples bought in the Calcutta bazaar:—

	* Farukhabad refined saltpetre,*					Calcutta refined.
	1	2	3	4	5	
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Moisture . . . . .	.98	2.43	2.40	2.80	2.85	.47
Common salt	1.11	2.42	2.47	3.18	1.63	7.82
Sulphate of potash . . . . .	.19	.88	.95	1.42	.17	.84
Insoluble matter . . . . .	...	...	...	.07	...	.12
Nitrate of potash	97.77	94.27	94.18	92.53	95.95	90.75
Total	100.00	100.00	100.00	100.00	100.00	100.00
Refraction	2.23	5.73	5.82	7.47	4.65	9.25

These were actual representative samples drawn from lots under sale to tea-gardens, all sold on a '5 per cent. refraction' guarantee, but it is fair to say that in every case the contract for sale provided for an allowance being made if the refraction was in excess of the guarantee. For instance, the allowance on the Calcutta sample above would be 11 annas per maund, reducing the price in December 1905 from R8-10-0 to R7-15-0 per maund.

Dr. Leather was good enough to make for me two more complete analyses of samples bought equally in the course of trade and under the same guarantee. The results were as follows:—

	A.	B.
Potassium nitrate	98.12	92.97
Potassium chloride	1.81	2.15
Sodium chloride	1.25	.59
Sodium sulphate . . . . .	.89	.70
Moisture	2.08	2.89
Insoluble matter, etc. . . . .	.85	.70
	100.00	100.00
Nitrogen	12.92	12.90
Potash	44.52	44.54
Refraction	6.88	7.03

There does not seem to have been much difficulty in regard to adulteration hitherto, and a buyer of any considerable quantity has never had any trouble in getting a guarantee from the traders in the bazaar. And any large adulteration is hardly likely in the future. The only probable addition would be common salt, and this would make the saltpetre quickly so wet, owing to the hygroscopic character of the salt, that it would very quickly be detected in the Indian climate.

By far the largest amount of saltpetre is exported. Mr. Hooper gives the average actual export from India in the ten years from 1893—1903 as follows:—

	R	a.	p.
1893-94—1897-98—408,585 cwts.	At a price of	11	0 8 per cwt.
1888-99—1902-03—374,810 cwts.	At a price of	9	15 0 per cwt.

Since 1903 the amount exported from Calcutta to foreign countries has been as follows:—

	R	a.	p.
1903-04—386,412 cwts.	At a price of	10	6 0
1904-05—343,812 cwts.	At a price of	10	6 0
1905-06—332,356 cwts.	At a price of	11	7 0

Hardly any saltpetre is expected from other Indian parts. Of the total quantity shipped in Calcutta in 1905-06, 3,476 cwts. went to Indian ports, the remainder going abroad. The relative quantity from the different sources of supply sent to Calcutta was as follows in the last three years:—

	1903-04. cwts.	1904-05. cwts.
Behar and other Bengal sources	324,271	259,262
United Provinces	131,011	114,552
Punjab	102,711	81,017
Other parts of India	2,425	1,888

The small use made of material in the area with which we are dealing is shown by the minute amount sent into other parts of Bengal than Calcutta, which was as follows:—

1903-04	11,828 cwts.
1904-05	16,592 cwts.

The amount utilised in Assam (where none is made) is exceedingly small also as follows:—

	Mds.	Worth. R
1900-01	407	3,068
1901-02	203	1,461
1902-03	378	2,808
1903-04	367	2,580
1904-05	443	2,954

Of course it is by no means certain that these amounts even are entirely used for manurial purposes, but this represents the maximum quantity.

It has been employed more or less experimentally for tea for some years, but never extensively. One large Calcutta firm sent to Assam during the past season no less than 960 cwts. to their estates, but this is quite exceptional, and so far tea-planters have fought very shy of these highly soluble manures for their crop. I am not aware of its being extensively used for indigo, but am informed that considerable quantities have been supplied and used on estates under the Court of Wards. In ordinary agriculture, crude saltpetre is occasionally used, but refined hardly ever in the area I am dealing with.

The prospects of its being used on a larger scale in the future depend very largely on the success of the experiments and demonstrations of the agricultural departments concerned. It is certain that it will not push *itself* as a manure, for the high cost and the temporary character of the effect would prevent in any case the rapid extension of its use. The agricultural department of Bengal seems, however, to have shown that combined with bones it forms the most profitable manure known for paddy, and some of the demonstrations of last year were markedly successful. But the adoption of such a method of manuring will be very slow.

The price of saltpetre in the Calcutta market on a 5 per cent. refraction basis varies, as has already been said, with the source of the material. During

the year from October 1905 to October 1906 Calcutta refined (5 per cent. refraction) has varied from a weekly average of ₹7-9-6 per factory maund in January 1906 to a weekly average of ₹8-11-0 in November 1905. These amounts are equivalent, respectively (the factory maund being 74½ lb), to ₹227-8-0 and ₹260-10-0 per ton. At the same time Farukhabad refined saltpetre (5 per cent. refraction) was selling (weekly average) from ₹8-2-0 per factory maund in March to ₹10-0-0 per factory maund in July. These prices correspond to ₹243-0-0 per ton in March and ₹300-0-0 per ton in July. To give an idea of the value of the lower qualities, I may say that in August 1906, when 5 per cent. refraction (Calcutta refined) was selling at ₹8-6-0 per factory maund, 10 per cent. refraction obtained ₹7-10-0 and 15 per cent. refraction ₹7-2-0 for the same quantity.

As regards tea, it may be said that, while there is abundance of oilcake to be had at anything like the present price, the use of saltpetre is quite unlikely to take any very great extension. The cost is approximately, for 5 per cent. refraction, say, ₹270-0-0 per ton in Assam. Taking the potash as being $\frac{1}{2}$ the value per unit of the nitrogen, this would give a value of nitrogen per ton unit of ₹10-0-0.

Now oilcake (rape cake) containing $4\frac{1}{2}$ per cent. of nitrogen, 3 per cent. of phosphoric acid and 83 per cent. of organic matter has been lately costing ₹1-6-0 to ₹1-8-0 per maund of 80 lb in Assam, or ₹37 to ₹40 per ton approximately. Reckoning phosphoric acid as $\frac{1}{2}$ and organic matter as $\frac{1}{200}$ the value of nitrogen, the value of the last named per ton unit is ₹6-12-0, or, in other words, the oilcake is very much cheaper. If bazaar castor cake has to be bought from Calcutta, costing, say, ₹3-8-0 per maund, or ₹94 per ton, the value per ton unit of nitrogen is ₹11-8-0, or higher than that in saltpetre. This is dearer than saltpetre, but the price is an unheard of one until the present season. Inasmuch as we want a fairly permanent manure in tea culture, as the potash is of only doubtful value, and as our soils are usually deficient in organic matter, it will be seen that one cannot recommend saltpetre as against oilcake at present, unless in some special case, and it will probably be some time before the price will justify its extended use.

Oilcake is the best and by far the most important of the materials in North-East India with which I have to deal. At present it is the *only* one of any real importance, and its use is no new thing.

The seeds chiefly used for making it are castor, mustard and rape, in their various varieties, til and linseed, chiefly the two first mentioned. Groundnut cake hardly occurs in Bengal and Eastern Bengal.

By far the largest amount is still made in local village mills, and with their produce the present inquiry has nothing to do. I may say, however, that the only case of serious adulteration which has come before me was in such cake, bought locally near Jorhat (Assam), which contained 26 per cent. of sand. This case came before the District Court as an ordinary civil suit, and adequate damages were given.

But there are a certain and increasing number of larger mills, chiefly in Calcutta and neighbourhood. Some of these are large establishments like the British Indian Oil Mills, of Garden Reach, Calcutta, which only work castor seed, or the Gourpore Oil Mills, which only work linseed, I believe. Most of the Calcutta oil mills are of a very different type. I quote notes made of visits to two of them.

1. Mill at Halsibagan Road, Shambazar, Calcutta, belonging to Babu Duanath Mookerjee. This concern is a good one, and the machinery and plant when imported cost nearly half a lakh of rupees. But the oil is not the main business of the mill. It produces a large quantity of flour, which is sold and delivered to large firms. The oil portion of the mill is in a separate building, and six crushers were at work. Only mustard seed is used. Some *Carthamus tinctorius* seeds were noticed about, but they were said to have come mixed with the mustard seed. The amount turned out was said to vary, but they sometimes produce 5,000 to 6,000 maunds per annum, and could make as much as 10,000 maunds. The cake is chiefly sold to cattle-keepers in small quantities of a few maunds, and also to merchants, who resell for cattle-feeding. At least half the produce of the mill is sold for cattle food

2. The second mill visited was in Goabagan, Calcutta, and is a much smaller one than the last, and is a very primitive with old fashioned machinery. Castor seed is crushed here, both the large and small-seeded variety being used. The mill probably turns out 1,000 maunds per annum. The oilcake is disposed of through the agency of brokers, said to be principally for export, but the manager has no direct dealings with buyers of oilcake.

These are, probably, two fairly typical Calcutta native mills.

In the districts mills are increasing fast in number. Three years ago one was started in Gauhati for mustard and has been very successful, and now quite large places are being founded at Chandpur, at Parbatipur and at Chaparmukh (Nowgong, Assam). There is also a fair sized mill at Phulchari in Rungpur. In addition quite a number of tea estates are putting up installations for their own use, e.g., the Jorehaut Tea Company, the Scottish Assam Tea Company, the Loongsong Tea Estate, etc., etc. The Gauhati mill is the largest of these and can turn out 200 maunds of oilcake daily, or, say, 60,000 maunds (between 2,000 and 3,000 tons) per annum. The Chaparmukh mill will make 100 maunds daily. The Assam and Bengal mills produce a certain small quantity.

Any attempt to judge the proportion of the total oilcake supply supplied by mills worked by machinery must be little more than a guess; the amount is constantly increasing, but there is no likelihood of machinery replacing bullock power in the near future. On the whole the cake made by bullock power is remarkably well pressed. Certainly as yet the quantity of oilcake made by machinery is not more than one-fourth of the total, probably much less.

Hitherto there has been an enormous foreign trade in oilcakes. Linseed cake stands apart, being exported chiefly in milled form for feeding. During 1905-06 (as extracted from the daily Customs entries) there were exported from Calcutta to foreign countries 22,549 cwts. of a nominal value of ₹23,595, though the real value was undoubtedly much higher than this. To Indian ports 524 cwts. were sent of a value of ₹3,348. This hardly interests the present question however, for linseed cake, milled or otherwise, is not used for manuring as such at all.

Of other oilcakes, the total export was 358,538 cwts., of which 21,442 cwts. only were re-imported at other Indian ports. Of the total quantity for foreign ports, 18,820 cwts. were declared as for manure.

I have not been able to obtain statistics of the production or places to which the cakes are sent from most of the mills, but can give it for some of them. The British Indian Oil Mills have been kind enough to supply figures for 1904 and 1905 of their 'castor meal' as follows:—

	Exported.	Tea-gardens.	Country and local consumption.	Total.
	Mds.	Mds.	Mds.	Mds.
1904 . . .	21,580	21,071	2,470	45,071
1905 . . .	7,485	45,816	11,298	64,099

They informed me also that their whole supply in 1906 to the end of August (5,000 maunds a month) were ordered from Japan. Of the oilcake exported as for manure the United Kingdom, China and Japan were the only large importers.

The production of Assam oil mills is entirely absorbed locally, and the same may be said of the other new mills run by machinery.

The details I have been able to ascertain regarding the crops for which oilcake is used are as follows:—

Tea.—The use of oilcake for tea in any large quantity is quite a recent development, but is increasing by enormous strides. One firm of agents last year sent up to their estates 4,050 maunds of cake and meal in 1905-06, and this is by no means the largest amount. It may, in fact, be said that almost every up-to-date concern in the Assam Valley either is regularly using oilcake now, or is experimenting with it. It has penetrated not to quite the same extent into the Surma Valley, and still less into the Duars and Darjeeling, but

is becoming more used in each of these districts. As a rule, hitherto, it has been applied to tea at the rate of 10 to 15 maunds per acre, but there is a tendency now to apply less on each occasion and repeat the dose more often.

Sugarcane—(information given by Messrs. N. G. and D. N. Mukerji) is regularly manured with oilcake, bought for the purpose, castor cake being usually much preferred. Twenty maunds per acre is the average amount applied, but even thirty maunds are bought and used for the purpose. In the Assam Valley I am told that practically no oilcake is used. Mr. Basu writes 'the Assamese raiyats may be said to be still ignorant of the use of oilcake as a manure.' Hence sugarcane seems chiefly to be looked upon as a homestead or virgin land crop and is usually poor.

Potatoes are manured commonly in Bengal and Eastern Bengal, but not in the Assam Valley, with oilcake at about the rate of 25 to 30 maunds per acre. I do not know whether oilcake is used for potatoes in the Khasi Hills.

Rice.—Oilcake is occasionally used for autumn rice in Bengal, at the rate of about 5 maunds per acre.

Tobacco.—Rape cake 'is very largely used by tobacco growers in Rungpur, the rate of application being 2 to 3 maunds per *bigha* ($\frac{1}{3}$ acre)' (Basu).

Pán (betel leaf) is manured with small quantities of oilcake in Eastern Bengal, and, I believe, all over Lower Bengal.

Ginger is also manured to some extent in Rungpur with oilcake (chiefly rape or mustard), and it is one of the staples of that district.

The oilcakes principally used, as I have said, are mustard (or rape) and castor, and, except for one sample of 'moula' or 'radish' cake, no others have passed through my hands.

Mustard cake.—The following are samples which I have examined, all locally crushed:—

	MUSTARD CAKE.				
	One year old, North Sylhet.	New, North Sylhet	Dibrugarh.	Bishnauth.	Nowgong.
Moisture	8.67	8.14	8.44	9.04	19.33
Organic matter	88.84	85.04	82.92	80.90	72.89
Lime, phosphoric acid and alkalies, etc.	6.52	5.70	6.80	6.67	6.98
Sand . . . . .	.77	1.12	1.84	3.39	1.80
Total	100.00	100.00	100.00	100.00	100.00
Nitrogen	5.48	5.64	5.17	4.61	4.78

As will be seen, these are all good samples and, except for the Nowgong sample being wet, there is no sign whatever of adulteration. The price is rapidly going up. In 1900 large quantities could be bought in the Assam Valley for 14 annas a maund, now it is difficult to get it at R1-6-0. The demand is so great at present that I doubt whether even mills like those at Gauhati would bother to sell on a guarantee, and my last year's advice to planters was to be satisfied if they get it at R1-6-0 to R1-7-0 per maund (80 lb), reckoning it at $4\frac{1}{2}$ per cent. nitrogen, delivered on the station or ghat. It is probable that during the present year the price will be higher than this. The local material is all bought from the traders in the bazaar, who finance the cultivators who grow the crop. The Gauhati and Chaparmukh mills dispose of their produce direct to planters, none going into ordinary agriculture. I have no means of knowing how the produce of the Phulchhari and Parbatipur mills reaches the cultivators, but it is almost certain that it is through bazaar traders.

Mustard cake in the Calcutta bazaar has risen in price much during the past year, but not to so great an extent as castor cake, and it is at present

distinctly of better value than the latter. The Calcutta prices for the last year have been as follows:—

	R a. p.	R a. p.	
October to December 1905	1 1 0	to 1 10 0	per Bengal maund.
January to March 1906	1 5 0	„ 1 11 0	„ „ „
April to June 1906	1 7 6	„ 2 8 0	„ „ „
July to September 1906	1 7 0	„ 1 11 0	„ „ „

Castor cake.—There are two distinct qualities of castor cake on the market, both of which seem to be pure, but of entirely different value. One of these contains barely 4 to 4½ per cent. of nitrogen, and the other 5½ to 6½ per cent. Curiously enough it is the bazaar castor cake which is high, and that produced by the British Indian Oil Mills which is poor. The latter firm are usually quite ready to guarantee 4½ to 4¾ per cent. nitrogen, but not more. No guarantee is, of course, obtainable in the bazaar. The prices have in the last three years almost exactly been proportionable to the nitrogen content. Thus, when the bazaar cake was $\text{R}1-14-0$ to $\text{R}2$ per Bengal maund (82½ lb), the oil mills were selling their cake at $\text{R}1-5-0$ to $\text{R}1-6-0$. The former means 5·3 annas per maund unit of nitrogen, and the latter 5 annas, counting all the value of the cake as nitrogen.

During the last few years, and the present year especially, the price of castor cake has been going up, and during 1905-06 the rise has been almost continual. The prices on the Calcutta market of the bazaar cake in the last year have been as follows:—

	R a. p.	R a. p.	
October 1905	2 0 0	to 2 4 0	per Bengal maund.
November „	2 0 0	„ 3 0 0	„ „ „
December „	2 0 0	„ 2 13 0	„ „ „
January 1906	1 11 0	„ 2 2 0	„ „ „
February „	2 0 0	„ 2 4 0	„ „ „
March „	1 14 0	„ 2 2 0	„ „ „
April „	2 0 0	„ 2 6 0	„ „ „
May „	1 14 0	„ 2 6 0	„ „ „
June „	2 2 6	„ 2 9 0	„ „ „
July „	2 5 0	„ 2 10 0	„ „ „
August „	2 5 0	„ 2 8 6	„ „ „
September „	2 8 0	„ 2 14 0	„ „ „

There has, in fact, on the whole been a distinct rise of 8 annas per maund or, say, $\text{R}13-8-0$ per ton during the year. In May last, when bazaar cake was selling at $\text{R}1-14-0$ to $\text{R}2-2-0$ per maund, the British Indian Oil Mills sent their material to Japan at $\text{R}1-7-0$ per maund f. o. b. Calcutta.

The composition of bazaar castor cake may be seen from the following typical analysis:—

Moisture	7·67
Organic matter	82·78
Lime	·88
Phosphoric acid	3·07
Alkalies, etc.	3·31
Sand	2·34
TOTAL	100·00

Nitrogen 6·46

Other commercial samples gave nitrogen 6·45, 6·52, and 6·07 per cent., respectively.

The castor cake produced and sold by the British Indian Oil Mills give figures as follows:—

Moisture	7·53
Organic matter	86·51
Lime	·20
Phosphoric acid	1·41
Alkalies, etc.	2·95
Sand	1·40
TOTAL	100·00

Nitrogen 4·12

Other commercial samples gave nitrogen 4·38 and 4·36, respectively.

The cake supplied by the British Indian Oil Mills Company is always sold a fine ground meal: the bazaar cake usually in the form of small pressed cakes. It has been objected in tea culture to the meal, that in consequence of its fine state of division its effects are very temporary, but as yet this is by no means certain.

Other cakes than those already mentioned are hardly used in Bengal at all, or if used do not enter in any way into trade.

It is evident from the summary that has been given that the use of commercial fertilisers in Bengal, Eastern Bengal and Assam is, except as regards oilcakes, in its infancy. As regards such materials as superphosphate, dissolved bones and the like, I feel almost certain that the prices will have to be materially reduced before there is even the remotest possibility of their use taking on a great extension even in planting and still more in ordinary country agriculture. In the case of bones and bone meal, caste difficulties will prevent the extension of their being anything but very slow. With saltpetre there is more likelihood of larger quantities being used in the near future, but here again demonstrations will have to be multiplied, largely before this result is likely to be brought about. Cakes are already used in much of the area, and their use is spreading fast without any Government interference.

MEMORANDUM ON THE USE OF, AND TRADE IN, COMMERCIAL FERTILIZERS IN SOUTHERN INDIA, BY DR. LEHMANN, M.A., B.S.A., PH.D., AGRICULTURAL CHEMIST TO THE GOVERNMENT OF MYSORE.

Having been asked by the Board to collect information regarding the commercial fertilizers in Southern India to assist in the discussion as to whether a law controlling the sale of commercial fertilizers in India would be desirable or not, I have the honour to state that Mr. Benson collected samples of all the commercial fertilizers he could find on the market and forwarded them to me for analysis. In all 137 samples were received from 13 firms. Most of these firms are milling bones and oilcakes with machinery. Many of them are large European firms which devote only a small part of their energies to the sale of commercial fertilizers. But a few firms are devoting their entire time and energy to the manufacture and sale of fertilizers. Chief of these in Madras is the Presidency Manure Works, of which Messrs. Parry & Co. are Managing Agents. They have made sulphuric acid in their works, and have been experimenting with considerable success with the manufacture of superphosphates. Messrs. Stanes & Co., of Coimbatore, are manufacturing a neutral sulphate of potash out of the acid sulphate of potash obtained as a by-product from the Cordite Factory at Wellington. The same firm is also manufacturing a considerable quantity of dried blood manure in several of the larger cities of Southern India. Besides these, the only commercial fertilizers produced in Southern India are saltpetre, both refined and unrefined, ground oilcakes, milled bone meal and milled or dried fish, which are all produced in considerable quantities. Prawn skins which are naturally met with in only small quantities need hardly be mentioned here.

Extent of Trade.—As to the extent of the trade in commercial fertilizers in Southern India, no figures could be obtained, as only one small European firm gave any figures regarding the extent of their sales. All the firms state that the bulk of the fertilizers are sold to the European planters, and that the demand for commercial fertilizers varies with the prosperity of the planting industries.

The demand by the native agriculturists is, barring oilcakes, which are used for sugarcane, very small at present, and is chiefly confined to experimenting with them. On this point Messrs. Parry & Co. wrote: "With the exception of that from European planters, the demand for the manures mentioned in the list given in your letter under reply can hardly be said to exist at all when the enormous area under cultivation in India is considered. By means of advertisement in local Agricultural Vernacular Journals and the employment of travelling agents ryots are beginning to be interested in chemical fertilizers, and a small demand, mostly for experimental purposes, is being created. The prospects of future increase depends very largely on the support of Government. If the Agricultural Departments would take up the analyses of soils and advise the ryots what fertilizers to order, a demand would almost certainly spring up

among the educated farmers." On this point the Secretary of the Kristna Agricultural Association wrote after saying that fertilizers were only being used by the ryots experimentally: "There is not the slightest doubt if respectable traders take up the sale of imported fertilizers, their use will become an assured fact." Judging from inquiries I have received regarding commercial fertilizers there is undoubtedly an interest being awakened in the minds of the native cultivators in regard to commercial fertilizers. Whether that interest will grow and lead to a general use of commercial fertilizers will, I should think, depend on the success those who try them first will have when using them.

But although no figures are available as to the extent of the fertilizers actually used, the fact that 137 samples were found on the market at one time (regardless of the brands held by firms such as Messrs. Arbuthnot & Co., from which no samples were received, and that some brands, if they may be so called, were sold out and others not procurable this year) and that at least 13 firms, some of them large European firms, are actively engaged in the sale of commercial fertilizers indicates that in South India there must be a considerable demand for commercial fertilizers.

Composition.—Most of the fertilizers sold in Southern India are liable to very great variations in their composition. This is partially due to adulteration and partially to intrinsic differences in composition of the material used for their manufacture. White castor poonac and dried fish manure are at present the fertilizers most grossly adulterated. This adulteration has increased very materially during the last eight years, especially with white castor poonac. Before this fish was already being adulterated with sand up to 50 per cent. and even 60 per cent. of the weight sold. An adulterated sample of white castor cake produced in or near Bangalore should contain 7 or 7½ per cent. of nitrogen. But it is difficult now to get white castor cake here in any quantity which contains 6½ per cent. of nitrogen, and it occasionally drops down to 4½ per cent. The latter represents an adulteration of over 6½ per cent. of the original weight. This great increase in adulteration has been due to the great increase in the demand for white castor, which eight years ago was the cheapest form in which nitrogen could be bought in Bangalore. Now safflower cake, locally called "*kardai*," imported from the Bombay Presidency is one of the cheapest forms, if not the cheapest, in which the Mysore planters can buy their nitrogen. But the variations in that of oilcake are even greater than those in white castor, for its nitrogen content has been found to vary from about 2½ per cent. to nearly 8½ per cent. But, fortunately for the Mysore planters, the firm supplying this oil cake has voluntarily agreed to guarantee their manures and has equipped a small laboratory for the purpose of testing their oilcakes before they are sent out. How far this variation in the composition of safflower cake is due to adulteration and how far to variety, or the locality where the seed is grown, has not been determined in any way.

That white castor-oil cake varies very much with the locality has been pointed out by Dr. Leather some years ago, Bengal producing a cake which contains nearly 8 per cent. of nitrogen, and Bombay one which contains not much more than half that quantity. As already stated, pure white castor cake in Mysore generally contains between 7 per cent. and 7½ per cent. of nitrogen. One sample, out of which nearly all the black husks had been removed, contained 8.69 per cent., but the samples of white castor from the west coast of Madras, though apparently fairly pure, contained only about 4½ per cent. This variation due to variety has been more clearly proven in the case of dried fish. Different varieties of fish which had been caught near Marmagoa about the same time were carefully dried to prevent admixture of sand and analysed; calculated to the same water content (4.41 per cent.) the following variations were noticed:—

Nitrogen	5.17 per cent. to 8.72 per cent.
Phosphoric acid	2.26 " to 6.12 "
Insoluble residue	3.54 " to 9.73 "

The sample containing least nitrogen also contained the least phosphoric acid and insoluble residue and *vice versa*.

Honge and *neem* oilcakes as produced in Mysore are as yet fairly constant in composition. And there is not much more variation when all South India is being considered. In *Ippe* (*Bassia latifolia*) there is, however, an enormous

difference due to variety. Dry blood is generally *very* constant and bone meal fairly so. But of the latter some badly adulterated samples have been noticed. These latter were ground very fine and contained a lot of sand.

Of the so-called "chemical" commercial fertilizers, saltpetre and perhaps sulphate of potash are the only ones produced at present on a large scale. In saltpetre very great variations occur. There is no sharp line of demarcation between the so-called refined and crude saltpetre. The material sold under one or other of these names or simply as "saltpetre" has been found to vary from 3.62 per cent. of nitrogen and 17.9 per cent. of potash to 13.61 per cent. of nitrogen and 46.93 per cent. of potash.

Guarantee.—The object of a guarantee for commercial fertilizers is two-fold. The one is to enable the purchaser to know what he is buying, so as to enable him to get what he desires at the lowest possible price per unit, by figuring out the price per unit as given in the last column of the various tables of analytical results sent herewith. The great variations which exist in fertilizers of the same name makes it impossible for him to know what he is buying when the name only is given. A number of firms dealing in commercial fertilizers refuse *at present* to give a guarantee of any kind. They may state that an analysis made some time ago gave such and such results, but decline to say that their present stock is represented by that analysis; some others, chief of which is the Presidency Manure Works, guarantee their fertilizers if asked to do so. For saltpetre no guarantee of any kind is obtainable now in South India by the agriculturists who may wish to use that fertilizer.

The other advantage of a compulsory guarantee is that it protects the honest dealer from the dishonest, careless or grasping competitor. The great difference in price per unit charged indicated that the trade is not at present built on a sound foundation. In countries where a fertilizer law exists the price per unit of each of the chief ingredients of plant food must be fairly uniform when supplied in the same class of fertilizer. But in South India fertilizers, even those imported from countries where fertilizer laws exist and which must cost practically the same per unit to land in India, vary very much in price per unit. Take, for example, the price per unit of nitrogen in sulphate of ammonia. When comparing the prices charged by various firms for this fertilizer differences of over 50 per cent. are met with. In Basic slag differences, of nearly 100 per cent. exist in the price per unit of the phosphoric acid contained in them, and in the price per unit of nitrogen in oil-cakes nearly as great differences are met with.

Why is a fertilizer law desirable.—Two of the reasons have already been given in the previous paragraph. It may be urged that as at present the principal consumers of commercial fertilizers are the planters, and these can insist on a guarantee being given them without the assistance of a fertilizer law; such a law is not yet necessary. In a measure this may be true, but as a considerable number of planters are at present not in the best financial circumstances and are more or less in the hands of their agents who "prepare" and ship their "crop," they are bound to purchase fertilizers from them whether they receive a guarantee with these fertilizers or not. Furthermore, even those planters who are perfectly free to buy where they please find it more convenient to purchase the fertilizers they require from the agent who prepares their crop. For that crop has to be sent to the "Coast" in carts, and these carts would have to return empty, unless they take back the fertilizers required on the state. Some planters no doubt insist on a guarantee and get it, even if they have to purchase their fertilizers abroad. The manager of one group of estates has just written that he is going to get his saltpetre from Calcutta, as he could not get it with a guarantee in South India. As the planters as a whole cannot insist on a guarantee for the fertilizers they purchase, it makes it much more difficult for those who can insist on a guarantee to get it. I have also been told that some of the firms are not free agents to give guarantees as they please, but do not know how much truth there is in that.

However, a much stronger reason than any of these exists, I believe, to make it desirable to have a proper fertilizer law to control the sale of fertilizers. At present it is, I believe, almost impossible to compel a guarantee being carried out even when given, unless both the person who gives the

guarantee and he to whom it is given live near enough to a chemical laboratory to be able to summon the analyst to appear as a witness in court. I have had to refuse analysing a sample of fertilizer sold under a guarantee and duly sampled and sealed, because I could not afford the time to appear in court to give evidence. The person sinned against in this case was a firm on the West Coast which had exported the fertilizer for which they had received a guarantee to Europe. How the matter was settled I do not know; the sample, with seals unbroken, is still with me. To enforce a guarantee for a fertilizer through an action in court is, I fear, practically impossible, unless a fertilizer law is introduced. Both the sampling and the final conviction in court present endless difficulties, unless there is a law introduced authorizing certain persons to take the samples and the same, or other persons, to make the analyses, and authorizing the courts to admit the samples and analyses to be correct without insisting on the analyst and sampler to appear in court as witnesses, except in special cases.

The view of the planters of South Mysore in regard to the desirability of an Act to control the sale of fertilizers may be best stated by giving the following resolutions passed unanimously at the last meeting of the United Planters' Association of Southern India:—

"That this Association views with regret the disapproval by the Government of India of the institution of any inquiry into the question of legalizing the sale of artificial manures as intimated by the Board of Revenue, Madras, in their Proceedings dated the 10th May 1906, and to learn thereby that the Officiating Inspector General of Agriculture proposes to take no further action in consequence. This Association is of opinion that the necessity for some control over the sale of artificial fertilizers is yearly becoming more urgent in view of the probability of the spread of the use of such manures among the ryots of the country as a consequence of the improvements in agricultural methods following the work of various Agricultural Colleges and Societies.

It is also of opinion that a short Act covering such control might easily be drafted which would bring no hardship to any but intentionally fraudulent vendors of manure, and that the provisions of such an Act could be enforced on somewhat the same lines as adopted by the United States of America, where it is controlled by the Commissioner of Agriculture, the State Chemist or the Director of the Experiment Station, and is therefore not in the hands of any subordinate officials, the only person employed outside the laboratory staff being a properly authorised sampler.

The Planters of Southern India have for some years past urged the necessity for legalised control; most of the largest manufacturers and vendors of such manures are not averse to—and some would welcome—it; but it is impossible for them to exercise the necessary control, unless aided by some enactment which would bring all vendors of chemical or prepared artificial manures under its provisions.

With a view of in no wise retarding the use of artificial fertilizers it would appear wiser to introduce legislation now instead of waiting until fraudulent practices have assumed larger proportions, as must certainly be the case with an increased demand, and thus to check the establishment of such fraudulent practices before they become as well established as they are in some industries in the country.

For further details with regard to the desirability of fertilizer control and for its introduction at the present moment, attention is directed to the full discussion on the subject, copies of which are enclosed.

This Association would therefore earnestly urge a reconsideration of the recent decision of the Government of India, and request that a searching enquiry be instituted with a view of the early introduction of some system of control on the lines existing in the United States of America."

Among the dealers in commercial fertilizers there is not yet that unanimity in favour of such an Act as there is on the part of the planters. But they have not yet studied that subject as carefully nor as long as the planters have done. A few firms may still be opposed to any *immediate* legislation controlling the sale of fertilizers, though they all admit the necessity for it at some future time. Chief of these was, I believe, the late firm of Messrs. Arbuthnot & Co. At the last meeting of the United Planters' Association of Southern India, to which all the firms dealing in commercial fertilizers in Southern India known to the Secretary were invited, Mr. Strickland, the representative of Messrs. Arbuthnot & Co., stated that the view of their firm was that they did not see the necessity for legislation at present. That might be necessary in the future when the ryot took to using fertilizers. But, judging from the conversation I have had with the members of two other firms, who were opposed to the immediate introduction of a fertilizer law, I am convinced that most if not all the objections to a law controlling the sale of fertilizers is due to the fact that the advantages of the law are not properly understood, and that *supposed* difficulties which do not really exist appear to be in the way. I can safely state that the majority of the firms dealing with fertilizers in South India are in favour of a fertilizer control being introduced. I may as well repeat what some of them have written. Messrs. Parry & Co., when writing about this subject, stated: " * * * We welcome the proposal to introduce a system of scientific control over the sale of commercial fertilizers in India * * * " Mr. Jackson, one of the members of that firm (who are, as already stated, the Agents of the Presidency Manure Works), as well as Mr. Bernard, the Manager of these Manure Works, attended the United Planters' Association of Southern India meeting and helped the proceedings materially. Messrs. Coen & Co., of Hubli, who were not represented at the United Planters' Association of Southern India meetings, wrote: "With reference to your circular letter No. 1346, dated the 4th June, we beg to state that we are in accord with the proposal that a system of control should be introduced over the sale of commercial fertilizers in India, more especially in regard to the furnishing of a guarantee of quality." This firm deals principally in ground oilcakes and bone meal. The Manager of Messrs. Matheson & Co., of Hunsur, writes: "I certainly think a system of control is desirable, specially so in chemical manures, where analyses can easily be got from manufactures; but the difficulties in the way of doing this satisfactorily with oilcakes are almost too great to be surmounted in our case, I fear." In speaking of the difficulties to be encountered, he states when speaking about a guarantee for oilcakes: " * * * Before this could be done, there must be a recognised place to send all manures, and some arrangement made so that both parties are satisfied that a fair sample has been taken; if not, there will be endless disputes."

Messrs. Fett & Co., writing to the Chairman of the United Planters' Association of Southern India, stated: "With, we presume, all other manure merchants in India we should welcome any law which would prevent fraud, but it would be useless to restrict this to fertilizers imported into this country: such fertilizers as nitrate of soda, sulphate of ammonia, superphosphates and potash salts are usually in the hands of well-known syndicates, who have a reputation to sustain, and their guarantee is considered sufficient all the world over * * * " In the matter of indigenous manures, however, there is much scope for improvement, and there is a crying need for a law prohibiting foreign admixture into oilcakes and fish, and a guarantee of the purity of saltpetre. Every manure merchant would welcome this in his own interests and those of the public."

Messrs. Saldanha & Sons wrote: "We are of the opinion that it is highly desirable to organise a system of control whereby the quality of fertilizers be guaranteed to the purchaser, especially chemical fertilizers * * *"

This will, I think, suffice to indicate that there is a strong feeling in favour of an immediate introduction of a fertilizer law controlling the sale of commercial fertilizers both among the dealers and the consumers.

I may add that all District Associations which have expressed their views on the subject are strongly in favour of a fertilizer control and would include all fertilizers under the same. But, in order that a fertilizer law may be worked successfully, it requires not only the support of both consumer and producer,

but also a Government Agency to carry it out; and in this will, I fear, he found the chief difficulty in bringing a law into effect just now. Naturally the work involved in the carrying out of a fertilizer control must fall upon the various departments of Agriculture, especially, or almost exclusively, on the Chemists of these departments. And up to the present very few of the departments of agriculture had a Chemist on their staff, and it was therefore impossible to establish any sort of fertilizer control in the past. But as soon as the various departments have their Chemist and he has his laboratory and assistants in working order there ought to be no difficulty in undertaking this control. In the United States of America these analyses are done in regular factory fashion, and I know of one laboratory in which a Chemist with four assistants claims to have analysed 4,323 samples of fertilizers and fodders, in connection with the control of these substances, in addition to considerable other work. But it will take a very long time before Indian assistants will be able to make analyses at this rate and retain a sufficient degree of accuracy. Two assistants would however, I think, be likely to do all the work required at present for an effective fertilizer control in any of the Presidencies or Provinces of India by devoting half a year to that work.

In conclusion, it may be well to consider if any useful purpose can be served by postponing the introduction of a fertilizer law which, in the opinion of all who have expressed their views on the subject, it would be desirable to introduce at some time or other. The fact that all dealers agree that such a law would be of advantage now or at some future time indicates that they are quite prepared to have the composition of their fertilizers known, and that if they should be unable to supply a fertilizer as cheaply per unit as some of their competitors, they are willing to let them sell that brand and devote the portion of their energies and time formerly spent on that brand to some other line of fertilizers or some other line of business. It is also practically certain that with a fertilizer law the relatively expensive fertilizers (as, for example, Kainit, in which the unit of potash costs often almost twice the money it is sold for by the same firms in the form of "muriate" or saltpetre) would disappear from the Indian market altogether. The inevitable result would be that with a satisfactory fertilizer law the consumers as a whole would be able to get their plant food at a cheaper rate than they now do even if the demand for fertilizers should remain the same as it is now. All the indications point in the direction that the native cultivator is likely to make use of commercial fertilizers in the near future. When this is the case and a comparatively large number of relatively illiterate men buy small quantities of fertilizers, the temptation for an unscrupulous man to become a dealer in commercial fertilizers is certainly great, and from the experiences we have he is not likely to leave such a field unoccupied for long. That an increased demand in fertilizers is liable to lead to adulteration is indicated by the adulteration which has taken place in dried fish and white castor cake (and probably also in safflower cake) in the past. That fraudulent adulteration of fertilizers must injure their usefulness and retard their extensive application is practically certain. It is also practically certain that frauds once established are hard to put down. And by punishing evil doers more ill-feeling is created than by preventing them from doing their evil-deeds. All this points, I take it, to the fact that the sooner a fertilizer law is introduced, the better. Besides it will be easier to introduce a law like this when practically everyone is in its favour than later when fraudulent men have become dealers and are sure to oppose a fertilizer law in every way in their power. Finally, it is much pleasanter, I take it, to gain the experience in administering a law like this when we need fear nothing but friendly criticisms than later when more or less animosity is almost certain to be developed. Besides, the law is likely to work much more easily and smoothly ever afterwards if started with a mutual feeling of trust and confidence on the part of every one concerned.

What the law should be can, of course, be only discussed after it has been decided to have a law.

About the way the law has worked in other countries I can add but little to what was said last year. It works well in the United States of America. A Committee to unify the law of the various States has ended its sittings, but their report, which was promised me, has not yet been received. In Ceylon a

fertilizer law has been working very satisfactorily, but I have not yet received the details of that law, but may be able to give them at the time of the meeting.

List of firms who sent samples of fertilizers regarding fertilizer control.

	Number of samples sent.
Messrs. Best & Co., Madras	1
„ Parry & Co., Madras, for Presidency Manure Works	57
„ Stanes & Co., Coimbatore	20
„ Peirce, Leslie & Co., Coimbatore (charged for samples)	9
„ Matheson & Co., Hunsur	3
„ Petrie Hay and Sons, Hunsur	7
„ Binny & Co.'s Coffee Works, Bangalore	10
„ Croft, Mody & Co., Bombay	4
Mr. R. H. Fett, Bombay	7
Messrs. Morgan & Co., Mangalore	6
„ Saldanha & Sons, Mangalore (other samples sold out)	4
Madras Bone Mills	6
Messrs. W. Coen & Co., Hubli. (Kurdy and Safflower cake not procurable this year.)	
„ Volkart Brothers. (This year only exporting manures to Ceylon.)	..
Kali Works and Manure Factory. (Messrs. Arbuthnot & Co., Calicut and Mangalore, supplies large quantities of fertilizers, but, although written to several times, no samples were received.)	...
Cossim Mohammed's Oil Mills, Mazagon . . . . .	..
Kurrumbhoy Bone Mills, Mazagon . . . . .	..
Indus Valley Bone Mills, Karachi . . . . .	...
Moracoon Bone-crushing and Coffee-curing Works, Tellicherry . . . . .	...
Messrs. Hollingshurt & Co., Cochin (Milled fish) . . . . .	...
TOTAL	137

Classification of samples of fertilizers received for analysis in connection with the inquiry into fertilizer control.

Milled oilcakes—

Black castor	7	
White castor	6	
Honge (<i>Pongamia globra</i>)	7	
Neem (<i>Melia asadirachta</i>)	3	
Groundnut	1	
Kurdi (<i>Carthamus tinctorius</i>) (generally sold in large quantities) . . . . .	...
Ippe (<i>Bassia latifolia</i>) (generally found on the market in Mysore) . . . . .	...	24

Milled bones, fish, etc.—

“Fine” bone meal	17	
“Steamed” bone meal	3	
Boan char	1	
Milled fish	5	
Prawn skins	1	
	—	27

Nitrates, etc.—

Saltpetre	5	
Nitrate of soda	3	
Sulphate ammonia	3	
Dried blood	2	
	—	13

Pure phosphatic fertilizers—

Superphosphates (two of Indian manufacture)	7	
Basic slag	4	
Christmas Island phosphate	1	
Trichi phosphates (largely advertised) . . . . .	...
	—	12

Potash fertilizers—

Sulphate of potash (including one of Indian manufacture)	5	
Mixed sulphates of potash and soda	2	
"Muriate" of potash	4	
Kaimit	3	
	—	14
Mixed fertilizers	47	
	—	47

TOTAL	137
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TABLE XI.

Results of analyses of oil cakes and dried blood.

Number.	Substance.	RESULTS OF PREVIOUS YEAR'S ANALYSES			RESULTS OF 1905-06.						Price per ton.	Value per unit of nit. gen. making no allowance for potash or phosphoric acid.
		Average	Maximum	Minimum.	Nitrogen.	Loss on ignition after drying	Phosphoric acid.	Potash	Insoluble residue	Source		
1	2	3	4	5	6	7	8	9	10	11	12	13
...	White Castor	6 37	8 89	4 53	...	...	...	...	...	...	R a. p.	R a. p.
386	Do.	...	...	...	4 25	84 11	1 83	0 80	3 14	Madras West Coast	60 0 0	14 1 10
309	Do.	...	...	...	4 95	87 15	1 84	0 98	1 83	Do.	60 0 0	13 1 11
286	Do.	...	...	...	5 26	86 98	1 87	0 96	2 81	Madras East Coast	72 0 0	13 11 0
309	Do.	...	...	...	5 46	85 93	2 27	0 85	2 03	Madras	77 8 0	14 3 1
344	Do.	...	...	...	6 22	84 78	2 27	...	2 57	Mysore	68 0 0	10 15 2
330	Do.	...	...	...	6 23	85 00	2 29	0 76	2 66	Do.	57 8 0	9 2 5
319	Black Castor	...	...	...	3 99	...	1 86	...	10 64	Do.	...	...
331	Do.	...	...	...	4 22	...	...	...	...	Do.	43 0 0	11 6 0
317	Do.	...	...	...	4 38	85 50	1 74	0 88	2 25	Do.	50 0 0	11 8 9
308	Do.	...	...	...	4 64	...	...	...	...	Madras West Coast	57 8 0	12 6 3
363	Do.	...	...	...	4 74	81 95	2 00	1 02	2 98	Do.	50 0 0	10 8 9
307	Do.	...	...	...	4 78	81 74	2 09	0 61	2 82	Madras	57 8 0	12 0 6
300	Do.	...	...	...	4 83	84 15	1 76	0 88	3 51	Do.	65 0 0	13 4 8
...	Honge (Pongamia glabra)	3 83	4 01	3 59	...	...	...	...	...	...	...	...
360	Do. do.	...	...	...	3 97	...	...	...	...	Madras West Coast	47 8 0	14 1 6
329	Do. do.	...	...	...	3 92	86 86	1 10	1 09	2 61	Mysore	40 0 0	10 3 3
301	Do. do.	...	...	...	4 03	88 04	0 88	1 28	1 52	Madras	57 8 0	14 4 3
287	Do. do.	...	...	...	4 05	85 01	1 50	1 08	2 95	East Coast	60 0 0	13 5 6
334	Do. do.	...	...	...	4 05	85 73	0 90	1 21	3 92	Mysore	40 0 0	9 15 10
348	Do. do.	...	...	...	4 11	83 69	0 83	1 05	3 07	Do.	45 0 0	10 15 2
...	Neem (Melia azadirachta)	4 86	4 12	0 99	...	...	...	...	...	...	...	...
293	Do. do.	...	...	...	3 89	83 20	0 92	1 83	4 98	Madras	62 8 0	16 1 1
335	Do. do.	...	...	...	5 11	81 92	1 12	1 83	2 77	Mysore	45 0 0	8 12 10
288	Do. do.	...	...	...	5 38	82 08	1 29	2 19	5 34	Madras East Coast	50 0 0	9 4 8
...	Iype (Bassia latifolia)	2 97	4 14	1 80	...	...	...	...	...	...	...	...
...	Kurdi (Carthamus tinctorius)	5 70	8 30	3 22	...	...	...	...	...	...	...	...
56	Do. do.	...	...	...	2 58	94 98	1 37	0 80	1 39	Madras	...	...
285	Ground-nut	...	...	...	7 80	88 33	1 30	1 19	1 77	Madras East Coast	70 0 0	8 13 11
262	Til	...	...	...	4 93	...	...	...	...	...	...	...
...	Dried blood	...	11 55	10 40	...	...	...	...	...	...	...	...
304	Do.	...	...	...	11 51	81 48	0 42	...	5 81	Madras	115 0 0	10 0 0

TABLE XII.

Results of analyses of bone meal, fish, etc.

Number	Substance.	RESULTS OF PREVIOUS YEARS.						RESULTS OF 1905-06.						Locality.	Price.	COST PER UNIT.			
		NITROGEN.			PHOSPHORIC ACID.			Nitro- gen.	PHOSPHORIC ACID.		Potash	Insoluble matter.	Moisture			Loss on ignition.	Nitrogen.	Phos- phoric acid.	
		Average.	Maximum	Minimum.	Average	Maximum.	Minimum.		Total.	Citrate soluble.									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
																R a. p.	R a. p.	R a. p.	
77 E	Milled fish	5.86	8.78	3.96	4.79	7.54	1.78	8.91	4.20	...	...	40.01	9.49	..	Madras West Coast	...	...	...
861 F	Do.	...	...	...	...	...	...	4.90	3.78	...	...	40.48	5.29	44.65	Do.	50 0 0	9 8	3 0 3
808 "	Do.	...	...	...	...	...	...	4.97	4.99	...	...	32.92	4.11	49.79	Do.	43 3 0	6 15	1 12 0
809 "	Do.	...	...	...	...	...	...	5.14	4.71	...	9	38.28	3.74	48.87	Do.	72 3 0	9 8	2 6 3
810 "	Do.	...	...	...	...	...	...	5.53	5.35	...	...	36.35	3.23	54.71	..	55 0 0	7 15 3	1 15 10
868 "	Do.	...	...	...	...	...	...	6.28	3.74	...	...	34.41	4.02	45.05	..	50 0 0	6 7 3	1 9 11
80	Prawn skins	...	...	...	...	...	...	4.98	3.68	...	...	33.3	4.37	46.65	Madras West Coast	85 0 0	12 14 10	3 11 3
9 E	Do.	8.14	...	...	8.37	...	...	...	...	...	...	4.47	...	78.46	Do.	...	...	...
	Bone meal	8.61	4.01	3.52	22.45	28.56	18.63	...	...	...	...	6.25	5.91	31.54	Madras West Coast	70 0 0	7 11 3	1 14 11
337 F	Do.	...	...	...	...	...	...	3.77	21.14	...	...	4.03	31.54	6.41	Mysore	60 0 0	6 7 8	1 9 11
811 "	Do.	...	...	...	...	...	...	3.86	21.0	...	...	5.99	31.54	6.23	Madras East Coast	63 0 0	6 11 9	1 10 11
868 "	Do.	...	...	...	...	...	...	3.73	22.18	...	...	1.06	6.83	31.79	Do. West Coast	57 3 0	5 15 5	1 7 10
333 "	Do.	...	...	...	...	...	...	3.73	23.97	9.06	...	3.47	5.82	29.96	Madras	75 0 0	7 11 4	1 14 10
337 "	Do.	...	...	...	...	...	...	3.95	24.04	6.94	...	1.44	5.23	32.14	Mysore	58 0 0	6 10 0	1 6 6
316 "	Do.	...	...	...	...	...	...	4.35	24.23	...	...	1.6	6.68	33.69	Madras East Coast	64 0 0	6 3 4	1 8 10
871 "	Do.	...	...	...	...	...	...	3.93	24.6	...	...	3.4	4.35	30.31	Do. West Coast	70 0 0	6 16 0	1 11 9
809 "	Do. steamed	...	...	...	...	...	...	4.00	24.67	...	...	3.91	4.87	30.46	Do.	69 0 0	6 11 9	1 10 9
367 "	Do.	...	...	...	...	...	...	3.91	24.7	...	...	...	6.43	30.6	Mysore	69 0 0	5 15 2	1 7 9
833 "	Do. steamed	...	...	...	...	...	...	3.96	25.09	11.23	...	...	5.29	30.6	Madras	85 0 0	3 5 0	2 1 3
296 "	Do. do.	...	...	...	...	...	...	...	24.5	11.88	28	...	...	...	Do.	60 0 0	...	...
320 "	Do. after being in soil 23 years.	...	...	...	...	...	...	1.62	33.49	16.36	...	...	9.2	3.2	Mysore	...	...	...
836 "	Bone meal	...	...	...	...	...	...	...	22.16	...	...	5.55	...	...	Bombay	65 0 0	...	...
345 "	Bone char	...	...	...	...	...	...	1.15	37.69	...	...	7.74	2.46	17.37	Mysore	40 0 0	...	1 7 1
342 "	Do.	1.21	...	...	27.3	...	...	...	...	...	...	9.11	3.23	30.06	..	...	...	...

TABLE XIII.

Composition of ammonia salts and nitrates.

Number.	Substance.	Moisture.	Insoluble residue.	NITROGEN		POTASH.		Received from	Price.	PRICE PER UNIT OF	
				Found.	Guaranteed.	Found.	Guaranteed.			Nitrogen.	Potash.
1	2	3	4	5	6	7	8	9	10	11	12
									R	R a. p.	R a. p.
272	Sulphate of ammonia . . . . .	.	0 08	20 60	...	...	...	Madras East Coast	225	10 15 8	.
280	Do. . . . .	...	0 14	20 48	20 00	...	...	Madras	330	16 4 1	..
312	Do.	0 17	1 78	20 13	...	...	...	Do.	315	15 10 4	...
291	Nitrate of soda (Chil saltpetre)	0 20	0 12	16 38	15 00	...	...	Do.	255	16 9 3	...
338	Do.	0 17	0 34	16 08	...	...	...	Mysore	360	18 10 6	...
353	Do.	0 68	0 16	16 75	15 60	...	...	Bombay	210	18 5 4	... c
260	Refined saltpetre (Nitrate of potash)	0 05	0 03	13 61	..	48 93	.	Madras . . . . .	...	...	...
284	Do.	0 60	0 23	11 62	8 10	40 46	35 50	Do.	205	8 15 7	2 9 0
66	Do.	3 00	...	9 88	..	38 36	...	Do. . . . .	...	...	...
237	Saltpetre (Nitrate of Potash)	0 46	0 44	10 19	...	35 78	...	Mysore	125	6 1 11	1 12 0
205	Crude saltpetre	1 25	0 12	7 48	3 40	23 38	18 25	Madras	105	6 14 10	1 15 8
M 20	Average of crude saltpetre analysed in former years.	6 18	...	8 62	...	17 90	...				

TABLE XIV

Composition of phosphoric fertilizers other than bonemeal, dried, fish etc.

Number.	Substance.	Water.	Insoluble residue.	Iron and Aluminium oxides.	Potash.	PHOSPHORIC ACID.						PASSED THROUGH STANDARD SIEVE 100 MESHES TO THE INCH.		PRICE PER UNIT OF PHOSPHORIC ACID.			
						WATER SOLUBLE.		CITRATE SOLUBLE.		TOTAL.		Found.	Guaranteed.	Price.	Available.	Total.	
						Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
204	Trichl Phosphate . . . . .	..	..06	..	..	..	..	..38	..	..	25 51	..	99 00	..	R a. p.	R a. p.	R a. p.
284	Christmas Island phosphate	37	..06	..	..	..	..	..	..	..	39 13	..	51 59	..	100 0 0	..	..
293	Basic slag	385	9 25	..	..	..	..	..	..	..	15 95	16 18	83 63	..	100 0 0	..	6 4 8
311	Do.	228	10 16	..	..	..	..	..	..	..	14 2	..	89 86	..	95 0 0	..	6 11 0
356	Do. . . . .	..	11 12	..	..	..	..	..	..	..	14 4	14 4	90 10	81 6	95 0 0	..	6 9 7
359	Do.	175	8 1	..	..	..	..	..	..	..	20 01	..	87 32	..	70 0 0	..	3 7 11
383	Superphosphate	6 6	..	..	..	16 37	..	1 66	..	..	18 13	..	..	..	108 12 0	6 0 6	..
292	Do.	7 04	..	..	..	21 07	..	2 21	..	..	23 98	20 23	..	..	150 0 0	7 1 11	..
314	Do.	10 79	..	..	..	17 6	..	3 69	..	..	21 45	..	..	..	130 0 0	6 1 8	..
354	Do.	3 79	..	..	..	17 17	..	2 83	..	..	20 49	15 16	..	..	115 0 0	5 12 0	5 9 10
355	Do.	14 23	..	..	..	37 27	42 44	..	3 66	..	42 82	44 48	..	..	185 0 0	..	4 5 1
72	Do. . . . .	..	..	..	..	11 71	..	..	..	..	18 12	..	..	..	..	..	..
73	Do. . . . .	..	..	..	..	13 67	..	..	..	..	14 00	..	..	..	..	..	..
76	Do. . . . .	..	..	..	..	12 04	..	63	..	..	29 35	..	..	..	..	..	..
306	Bone Superphosphate and Potash	2 76	..	..	..	2 29	..	9 70	..	..	15 66	..	..	..	30 0 0	..	..
61	Do.	3 61	..	..	9 76	2 92	..	8 69	..	..	17 55	..	..	..	..	..	..
82	Do. . . . .	..	..	..	4 07	2	..	8 16	..	..	19 2	..	..	..	..	..	..

TABLE XV.

Showing composition of potash fertilizers.

Number.	Substances	Water.	Insoluble residue.	POTASH, WATER, SOLUBLE		Chloride	Sulphuric acid.	Received from	rice per ton.	COST PER UNIT OF POTASH.	
				Found.	Guaranteed					Considering Potash only	After deducting Nitrogen
75	Double sulphate of potash and soda	0 12	1 49	31 53	..	0 16		Madras	R a. p.	R a p	R a p.
79	Do. do . . . . .	..	2 00	32 38	..	0 88		Do.	..	..	..
83	Stanes' sulphate of potash . . . . .	..	3 23	45 13	40 00	..		Do	120 0 0	2 10 6	..
283	Sulphate of potash	0 10	0 45	51 33	..	..	44 43	East Coast Ma'ras	197 8 0	3 13 5	..
290	Do. . . . .	..	..	..	51 00	..	..	Madras	250 0 0	..	..
313	Do.	0 37	0 64	44 06	..	..	44 23	Do	235 0 0	5 5 4	..
352	Do.	0 18	0 77	46 68	43 60	..	43 97	Bombay	190 0 0	4 1 3	..
281	Muriate of potash	0 18	0 30	53 32	..	48 37	..	Madras East Coast	210 0 0	3 2 2	..
315	Do.	0 08	0 59	58 63	..	44 03	..	Madras	168 12 0	3 9 4	..
336	Do.	0 09	0 23	51 92	51 40	46 39	..	My-sore	260 0 0	3 1 7	..
351	Do.	0 42	0 16	54 88	50 50	48 57	..	Bombay	170 0 0	5 14 8	..
280	Kainite	1 28	1 14	12 25	..	..	17 40	Madras East Coast	77 8 0	5 13 5	..
339	Do.	0 34	0 88	13 70	..	..	17 21	My-sore	60 0 0	5 3 11	..
360	Do.	2 68	1 09	13 35	12 40	..	15 09	Bombay	70 0 0	5 1 1	..
204	Saltpetre	0 60	0 23	40 46	..	..	..	Madras	205 0 0	3 14 6	2 9 0
295	Do.	1 25	0 42	26 88	..	..	..	Do	106 0 0	1 12 0	1 15 8
337	Do.	0 46	0 44	30 78	..	..	..	Mysore	125 0 0	..	..
	Mixed wood ashes maximum of former analyses . . . . .	..	..	2 31	..	..	..	..	..	..	..
	Do. minimum do. . . . .	..	..	0 40	..	..	..	..	..	..	..
250	Lantana ashes . . . . .	..	..	18 26	..	..	..	Mysore	..	..	..
	Paddy husks . . . . .	..	..	1 57	..	..	..	Do.	..	..	..
	Bamboo . . . . .	..	..	5 40	..	..	..	Coorg	..	..	..
	Bratty . . . . .	..	..	2 53	..	..	..	Mysore	..	..	..

APPENDIX F.

PAPERS ON THE UTILIZATION OF SILT.

SIR EDWARD BUCK'S ADDRESS TO THE BOARD OF AGRICULTURE ON THE UTILIZATION OF SILT.

When in the Government of India I made it a practice in dealing with Local Governments, only to put before them broad principles—the broader the better—and to leave it to them to apply the principles in accordance with local conditions. Wherever possible, I first took an opportunity to have the principle itself discussed and formulated by a conference representing all Provinces. I would follow this practice now. And the principle which I would place before this assembled Board is that contained in the Resolution passed by an Agricultural Conference in Italy two years ago:—“*It is a ‘grave error’ not to utilise fertilising silt whenever it can be profitably used.*”

I suggest that there is *prima facie* evidence that, especially after the first heavy rainfalls, there is a material amount of fertilising silt in many of our rivers and streams and in much of our surface drainage. The abstract of replies to my circular of 1893 given in Appendix C of my Report indicates so much. The replies also indicate that it is in some cases profitably used. I do not, however, suggest that any immediate measures involving large outlay should be taken to give effect to the principle which I place before the Board. I only propose that if the principle be accepted, a working-plan should be commenced in each Province, at first, perhaps, only in one or two Provinces, for giving effect to it.

The first step must be, as in the case of all working-plans, a careful investigation of the facts, of the possibilities, and of the methods to be employed. I have suggested in my report that this involves:—(1) An analysis of the fertilising silts available in our rivers, streams and surface drainage; (2) A map of the drainage system; (3) A study by our Engineers of the methods adoptable.

In dealing with these questions in further detail I ask permission to confine myself to the United Provinces with which only I am familiar. Conditions no doubt will widely differ in other provinces.

First the analysis of our silts. Dr. Leather has made a good beginning already. We have now a record of silts taken from streams and canals when in flood in some twenty or thirty cases at the commencement of the last monsoon. I only received five of these in Italy where two at least were considered by the Agricultural Chemists who deal with silts in that country to be of material value for agricultural purposes. I have suggested that these analyses should be continued. But I would add the suggestion that in promising cases they should be made in greater detail with still closer reference to the first fall of rain. In Italy analyses are made in some rivers when in flood every two hours and both at varying distances from the bank and at varying depths.

Taking a broad view of the conditions in these Provinces, I would divide the possibilities into three classes:—

- I. The capture of silts from streams and connected cauals at no great distance from the foot of the Himalayas.
- II. The capture of silts from minor and surface drainage throughout the provinces, with simultaneous prevention of erosion.
- III. The control of drainage in mountains and hills.

I need say no more about the first class. That is sufficiently dealt with in my report and no action seems to be for the present needed except that already suggested. But I should like to say more about the second class. Here we have not to deal with the silt brought down from the forests of the mountains but with the silt washed from the surface of the plains themselves. Now I contend that the silt absorbed in the first rainfall—I would go further, and say the first hour of rainfall—may be of considerable manurial value, and if so that none of it should be allowed to escape. What are the conditions?

As a rule (I am sorry that this year is the exception to the rule) there are some five months—say from January 15th to June 15th—in which not a drop of rain falls. During those months a considerable quantity of human and cattle manure (all of which latter is not burned) is deposited on the surface of the land. It is desiccated by the sun and hot air and brought into a condition in which much of it is readily taken into solution by the first hour's fall of heavy rain. Probably the drainage water of the first day or two's rain contains some fertilising ingredients not only in solution but in the form of silt, including a material washing from the surface of manured fields as well as from village lanes, and houses, the walls of which are covered with nitrates (often scraped off for manuring tobacco and opium), in addition to what may be washed from the open lands.

I was myself led to discover the curious part taken by the first rainfall in the distribution of *reh* where natural drainage had been interrupted over new ground. The *reh* could only be carried where the first drainage could find an opening. It was interrupted by a *bund* 3 or 4 inches high. As in the dry weather the *reh* itself painted, in snow white colour, the course which the first rainfall drainage had taken. It was easy to see what had happened. Its distribution was not affected by later drainage of sometimes 2 or 3 feet in depth. The maps in the *reh* report on the table open to your inspection clearly illustrate the process. After the first rainfall the *reh* sank in solution below the surface and was not touched by later falls of rain.

Now something of this sort must happen to the early drainage carrying fertilising matter in solution or in fine silt—and if so it would seem that what was an accident in the case of *reh* should be purposely done in the case of the fertilising water of the first drainage. We should *interrupt* its escape into the naturally formed drainage channels and hold it up in places where it can be utilised.

If there is any truth in these conjectures it might be desirable to test the value of the first drainage in suitable places. I may add that the scheme for "doctoring" ravines suggested as famine works would give an opportunity for holding up such if it is found valuable.

There is another question connected with the first rainfall which is still more conjectural. During the five months of dry season, but especially in the last 3 of those months when the strong west winds blow in the day, a material amount of fertilising dust must be taken up in the air. A question was asked yesterday whether *reh* was distributed by the wind. Of course it is. I have seen the east end of an *usar* maidan covered 6 inches deep with *reh* powder flanked by miniature *reh* dunes, and on one occasion when accident obliged me to travel over *usar* plains in a *palki* in May I have carried about a bushel of *reh* blown into it daily to my tents. The same occurs with the desiccated powder of manures on the fields and plains. As the weeks go on the sky becomes more and more obscured with dust raised from the land until at the end of June the sun can hardly be seen however much it can be felt.

Now it would seem worth while at any rate to analyse the first hour's rainfall of the monsoon which is the very rainfall that after reaching the ground carries off so much of the surface manure. May not the manure of the air increase its value and make it more worth while arresting?

You may however consider this too much of an airy speculation, though I believe that much of the unmanured land of the Province owes not a little of continued productiveness to that cause.

The second measure advised is the preparation of a drainage map. I am sorry that a complete map which Mr. Wright and myself made for the Cawnpore District cannot be found, but a portion of it has been re-issued in the *reh* report on the table to which I invite your inspection. Such maps are useful for many purposes and can be, as explained in Appendix D, constructed in two or three years with very little expense.

The Board's views on this question are solicited. The preparation of maps might be at first confined to United Provinces, Punjab and Central Provinces.

The third measure, the study of methods, would be commenced, I suggest by the deputation of an Engineer or Engineers, preferably of the Canal Department, to Italy.

Would the Board advocate this measure ?

I may repeat that none of the measures suggested for present adoption involve any material outlay.

REPORT BY SIR EDWARD BUCK, K.C.S.I., LL.D., ON THE UTILIZATION OF RIVER SILT FOR THE FERTILIZATION OF LAND AND THE MITIGATION OF MALARIA.

[Printed separately]

Prefatory Abstract.

REPORT BY DR. J. WALTER, LEATHER, PH.D., F.I.C., ETC., IMPERIAL AGRICULTURAL CHEMIST, ON THE CHEMICAL COMPOSITION OF RIVER SILTS OF THE UNITED PROVINCES, COLLECTED DURING THE MONSOON OF 1906.

With reference to the orders of the Government of India No. 1087-70-7, dated 22nd May 1906, I have the honour to submit my report on the chemical composition of the various samples of silt which have been collected during the past monsoon by the Irrigation Department of the United Provinces.

2. I have only determined those items in the chemical composition of the silt which are likely to prove of service in relation to the enquiry. The results are set out in the accompanying ten statements, one for each river which has been under observation.

The column showing the proportion of carbonate of lime (*calcium carbonate*) will indicate the "chalkiness" or otherwise of the material and this appears to be a definite characteristic of the silt of any one river

The *quantity* of silt varies naturally very much indeed even in the same stream; but if the samples of the Betwa and Dhassan rivers are average specimens, it is clear that their flood-water does not contain anything like so much silt as the Himalayan streams.

In chemical composition (excluding the calcium carbonate) there is nothing very striking about any of the samples, they are usually as poor in organic nitrogen as Indian soils are, though there are some exception such as the first sample of the Tons river silt and the Betwa river silt. A good deal of the silt (as for instance that of the rivers Tons, Song and Jumna) is fairly rich in phosphates, but most of this is in a very unavailable form, as indeed one might anticipate from freshly weathered rock material.

Generally, indeed, it may be said that these river silts are not to be considered as supplies of "rich manure" in the chemical sense, and any agricultural value they possess must be referred to some physical influence on the land.

Regarding the thickness of a deposit of silt from such waters, the following data are of interest.—

- (a) An acre of water 6" deep = 21,780 cubic feet and if this water contained 1 lb. of silt per cubic foot the quantity of silt is 21,780 lbs.
- (b) An acre of soil 12" deep may be assumed to be 4,000,000 (four million) lbs. for the purpose of a rough approximation or an acre 1" deep = 333,000 lbs.
- (c) Accordingly, if an acre of land were flooded 6" deep with water containing 1 lb. silt per cubic foot, and the silt entirely deposited, the layer would be equivalent to about .066". It will be seen that the river water only rarely contained much more than 1 lb. of silt per cubic foot and very commonly much less than this.

It will naturally be found, indeed, I know it is fully recognised by the Irrigation Department, that some silt is useful, whilst other silt is harmful, to agricultural land, and this depends not merely on the nature of the silt but also on that of the land. In the District of Dehra Dun, for instance, the soil is generally so stony in character that deposits of almost any kind of "silt" would be found serviceable.

On the other hand, in the Hoshiarpur District of the Punjab, the flood silt has done harm, for it is of a sandy nature, and of lower agricultural value than the cultivated land.

It is clear therefore the silt of any particular stream would be serviceable or otherwise is a question of local consideration.

Statement showing chemical composition of samples of silt obtained from ten Indian Rivers.

Laboratory No.	Description	Silt gm. per 100 c. c.	Silt lbs. per c. ft.	Organic Nitrogen.	Total Phosphoric acid.	Available Phosphoric acid.	Available Potash.	Calcium carbonate.	
TONS RIVER—(Dehra Dun).									
707—706	Tons river, 31st July 1906	·97	·61	·10	147	·005	·009	15 06	High flood for two hours.
750—751	" " 18th Aug. 1906	55	·85	·08	·153	not done— sample too small.		11·99	
776—777	" " 29th " "	1 72	1·07	·06	·132	Ditto		16 32	
SONG RIVER—(Dehra Dun).									
706—703	Song river, 31st July 1906	1 63	1·02	·02	·105	·004	·004	23·16	Exceptionally high flood for six hours.
731—722	" " 3rd Aug. 1906	2 06	1 29	·05	·200	·002	·006	21·27	
748—749	" " 18th " "	6 44	4 03	·04	·149	003	·002	17·34	
774—775	" " 29th " "	1 23	77	·03	·271	·008	·004	25·18	
GANGES RIVER—(Hardwar).									
715—713	Ganges river, 3rd Aug. 1906	·80	·56	·07	·123	·015	·011	9 52	
817—818	" " 16th Sept. "	·17	·11	·05	·052	·009	·015	5·61	
KOSI RIVER.									
780—781	Kosi river, 2nd Aug. 1906	1 97	1·23	·03	·077	·001	·005	3·97	
782—783	" " 6th " "	1 85	1·16	·07	·054	·014	·008	2 03	
988—984	" " 15th Sept. "	·89	56	·06	·072	·012	·007	1·95	
KICHA RIVER.									
888—889	Kicha river, 31st July 1906	·73	·49	·05	·081	·003	008	5 28	Two bottles received broken and two labels were illegible.
890—891	" " 3rd Aug "	2 75	1·72	05	·153	·008	·010	3 61	
892—893	" " 6th " "	2 62	1·63	·05	·106	·007	·010	5 24	
894—895	" " 15th " "	1 33	·88	04	·113	·006	·011	4·80	
896—896	" " 17th " "	1 61	1·01	·04	·075	·005	·012	2·98	
898—899	" " 4th Sept. "	89	·56	03	·114	·005	·009	5 09	
875—879	" " 7th " "	·98	·61	·08	·087	·007	·005	4 83	
880—881	" " 8th " "	·51	·32	·02	117	·003	·005	3·69	
882—883	" " 16th " "	1·11	·70	·03	·126	·006	·005	4·10	
JAMNA RIVER AT KHANA.									
723—724	Jamna at Khana, 26th July 1906	·89	·62	·08	·120	·021	·012	3 12	
762—763	" " 3rd Aug "	1·56	·99	·07	·111	·011	·010	3 33	
770—771	" " 9th " "	·86	·54	·05	·100	·007	·019	3 73	
772—773	" " 19th " "	·89	·56	·05	·122	·012	·012	3 29	
926—927	" " 1st Sept. "	2·23	1 39	·08	·116	·009	·014	3 12	
928—929	" " 15th " "	1·05	·66	·07	·104	·013	·016	3 94	
* KHOK RIVER.									
740—741	Khok river, 1st Aug 1906	1 24	·77	·07	084	·021	·008	1 07	
760—761	" " 8th " "	·48	30	·06	·074	·019	·007	·91	

* REMARKS:—1st Aug. 1906. Sample taken 200 ft. above junction of Khok and Sukhras rivers.
Gauge where sample was taken 4 5.
Full flood gauge - - - - - 5 2.
Duration of flood, 2½ hours.
8th " " Sample taken 1,000 ft. above the junction of Khok and Sakras rivers.
Gauge where sample was taken 4 3.
Full flood gauge. - - - - - 5 0.
Duration of flood, 7½ hours.

Statement showing chemical composition of samples of silt obtained from ten Indian Rivers—
concl'd.

Laboratory No.	Description.	Silt grm. per 100 c. c.	Silt lbs. per c. ft.	Organic Nitrogen.	Total Phosphoric acid.	Available Phosphoric acid.	Available Potash.	Calcium carbonate.	
GAULA NADI (Naini Tal).									
699-700	Gaula Nadi, 19th July 1906 .	2.24	1.40	.07	.147	.025	.014	1.60	Water flow was 5½ ft. high.
725-726	" " 29th " " .	.99	.62	.04	.079	.004	.009	2.89	
727-728	" " 2nd Aug. " " .	2.06	1.29	.03	.103	.001	.013	3.27	Flood 18½ ft. high at 8 P. M., and remained flooding up to 2 A. M.
784-785	" " 3rd " " " .	.95	.59	.05	.142	.016	.018	5.76	
742-743	" " 6th " " " .	1.49	.98	.04	.091	.004	.008	4.84	Flood 12½ ft. high at 7 A. M.
754-755	" " 19th " " " .	.27	.17	.08	.032	.005	.009	5.00	
810-830	" " 11th Sept. " " .	.80	.50	.08	.104	.002	.007	3.16	Flood 5½ ft. and lasted one hour Height of flood 6 ft.
821-822	" " 15th " " " .	.22	.14	.04	.086	.011	.009	2.04	
BETWA RIVER.									
815-816	Betwa river, 14th Sept. 1906 .	.08	.05	.13	Not determined— sample too small.			1.24	
46-847	" " 28th " " " .	.14	.09	.12	.116	Not determined—sample too small.		3.55	
DHASSAN RIVER.									
778-779	Dhassan river, 25th July 1906	.1	.06	.11	.066	Not determined—sample too small.		.80	Flood lasted 3 hours, gauge 558.9

APPENDIX G.

PAPERS ON THE UTILIZATION OF THE GRANT MADE BY THE BRITISH COTTON GROWING ASSOCIATION FOR THE IMPROVEMENT OF INDIAN COTTON.

Letter No. 121—87, dated the 23rd January 1907, from the Under-Secretary to the Government of India, Department of Revenue and Agriculture, to the Inspector General of Agriculture in India.

I am directed to forward a copy of a despatch received from His Majesty's Secretary of State for India, No. 181 (Revenue), dated the 14th September 1906, with enclosure, relating to the utilization of the funds placed at the disposal of the Government of India by the British Cotton Growing Association for the improvement of Indian cotton growing, together with a copy of a despatch* addressed to the Secretary of State by the Government of Bombay regarding the scheme for the disposal of this year's crop of Egyptian cotton in Sind.

* No. 2, dated the 3rd November 1906.

2. It appears to the Government of India that the system adopted in Sind has considerable merits and I am to request that you will favour them with your opinion on the scheme in connection with the disposal of cotton grown with the aid of funds furnished by the association after consultation with the Board of Agriculture at their meeting in February.

INDIA OFFICE, LONDON.

14th September 1906.

Revenue No. 181.

To His Excellency the Right Honourable the Governor-General of India in Council.

My Lord,

With reference to the letter from your Secretary in the Revenue and Agriculture Department, No. 158, dated the 15th July 1906, and its enclosures, I forward copy of a letter from the British Cotton Growing Association, dated the 22nd August, in which they make suggestions for the utilization of part of the funds, now at your disposal, for the improvement of Indian cotton growing, in guaranteeing to planters who undertake the cultivation of better class cottons a full price for their produce during the earlier years of the undertaking.

2. I request that I may be informed of your views on this suggestion; and also that you will take into consideration the objection raised by the Association to the scheme which has been put forward with this object in the case of the Punjab.

3. The sum of £ 1,233-6-8 has been paid in by the Association, being the equivalent of the sum of Rs. 18,500 asked for in your Revenue and Agriculture Secretary's letter above quoted, and it will be credited in the account current to be sent to India for the month of August.

I have, etc.,
JOHN MORLEY.

The British Cotton Growing Association.

EQUITABLE BUILDINGS,
13, ST. ANN STREET,
MANCHESTER,

August 22nd, 1906.

The Under-Secretary of State, India Office, London, S. W.

SIR,

I beg to acknowledge receipt of your letter of August 13th, R. and S. 2197, which was placed before the Indian Committee of this Association yesterday,

and in accordance with their instructions the sum of £1,233-6-8 will be placed to the credit of the Secretary of State in Council at the Bank of England.

2. The proposals generally seem to have been carefully thought out, and should be most useful in promoting the growth of better classes of cotton, and I am instructed to thank you for the very full information forwarded with your letter. My Committee, however, wish me to call attention to paragraph 8 *Punjab*. It is certainly absolutely essential that a market should be found for any cotton produced from better classes of seed, but at the same time it seems to the Committee that the cost of the proposed arrangement, namely, £ 500, is rather excessive, and they would be greatly obliged if you could ask the Inspector-General of Agriculture to look into this proposal again to see if some better and more economical plan could be adopted. In any case I trust that arrangements can be made for the planters to receive the full market value of their produce, as it is felt here that in the case of the arrangements made for the purchasing of the Egyptian cotton grown in Sind, native planters were not sufficiently protected. It is probable that if they had received the full prices which the state of the market justified, they would have been more encouraged to extend the growth of Egyptian cotton.

3. In connection with this point, there is not the slightest doubt that in order to establish the cultivation of better classes of cotton, which have been proved by experiment to be suitable for any particular district, it is essential, especially in the early stages, that the natives receive a satisfactory price for the cotton grown. In West Africa this Association entered into an arrangement with the local authorities to guarantee a fixed price for a period of three years, which arrangement has had most satisfactory results, and I would suggest for your consideration whether part of the funds placed at your disposal by this Association should not be devoted towards extending the growth of cotton by guaranteeing the planters full prices for their cotton. My Committee is afraid that if the matter is left in its initial stages to the ordinary commercial people, that the latter will not have sufficient foresight to see the advisability of giving the natives the highest price possible. There is no doubt that in the long run any money that might be lost, either by the Association or by others, in paying high prices in the initial stages would be more than recovered at a later date by the establishment of systematic cultivation of better qualities of cotton. One can hardly expect ordinary commercial houses to look at things from this point of view, and I would respectfully suggest for your consideration the possibility of the local agricultural officials lending every assistance to the ryots to obtain full prices for their cotton where there is not sufficient local competition to enable them to obtain the proper market value.

I am, &c.,

A. ARTHUR HUTTON, *Vice-Chairman.*

No. 3, dated Bombay Castle, the 3rd November 1906.

From—The Government of Bombay, Revenue Department,
To—His Majesty's Secretary of State for India, London.

With reference to our telegrams, dated the 11th, 14th and 18th instant, on the subject of the offer of the British Cotton Growing Association to purchase the produce of Egyptian cotton seed in Sind, we have the honour now to explain the considerations on which our views were based.

2. The British Cotton Growing Association observe that it is of vital importance in the earlier stages that the native cultivator should receive a good price for his cotton and that the arrangements made last year were not satisfactory. The measures adopted for the disposal of the crop of 1905 were described in the report of the Director of Agriculture, No. O. 44, dated the 19th May 1906, a copy of which was forwarded to you with our despatch No. 1, dated the 2nd June 1906. From this report we became aware that the results obtained from the cultivation of Egyptian cotton in Sind during the season

of 1905 fell somewhat short of the high expectations originally formed both as to yield and the price obtainable. The deficiency of outturn was apparently due, first to the unfavourable character of the season, and secondly, and perhaps more largely, to the very partial adoption by the Sindhi zamindar of the Egyptian methods of cultivation, which are far more expensive and laborious than the indigenous methods to which he is accustomed. The prices obtained were considerably lower than was hoped, but not lower than was reasonable under the special circumstances of the case. Egyptian cotton was a new commodity for the Sindhi zamindar to dispose of, and the formation of a market in which to dispose of at prices sufficiently favourable to encourage him to continue the experiment constituted, at the outset, a problem of no small difficulty. It was impossible for Government to buy up the whole crop and dispose of it in England, both because such a course would have been extremely unsatisfactory to cotton merchants doing business in India and because any departure from the well-established principle that Government should not enter into competition with the trade, would have been most undesirable. The efforts made to stimulate the Indian market failed to have any great effect, for there was no expert valuer on the spot to inform the cotton merchants of the true value of the product, and owing to the small quantity of the crop and the difficulties of collecting and marketing it, few of the large firms could be induced to make arrangements for purchase. That it was purchased in large quantities at all was due mainly to the enterprise of a single firm, who gave for it prices comparing not unsatisfactorily with the valuation reported by Mr. Fletcher, Deputy Director of Agriculture in this Presidency.

3. That the market would grow as the success of the experiment became assured and the zamindars learnt the value of their cotton we were confident. It was however apparent that the zamindars themselves could not combine to make a fair field for themselves, and that Government could with advantage intervene in order to bring buyers and sellers together, and accordingly the Director of Agriculture and the Commissioner in Sind were requested to consider what arrangements to that end could be devised in time to meet the requirements of the current season. The reports received from these officers contained the suggestions that the zamindars should be assisted to convey their cotton from their fields to a central spot, such as Mirpur Khas, where it should be ginned and that the ginned cotton should then either (a) be despatched by rail to the large markets at Bombay or Karachi for sale on behalf of the zamindars, or (b) be sold at public auction on their behalf at Mirpur Khas, the idea underlying this latter suggestion being that the larger exporting firms would find it worth while to send their agents to purchase, provided the cotton were collected in one place and put up for sale in large lots instead of being scattered in small and varying quantities in many villages. After careful consideration we have approved the adoption of the second alternative desiring to reduce to a minimum the interference of Government with the ordinary course of trade and have authorized the Commissioner in Sind to incur the necessary expenditure up to a limit of Rs. 5,000 and entertain the special temporary establishment which the scheme will require. The establishment has been entertained accordingly, and arrangements are now complete under which cotton which zamindars wish to sell will under the supervision of an officer of the Mukhtiarkar's grade be collected from the villages in sub-depôts and thence despatched to a main depôt at Mirpur Khas, where collections will periodically be put to public auction.

4. The offer of the British Cotton Growing Association to purchase all Egyptian cotton grown in Sind at 2d. per lb. of seed cotton or Rs. 10 per maund which was communicated to us in the letter from the Assistant Secretary, Revenue and Statistics Department, No. R. and S. 2632, dated 21st September 1906, received our very careful attention before we despatched our telegram of the 18th instant. It is an offer which leaves us in considerable uncertainty as to its exact meaning since it deals neither with the method nor the time of payment and omits to specify whether the price named is for seed cotton collected at Mirpur Khas or bought at the threshing floor. On examination of it we are moreover in doubt whether the price offered is appreciably better than that paid by Messrs. Ralli Brothers last year, which

worked out to 7½d. per lb. of lint for *abbasi*, on the basis of 26·2 per cent. of lint to seed; assuming that the zamindars themselves have to bear the cost of collection, the Association's offer amounts to no more than 7¼d per lb. of lint. Reports received from Sind show that competition for this season's crop is fairly brisk, and already some of the zamindars have sold at Rs. 12 per maund of seed cotton delivered at the threshing floor; signs of activity among purchasers are most encouraging, and it is not improbable that very little use will be made of the machinery which Government have provided for helping the zamindars to dispose of their crop for good prices.

5. The letter from the British Cotton Growing Association conveys the impression that they imperfectly apprehend the actual position and believe that the crop is or can be made to be, at the disposal of Government. The crop is of course the property of zamindars who can sell or not as they choose and who could not be bound by any undertaking which Government might enter into. But apart from that consideration, we should be indisposed to grant the Association a monopoly which we believe to be undesirable in view of the competition which is coming into play, a monopoly which might conceivably have a very prejudicial effect on the future local market and stand in the way of the utilization of Sind Egyptian cotton in the mills of this country.

6. Probably the competition on a large scale of the British Cotton Growing Association would exercise a very healthy effect over the sales in Sind, and bearing that in mind, we have in our telegram indicated the terms of the offer which it might be of some practical use to make. Twelve rupees per maund of seed cotton for delivery at the threshing floor (all freight charges being borne by the Association) would, we are advised, be a fair offer to make, it being understood that the Association should appoint their own agent to purchase for them; Government could, of course, render them no assistance in the matter of selection or purchase, nor could they give any guarantee as to the quality of cotton offered for sale, nor as to the quantity to be obtained. In the very possible contingency of this suggestion failing to find favour with the Association they might be recommended to consider the advisability of being represented by an agent at the auction sales to be periodically held at Mirpur Khas.

APPENDIX H.

PAPERS ON THE IMPROVEMENT OF THE INDIAN SUGARCANE INDUSTRY.

SCHEME FOR PROVINCIAL ENQUIRY INTO THE SUGARCANE INDUSTRY BY C. A. BARBER, M. A., F. L. S., GOVERNMENT BOTANIST, MADRAS.

PART I.

INTRODUCTION.

The following note has been prepared with the object of suggesting suitable lines of enquiry into the present position of the sugarcane industry in the various parts of India. Such an enquiry will be necessary before it is possible to determine the directions in which improvement should take place in each province, and where any great extension is possible. There is no doubt that India has certain advantages over other sugar-producing countries, such as its cheap and abundant labour and its well-developed system of irrigation. But in spite of these advantages, the past history of attempts at improvement is not encouraging and presents an unusually long list of failures. One of the objects of this enquiry is to determine the causes of these failures and to guard against them in future.

The cultivation of the cane and the manufacture of sugar varies greatly from place to place. In some tracts it is of a very primitive nature, while in others the cultivation is most expensive and complicated. In most instances the manufacture leaves very much to be desired. The relative importance of the sections following will accordingly differ greatly in the various provinces. Where intensive cultivation and careful manufacture are not at present attempted, the note may be considered as suggestive of the directions in which improvements are to be sought.

2. *Climate*.—There can be no doubt that the general character of the climate has a very great influence on the cultivation of the sugarcane. Attention has been drawn to the fact that the hot, muggy weather during which the cane grows most rapidly is exactly that which the white man is least able to endure. Hot sun and moist air are the two essentials for the best results. The scant rainfall and dry air of India are, therefore, distinct disadvantages, but these have been largely overcome by irrigation facilities.

A general statement of the average temperature and rainfall and their distribution throughout the year will be of interest as throwing light upon the far greater yield obtained in some parts of India than in others, and the possibility of remunerative results being obtained in regions inhabited by European planters.

3. *The age of sugarcane cultivation in India*.—It appears to be highly probable that the cane first became a cultivated plant either in India towards the head of the Bay of Bengal, along the Malay Peninsula or in Cochin China, or in some of the islands of the Malay Archipelago. The cultivation in India is at any rate of great antiquity. A brief historical statement of the earliest references to cultivation would be of interest.

There are also cases where, owing to the spread of population or irrigation the cultivation is of comparatively recent introduction. Such instances will be of special interest in considering possible future extension.

4. *The extent and character of cultivation*.—What is the area under cultivation in each province? Has there been any marked increase or decrease during recent years? If so, to what cause can this be assigned?

It cannot be too strongly insisted on that, for any real progress to be made in the extension of sugarcane cultivation, it must be conducted with very great care. Such differences in yield as are to be noted in the various provinces cannot be explained by mere difference in climate, and are largely due to the class of cultivation practised.

A statement of the general character of the cultivation in each province will be of interest. In some parts, for instance, the cane is cultivated in isolated patches of an acre or more in surrounding paddy. In others cane takes its

place in a regular rotation of various dry or garden crops, being irrigated from wells or other local sources. Lastly, there are parts where irrigation is not or barely attempted, and hundreds or thousands of acres are under a low, bushy growth of inferior varieties. It will usually happen that the cultivation varies a good deal in different parts of one province. The relative importance of the different classes of cultivation might be briefly stated.

The origin of the soil, whether deltaic, alluvial or the result of the breaking down of sedimentary or volcanic rocks, may be specified, and its character, whether heavy clay, loamy or light and sandy, may be specified. Comparisons of such soils are not readily made on paper, and it would be a useful proceeding if samples of the chief sugarcane soils of each province were collected and placed before the next meeting of the Board of Agriculture, under the direction of the Imperial Agricultural Chemist.

5. *Varieties of cane grown.*—There is at present no satisfactory basis for the classification of canes. The close similarity of all the varieties botanically, and the known alteration of the same canes when moved from one part of the country to another in habit and size, renders the subject especially difficult. Shades of colour are not constant, and these even change during the growth of the cane itself. Lastly, it is generally conceded that the richness of the juice must be included in any system of cane classification.

This renders a statement of the varieties grown in any province difficult. But in each tract there are differences well known to the cultivators both in the field and at the mill. A summary statement of the varieties met with and their native names will be the first step towards a regular survey of the canes of India, which is, from many points of view, a desirable piece of work.

Attention should be paid to the following main classes:—

Wild canes, that is to say, such as do not yield *gur*, but are used in medicine or for fodder.

Reed or grass canes, such as have proved themselves capable of resisting disease when neglected, hardy, bushy or small-growing canes, of poor sugar content and as such not especially sought after by wild animals.

Hardy field canes of good quality. This is usually the best class of cane for India. They have hard rinds and rich juice, yield heavily, and are not much attacked by jackals and wild cats. In many parts of the country they have, however, dwindled from lack of care, and are with difficulty distinguished from the previous class.

Canes for eating and jaggery canes. These have much juice, frequently of low sucrose content; they possess soft rinds, and are usually very delicate and liable to disease. They are great favourites for the production of jaggery or *gur*, but are not suited for the production of high grade sugars.

Giant canes. Generally of enormous size, but with poor juice. They are difficult to mill because of their thickness and have often to be split before crushing. The outturn from these canes is sometimes very great, and they would appear to be best suited to climates with comparatively heavy rainfall.

As to colour, the canes may be distinguished as the red canes, the ashy or dirty canes (greyish or brownish in tone), red striped canes (the red alternating with green or yellow), green striped canes where yellow and green alternate but with no red, and the various "white," yellow or green canes. The latter three are not distinguishable as a rule, but the prevailing colour should be noted.

Where a sugarcane classification has already been attempted, the details of such classification should be mentioned. There is no doubt that certain points of difference are of systematic importance while others are not, and the experience of workers in this field will be of the greatest value, whether these characters are of chemical or botanical nature, or as to their behaviour in the field or at the mill.

It would add greatly to the interest of the proposed meeting at Coimbatore if a collection of canes was brought from each province and placed side by side for comparison. Such canes should in all cases be as fresh as possible, each single cane being carefully wrapped in paddy straw rope. There should be at least half a dozen canes of each kind, and each variety should be carefully labelled and packed in a gunny bag. Care should also be taken to select average canes, and not exceptionally good ones.

It will be seen that the classification proposed for the purposes of the preliminary enquiry is neither botanical nor specific, but is regarded solely from the point of view of cultivation. The proposed preliminary grouping of canes may be imperfectly suited to the conditions of some provinces, which may demand a more detailed classification. A true botanical classification is, probably, a matter for a later stage of the enquiry.

6. *Recorded introduction of new varieties.*—The canes of many parts of India are of the poorest description. It is impossible now to determine where these canes came from, but they have probably been in the country for a very long time. It is certain that a constant interchange of varieties has been taking place ever since sugarcane was first cultivated. There are numerous traces of exotic canes in various parts of Bengal, Bombay and Madras, and detailed records exist of such introductions during the last hundred years. It would be well for these cases to be noted and at the same time to mention what changes have taken place in the character of the canes introduced. Some of them have evidently deteriorated greatly, while others have taken their places among the best canes of the country.

When we read of such results as 105 tons of stripped canes to the acre, as is recorded of the Rappoe in New South Wales, it is not unnatural to assume that such large yields are dependent on the kind of cane cultivated, and due attention is not always paid to the special conditions attending such abnormal crops. This has undoubtedly been the main reason for the various attempts at introducing foreign kinds. But the Indian climate has not been sufficiently considered, and past efforts have been more or less haphazard, on the chance of valuable results being obtained. There is no doubt that the introduction of exotic canes, methodically and persistently practised, with due regard to climatic conditions, is likely to lead to very valuable results, and a full statement of past experiments in this direction will be of value.

In the same way the export of known varieties to Java and other countries should be noted with, if possible, some remarks as to their ultimate fate.

7. *"Sports" and seedling canes.*—Allied to the introduction of new kinds of cane is the appearance, by sports or otherwise, of new canes in India itself.

The striped canes are known especially to lend themselves to the production of varieties of one colour. In the Godavari district of Madras, the ryots assert that if you plant a field with *Namalu* (a striped cane) it soon becomes half *Keti* (a green cane), and several new varieties have recently been obtained in this way at the Samalkota farm in the same district, differing markedly in the richness of their juice from the parents. While this "sporting" is rendered evident in the striped canes because of their colour, it probably also occurs in most canes grown, and it is quite possible that most varieties of the sugarcane have arisen in this way. Any instances known of such varieties arising locally should be carefully recorded. For some reason the fertility of the cane flowers or "arrow" is very low in India. Cases have, however, been recorded of fertile seed having been obtained and seedlings raised. Considering the immense importance which this line of work has attained in Java, the West Indies and some other countries, any information obtainable as to seedlings raised in India will be valuable, together with the probability of this method being feasible. It seems probable that the climate of the country is against any great development of this mode of raising new varieties.

8. *Other sources of sugar and spirit.*—Before proceeding to the detailed study of the sugarcane industry, it would be well if a summary were prepared of other sources of supply of sugar and spirit in the different provinces. Sugar is obtained from various palms, from the juices of trees such as the maple, from members of the grass tribe such as sorghum, and from roots such as beet, while spirit is obtained from the most diverse substances. The two chief plants other than sugarcane from which sugar is obtained in India are the date and the palmyra. Spirit is produced among other plants from the mahwa (*Bassia latifolia*). Considering the close connection between the sugar factory and the distillery, an enumeration of the sources of spirit should be included.

It will also be of interest if any experiments with beet and sorghum made in the past are recorded with the results obtained.

PART II
CULTIVATION.

9. *Planting and reaping seasons.*—The planting and reaping seasons and the time during which the cane is in the ground should be specified. This will very largely depend on the climate and the irrigation facilities. But the importance of reaping the canes at the correct time is perhaps hardly fully realised, and cannot be too strongly insisted on. The time during which the cane is in the ground varies from 6 to 18 months. This will obviously make a great difference in the yield obtained, and the enormous crops sometimes reported from different parts of the world largely depend on the possibility of keeping the cane growing for a long period without ripening off.

At the same time certain canes ripen more quickly than others, and it is unwise to try and grow a cane which ripens slowly in a place where irrigation is deficient. A knowledge of the ordinary seasons of cane growth is necessary before any attempts are made at introducing new and improved varieties.

It is usual to reap the canes in the earlier months of the year, this being the time when the air becomes dry and the rains cease. But in the Coimbatore district of the Madras Presidency, there are two distinct reaping and planting times—February and September. In other places the reaping times are determined by the labour required for other crops, and these and similar facts must be borne in mind when considering the possibility of any great extension in cultivation.

10. *Rotations and mixed cropping.*—The question of rotations is an important one. In many places the sugarcane alternates with wet paddy. This is especially the case in the irrigated delta lands and, although at present perhaps unavoidable, may be regarded as essentially bad practice. This also applies to the few cases of continuous cane-planting on the same land, excepting where an annual overflow of silt-laden water serves to recuperate the soil.

A statement of the chief rotations in the different portions of the province will be of interest, especially such as include a leguminous crop in the series.

The practice of green-dressing, or planting a pulse crop and digging it in before cane planting, is usually considered very good practice, although its value probably differs considerably in heavy delta lands and clay soils from those of lighter character.

Mixed cropping or the growing of catch crops with the cane should be noted. The cane shoots are at first quite unable to cover the ground and a quick-growing crop of maize, tobacco, onions, or pulse is not infrequently taken off during the first two or three months after planting. In lighter soils, such as the volcanic soils of St. Kitts in the West Indies, it is considered very good practice to bury pigeon peas (*Cajanus indicus*), castor or sweet potatoes thus planted, before they are ripe, the ground being covered during the hot, dry months, and the canes receiving a useful manure when they most need it.

Lastly, the fringes or outskirts of cane fields or the bunds separating the different plots in irrigated land are not infrequently sown with tur (*Cajanus indicus*), hemp (*Hibiscus cannabinus*) or okras (*Hibiscus esculentus*). Are any such crops planted for the protection of the cane crops, such as *Sesbania ægyptiaca* or sorghum? It has been suggested that the latter plants may serve as a useful trap for the moth-borer where it is prevalent.

11. *Ratoons.*—After the canes have been cut, the stools or "roots" are not infrequently allowed to grow for a second year. This practice of ratooning is carried on for many years in some places. In India it appears to be unusual and unprofitable to ratoon for more than one year, but cases are on record where the cane field is thus treated for as many as twenty years. As the practice has many advantages, it will be well to consider its practicability in each cane tract. The canes ripen earlier and the joints are closer together, thus rendering ratoons particularly suitable for cane seed.

On the other hand, there are certain dangers in the practice which should be carefully considered. The prevailing Indian sugarcane disease, the red smut, appears to be much worse in ratoons than in plant canes. Not only is the *outtura* rendered doubtful, but fields thus diseased are the worst possible for seed purposes. Without doubt the spread of this deadly disease has been largely fostered by the practice of using ratoons for seed.

12. *Preparation of the land for planting.*—It is of prime importance in cane cultivation to bring the lands as soon as possible into what is known as "good heart." This cannot usually be done where the rotation is one with wet paddy, this forming one of the chief objections to this kind of cultivation. The various operations having this end in view may be conveniently divided into those before and after planting the cane sets, and those referred to here deal exclusively with the manner of working up the soil. The main object in the earlier operations is to thoroughly clear the land, to ærate it and to render its condition such that the manures already in the soil or subsequently applied to the land are readily available. The later operations are largely intended to keep down weeds and to keep the surface tilth for the better conservation of moisture.

The actual mode of tillage, with the implements used, such as crowbarring, ploughing, the absence of either, puddling before ploughing and other methods in different kinds of land in each province should be mentioned.

Bare fallow is perhaps of special value in heavy lands and where the tillage is deep. In crowbarring the clods are large and heavy and need much weathering. Opinions as to the value of this practice in India are somewhat conflicting and the local practice will be of special interest.

Sheep and cattle folding, spreading compost, village manure or other substances before tillage may conveniently be considered here.

The after cultivation may be discussed at a later stage.

13. *Planting.*—There are a number of points to be considered under this head, and the whole growth of the cane will depend very largely on the manner in which planting is done. The matter is therefore of considerable interest, and fairly full details should be given as to the practice in vogue in different places.

14. *The source from which the seed is obtained.*—It is usual in most places, while the crop is being removed, to separate the "tops," consisting of the two uppermost joints with little or no sugar in them, and keep them for planting the next season's crop.

In some places this is done from first year's canes, in others ratoons are selected for the purpose. The latter practice has been referred to already and has this advantage that the crop can generally be planted earlier than otherwise.

Bringing sets from a distance has been frequently referred to in cane literature. This practice is carried out in Java on a very large scale, special plantations being set apart in the higher regions as nurseries for the fields in the plains. The object in Java is mainly to prevent the ravages of *serek*, a destructive cane disease, and ratoons are never used for seed. In the Godavari district sets for planting in the delta lands are frequently brought from the uplands, where the soil is lighter and the prevailing disease is less severe. The removal of canes from one part of the country to another cannot be generally adopted because of the expense, but a considerable mass of information is available as to the effect of this practice upon the character of the growth and especially on the richness of the juice. It would be useful if information on these heads in various cane tracts were recorded.

When the canes for seed are allowed to stand in the field for some months after the bulk of crop has been reaped, the practice should be recorded. These canes are called "Standovers" in the East Indies where the practice is not uncommon.

15. *The part of the cane used for planting.*—This again varies a good deal. There is no doubt that the practice of using the upper part of the cane for planting and the lower for milling is sound. But in many parts of the country the whole cane is cut up into sets and planted, only the lower rooting joints being rejected. The method should probably vary a good deal with the kind of cane grown, for, from experiments conducted at the Samalkota farm, it has been demonstrated that in certain canes, while the tops produce a good even stand of canes, beds planted from the whole cane cut up leave many gaps. In other varieties planted at the same time and on similar land, any part of the cane can be used with impunity. The laying of the whole cane in shallow trenches is reported from certain districts.

The mode of preparing the sets and the part of the cane used is of some importance when considering the future action of Government farms in

distributing seed of new and improved kinds of cane. If tops alone are to be used, the rate of introduction of the new kinds will be extremely slow.

16. *The actual preparation of the sets for planting.*—The number of joints in a set should be specified and the general mode of preparation. It is the practice in careful cultivation to pickle the sets in various solutions before planting. This is usually done on account of definite diseases which may be passed from parent to child. The indiscriminate soaking of sets in various solutions is therefore not necessary, but any action will depend on the disease to be guarded against. The following cases may be mentioned in illustration of this.

Where white ants are a serious menace to the newly planted cane, various infusions are recommended to render the sets unpalatable. The same has been done with regard to jackals which dig up the pieces at night immediately after planting. Where the moth-borer is a serious pest, the soaking of the canes in strong lime solution has been found useful. Where acari or mites (causing one of the diseases called "rust") are abundant, carbolic acid is said to be a useful preventative. Where, as in the West Indies and Java, the sets are attacked by certain fungus diseases, the use of copper sulphate and tar is recommended. Any instances of such action in the provinces will be worth recording.

17. *The number of sets per acre.*—This is a matter requiring some attention, as without doubt improvements may be made in some cases. The rate of planting may vary anywhere between 4,000 and 50,000 per acre. It is obvious that this large number not only increases the cost of cultivation to a considerable extent and renders the introduction of new varieties more difficult, but the chances of carefully selecting good seed are greatly diminished, if not rendered impossible. As a rule the tillering power of canes in India is far inferior to that in tropical islands where irrigation is unknown. More plants are, therefore, required to the acre. At the same time the planting of a very large number of sets with the object of "somehow" getting a crop tends to carelessness in the early treatment of the canes, and a bad start is hardly ever fully recovered during the subsequent growth.

18. *The mode of planting.*—Planting is done in pits or trenches, in rows or broadcast, in dry ground or in puddle. It depends greatly on the nature of the soil and its capacity for retaining moisture and on the weather at the time of planting. The cane usually takes about one year to mature, and this regulates the time of planting. Reaping and planting must usually proceed at about the same time of year. This, in most parts is in the hot dry months, and as a natural consequence the depth at which the sets are placed is a somewhat important matter. The young plant, with the small amount of nutrition available in the set, is very delicate, and specially liable to withering, if not planted deep enough. On the other hand, deep-planting cannot be successfully introduced in most cases, in heavy land because the power of germination is impaired, and in lighter soils because of the white ants. Considering the great mortality in newly planted cane fields, the exact depth should be carefully gauged.

Broadcasting is not infrequent, but it is obvious that the proper distances of the plants from one another cannot thus be well regulated and also that all the subsequent operations of weeding, hosing and wrapping are rendered more difficult and costly. Planting in pits is not usual in India. It is of special significance in rain-fed plantations where it is important to conserve the rain for as long a period as possible. The distance of the rows apart is worthy of consideration but will depend to some extent on the number of sets per acre. The best practice aims at placing the canes as equidistant as possible.

19. *Supplying vacancies.*—It is very important in planting a cane field to obtain a perfectly even stand, where each plant has the maximum of surrounding earth to draw upon for its nutrition. This is not obtainable by the excessive planting of the native. The more careful cultivators recognize this fact and in many parts of the country special arrangements are made for supplying any vacancies detected when the germination has taken place.

In some cases a supply of extra sets is kept in pits, and these are planted when the vacancies declare themselves. In other cases small strips or

outskirts are thickly planted and the young plants are removed from these to fill the gaps. The latter practice appears to be preferable. The time elapsing between the general planting and the date of supplying should be carefully noted and recorded. It appears that if supplying is delayed too long, the plants thus added have not time to establish themselves before they are overshadowed, and in fact never come up with the main crop. In the neighbourhood of Coimbatore the extra plants are added within a month or at latest six weeks from the time of planting.

The matter of keeping out canes for some time before planting invites attention, and the local practices are worth recording. This "hatching," as it has been called is necessary sometimes, both in the fields of the cultivators when the land is not quite ready and on Government farms where canes are received from a distance. It would be a useful thing to determine how long they can be kept after cutting without losing their vitality and what are the best methods for thus keeping them in the different provinces.

20. *Seed-bed and nursery.*—In some districts, as in that of Ganjam in Madras, it is the custom to lay the sets thickly in seed-beds (much like paddy seed-beds) and, later on to transplant them to the fields. This curious practice has probably arisen because of the short period during which water is available or because of doubt as to when it will arrive in the channels. The practice is of especial importance where water is abundant for the greater part of the year, but cannot be obtained just when the canes must be cut and the sets planted for the succeeding crop.

The seed-bed may be made to serve for ten to fifteen times its area in the field. It may be placed under a well, and as a matter of fact, is usually located near the village on the specially rich fields to be met with in such localities. Details of any such system in India will be of interest.

21. *Stool planting.*—The old roots of the cane have usually to be removed at some expense after reaping, in order to prepare the land for the next crop in the series. The splitting and planting of such roots or stools entails comparatively little additional expense and has its advantages. The fields thus planted need no supplies and are perfectly filled when planted at the rate of 5,000 to the acre. The resulting canes appear to be very healthy and assume a character midway between plant canes and ratoons. It will be interesting to know if this system has been adopted anywhere by the local cultivators. It is of special usefulness when it is desired to multiply rapidly any particularly valuable variety for distribution. The crop raised appears to be perfectly healthy and in this respect shows a marked contrast to ratoons.

It may be pointed out that, both in this system and in the planting from nursery beds, a means may be found of combating the white ants which will less readily attack living plants but devour the cane sets with the greatest avidity.

22. *Irrigation and drainage.*—It is well, before considering the watering of the cane, to refer again to the great difference between the climate of India and that of most sugar-growing countries. In India the bulk of the rain falls during some four months, and the severe drought following renders irrigation a necessity. In most other countries where the cane is grown, irrigation is unknown and a well distributed rainfall brings the cane to perfection.

The great mass of rain falling during the wet period in India emphasises the importance of thorough drainage of the land, and the subsequent drought brings into special prominence the after-cultivation of the soil for the purpose of retaining the moisture.

For large crops and intensive cultivation irrigation may be considered a necessity in India. But it varies much in character, and a statement of the different means adopted will be of interest.

In certain tracts the crop is purely rain-fed and the resulting crops are meagre; in other places advantage is taken of river and spring channels; wells are used over large areas where the subsoil water is easily accessible; excellent canes are grown under tanks; but for the production of sugarcane on a large scale irrigation canals are usually needed.

A statement of the season of the year during which the water is available will be of interest, for it should be possible in many places to supplement

the natural supply by pumping the sub-soil water with the aid of oil-engines. Undoubtedly there are many areas where the sub-soil water could be thus made use of, but where the expense of lifting the water by the native methods is too great.

In certain parts of India canes are grown which seem able to endure prolonged submersion. These are probably of little value from a sugar-making point of view, but the fact should be noted, as it is of interest, and enquiries on the subject are frequent.

23. *Cultivation*.—The after-cultivation of the cane fields has for its object the destruction of weeds, the retention of soil moisture and the protection of soil bacteria.

It is usually of short duration, for the canes quickly cover the ground and form a mulch of decaying leaves which answers these purposes. Where the cane has once covered the ground, it quickly becomes impossible to enter the fields. Where however "wrapping" is done, cultivation may continue throughout the life of the plants. Generally speaking, it is of advantage to the growth of the canes to continue the cultivation as long as possible, but as to whether it pays beyond a certain point remains to be decided.

A statement of the number of hoeings and weedings considered necessary in different places should be made, together with the implements used. The two operations mentioned may, for the purposes of this note, be separately considered, that of weeding being much deeper and more thorough, while the chief object of hoeing is to break up the cake on the surface after rain or irrigation and thus prevent undue evaporation.

The use of improved cultivators should certainly receive very careful attention and any cases of their successful introduction into India might be noted, as probably of far greater efficiency and economy than the current native methods.

Native expedients for the prevention of evaporation, such as laying a mulch of grass on the land, should be carefully noted, as well as any other matters connected with the use of water and its retention in the soil, although this should if possible be considered under the previous heading.

24. *Manuring*.—Next to the preparation of the land and the supply of water, manuring is the most important operation in the intensive cultivation of the sugarcane. Perhaps in no respect does the practice of the country vary more.

The manuring before planting has been mentioned under the preparation of the land and may be conveniently considered there, but, inasmuch as it has an influence on the later applications, it will be necessary to refer to it here as well in any carefully considered system.

The two materials regarded as essential in the most advanced sugar-growing countries are a good supply of well-rotted cattle manure and artificial fertilisers. Neither of these sources of manuring is available in the desired quantity in India at present. The existing practices will, therefore, form a specially interesting subject for study and the possibility of their improvement a useful field for experiment. A statement of the results of experiments thus far made will be of value. It is needless to point out that artificial manures are of little value where the land is not in good condition, and this is specially applicable to heavy delta lands.

Various oil-cakes are used in different parts of the country, and the advisability of combining the growth of oil-yielding seeds with sugarcane is obvious. A statement of the available supply of oil-cake in the different sugarcane tracts, its cost and comparative richness in nitrogen, should be prepared.

The time and mode of application of the manures should be studied. While most artificial fertilisers may be applied as soon as growth is established, the addition of nitrogenous manures should probably occur later. The practice in the Godavari delta is to apply oil-cake when the canes are four months old and there is an abundant supply of water in the canals.

It will be useful to consider here the practice of burning the trash or dead leaves after cutting the canes. This is frequently done, even where this material is not used for boiling the juice. When we consider that every ounce

of this valuable material is dug into the soil in the West Indies, it will be interesting to know if this practice is ever adopted in India.

The application of green-dressing after planting has already been considered. In many parts considerable sums of money are spent in bringing cart-loads of wild indigo (*Tephrosia purpurea*) and laying it at the roots of cane. Instances of this practice with wild indigo or other plants might be mentioned here.

Curious local superstitions are frequently met with regarding the cultivation of Indian crops. These should be noted wherever possible. With regard to the application of manure to cane fields, cattle manure not well rotted is said to increase the quantity of treacle in the *gur*, while the addition of nim-*cake* is said to make the jaggery bitter. These local superstitions should be investigated if only to expose their fallacy. But more often there is some grain of truth which should be carefully sought for.

A brief statement should be appended as to what results of value have been definitely obtained by the many manurial experiments with sugarcane conducted in the country by agricultural departments.

25. *Treatment of the canes during growth.*—This will vary a good deal in different parts, in most places nothing whatever being done to the canes themselves. Wherever any special treatment is resorted to the fact should be mentioned.

Trashing, or the stripping of the canes of their old leaves, is supposed to let in light and air and to quicken the ripening of the canes. It is of doubtful advantage, excepting in moist, waterlogged situations. It is thought to render the canes more liable to diseases and undoubtedly exposes them to the attacks of wild animals.

Wrapping or tying the old leaves round the cane and to one another probably delays ripening, but also protects the canes from sunburn and cracking. The attacks of wild animals are diminished, and the canes are supported and prevented from lodging. The use of bamboos is perhaps advisable in heavy crops, and is rendered possible by wrapping the older leaves being tied to one another and to a central bamboo. This operation, while most useful in places where sudden wind storms arise, is costly and is perhaps sometimes carried to an extreme. As many as 5,000 bamboos per acre are not infrequently used in the Godavari district. Some modification of the practice will probably be found useful in most cane-growing areas, whether for straightening the cane and rendering it easier to manipulate, for protection or for support. Local modifications of the practice will, therefore, be of general interest.

The protection of the canes from jackals, although probably belonging to the next section, may be conveniently considered here. The matter is of considerable importance, and a careful study should be made of the native methods of dealing with this and kindred pests.

Many kinds of cane, in themselves valuable, are out of the question for general cultivation because of their liability to the attacks of jackals, pigs and wild cats. The first essential from this point of view in a field-cane is the possession of a hard rind. Wrapping has been referred to as a useful protection. In some places the mud is splashed from the irrigation channels over the lower leaves, which renders the canes distasteful to the jackals. Fencing of various kinds, sometimes at great cost, is resorted to keep down the pest, but once the jackals get inside, it rather tends to aggravate the evil. Traps of various kinds are used. Perhaps the best form is a simple pan of jaggery water of which they are excessively fond placed near their regular run. The jackals will come in numbers to this and may be easily killed. The usual beating of drums in cane fields towards harvest time is less useful than generally supposed. One of the greatest advantages of wrapping the canes is that you can at once detect the presence or ravages of animals by looking down the lines. Lastly, the planting of harder kinds outside the fields is sometimes resorted to with very doubtful results. The local practices in such matters frequently afford valuable hints as to ultimate successful treatment, and should be carefully recorded.

26. *Treatment of the fields preparatory to reaping the canes.*—Before cutting the canes, it is not unusual among the native cultivators to irrigate

profusely in order to increase the quantity of jaggery or *gur*. In other cases, where the water is deficient and the canes are judged to be ready for harvesting, they are allowed to stand in the field for a considerable time without watering.

Any facts throwing light on these practices will be of use. It is thought by some that before reaping, all water should be rigidly cut off so as to increase the richness of the juice and decrease the cost of fuel. The local practice among the native cultivators or in connection with European mills would be worth recording.

27. *Disease phenomena*.—These are of special importance in the sugarcane because of the comparatively great cost of its cultivation. The mature cane may be likened to a fruit. It is filled with rich, sweet juice of a kind eagerly sought after by all the animal kingdom, while many fungi of feeble power of parasitism multiply rapidly in solutions of cane juice. Destruction thus frequently occurs at the end of the season and after all the expenses have been incurred with the prospect of an abundant harvest.

Of the numerous pests and diseases to which the sugarcane is liable, perhaps the most serious in India are the red smut, white ants, moth-borer and jackals. Many other diseases of wide occurrence become locally important, and lists of the chief ones in the different sugarcane tracts with their native names will be of interest. Such diseases and pests may be roughly classified as follows.

28. *Diseases affecting the sets after planting*.—Such is the "pine-apple" disease of Java and the West Indies, caused by the inroads of a fungus, where the sets acquire a distinct smell of the fruit named and fail to germinate. White ants frequently destroy the sets in lighter soils before they have time to germinate. Jackals collect in packs at night and dig up the newly planted pieces of cane. While sets taken from plants heavily attacked by red smut often fail to grow at all.

29. *Diseases affecting the whole plant*.—Foremost among these are the various forms of arrested growth. It is not always easy to determine their cause. The most deadly cane disease of modern times, the *serek* of Java belongs to this class and there is some ground for believing that it occurs sporadically in India. The whole plant assumes the character of a bush of lemon-grass (*Andropogon schænanthus*) and no cane is formed even after a year's growth. Sometimes one or two canes are formed, while the rest of the plant grows like a tuft of grass. A similar form of growth has been attributed in the West Indies to a definite mushroom growing on the cane roots. Another disease is the black smut (*Ustilago sacchari*) where the whole end of the shoot becomes a black powdery mass. And, lastly, the moth-borer eats the young apices, causing each in turn to die and the whole plant to assume a stunted, withered appearance.

30. *Diseases confined to the underground parts of cane plants*.—Besides those mentioned in the last paragraph, numerous grubs are to be found attacking the roots and underground stems of the cane. These usually belong to various classes of beetles. White ants are of course specially destructive in this part of the cane. Different species of flowering plants attach their roots to those of the cane and absorb their nutriment from these (such are *Striga* and similar *scrophulariaceæ*.)

31. *Diseases affecting the stems*.—These are perhaps most serious. The red smut is distributed throughout the tropics and is perhaps a peculiarly Indian disease, occurring disastrously wherever the land is insufficiently drained. Borers in the cane do great damage, not only causing the canes to break up but affording an easy entrance to other enemies, notably the fungus pests. Mealy bugs can by no means be neglected, although their presence is connected rather with the spoiling of the juice in milling. Gumming is possibly present, but has not as yet forced itself on our attention in this country. Finally, jackals are universally feared and should everywhere be guarded against.

32. *Diseases affecting the leaves*.—In numbers the leaf diseases of the cane exceed all the rest put together. Numerous fungi are found causing blotches, rotting or withering. Insects of the most various orders are to be found attacking the leaves by piercing or sucking or wholesale eating. Rusts caused by mites are also by no means uncommon.

Some of these diseases are comparatively harmless. Others are the direct result of careless cultivation. But there are some which are difficult to deal with, and these should receive the greatest attention in the selection of the kinds of cane grown. There is little doubt that, while no cane can be considered immune from disease, different kinds vary greatly in their liability to attack. Care should, therefore, be taken in fresh introductions that no cane should be brought into a climate unsuited to it or from a region permeated by disease.

33. *Reaping. Time of cutting the canes.*—No general rule can be laid down as to the correct time at which the canes should be cut. It is largely a matter of expert knowledge. Most native growers know pretty well when the canes are ready for the mill and there are tests which can be readily applied by anyone having a knowledge of canes in the field.

A statement of the local knowledge of cane-ripening would be interesting and how far this is utilised and how far neglected and for what reasons.

The exact date of reaping is largely influenced by local superstitions and the labour available. Sugercane is, in many places, a minor crop and the ryots are frequently busy in other directions at harvest time. In places where it is the main crop, on the other hand, the labour is often insufficient. The milling power of the district is also sometimes inadequate to deal with the crop to the best advantage.

The cutting of canes at the wrong time is, by no means, a fault peculiar to native cultivators. It is perhaps one of the most important matters connected with the economical working of a large factory that the machinery should be kept in continuous working and that the reaping season should be spread over as long a period as possible. A carefully thought out system of planting may get over the difficulty to a certain extent but not altogether. Of necessity some of the canes are cut before they are fully ripe, while others are left for some time after they have reached their optimum. This is a matter for very careful consideration in framing estimates of the outturn. The adjustment of field and factory is a problem of some difficulty, and this perhaps accounts for the fact that excellence of manufacture and first class cultivation are so rarely combined in sugar-growing countries.

34. *Deterioration after cutting.*—After the canes are cut they rapidly deteriorate. This is caused by change from cane sugar to grape sugar, usually called "inversion." The distance of the canes from the mills thus becomes a matter of importance.

Delay in milling the canes is of comparatively little moment in the manufacture of jaggery, but it is of much more importance in sugar-making, and especially when we have to deal with a large steam plant. There are obvious difficulties in getting the canes cut on the exact date suited to the mill, and this is more particularly the case where cultivation and manufacture are in different hands. It is by no means unusual for canes to lie in the yard for days before they are dealt with. The probability of this delay and deterioration should be carefully considered when entering into calculations for any large new undertaking.

We should naturally suppose that this inversion in the cane after cutting would be greater in the hot Indian climate than elsewhere. But this has not been proved, and any facts bearing on the subject would be of interest.

35. *Mode of cutting the canes.*—It is important that the canes should be cut as low down as possible, if anything a little below the ground. Is this attended to? It is not likely that any cane-cutting machine will succeed, partly because of intrinsic difficulties and also because of the great weight of the material to be dealt with. If any experiments have been made in this direction they should be mentioned.

Where wrapping is in vogue, cutting the canes is comparatively easy; they are clean and straight and very easy to pass through the mill. The removal of the leaves used in wrapping is however an additional operation. Where the canes are allowed to grow naturally, it is not uncommon in a good field for two cuttings to be necessary, the first one about three feet from the ground and then at the base. The tops are removed either before or after reaping. The local practice will vary with the size of the plants and the denseness or growth, and should be stated.

36. *Yield per acre in canes.*—This is not usually calculated by native cultivators. But there are numerous "crop experiments" recorded from which some idea can be obtained for each district. This is an important item in the profit and loss account, especially where improved mills are erected, and information on the point is needed. The weight should be recorded in pounds.

PART III.

MANUFACTURE.

Manufacture of jaggery or gur.—This is the main form in which the produce of the cane fields is placed upon the Indian market, and it will be convenient to treat it separately. Jaggery is usually stated by manufacturers to be unsuited for economical sugar-making, and the markets for the two substances are to all intents and purposes distinct.

A general account should be given of the methods in vogue among the native jaggery makers, and in suggesting improvements in its manufacture, it is advisable to consider the effect of these upon the price paid for the jaggery in the local market.

What mills are used? Have there been any recent improvements which have been largely adopted? A statement of the expression obtained from various mills should be given, but note should be taken of the fact that this will vary with the kind of cane and the mode of removal of the "tops."

In describing the treatment of the juice before boiling, mention should be made of the kind of pots used and their distribution, and the time elapsing between crushing and boiling. Is the juice strained at the mill or when it is poured in to the pans? Are collecting pans used or are the pots allowed to stand until there is sufficient juice to fill the pan? Is the collecting pan heated?

What pans are used? Are they single or in batteries and how are they heated? A statement of the fuel and its preparation would be of interest. In most regions it is found that the megas or residue from the mill and the trash or dead leaves are sufficient for the boiling of the juice. A start has sometimes to be made with other fuel. How far do these substances suffice for the boiling? It is obvious that this will depend on the relative quantity of juice and fibre in the cane. There can be little doubt that such light material is eminently suitable for the rapid boiling and shallow open pans. Is any wood used? Is the whole of the trash used up? This is an important question because of the value of this substance as manure.

Is the scum removed, and if so, what is done with it? Are there any native methods of clearing the juice by the addition of foreign substances?

To what extent is liming carried, firstly in treating the pots used for holding the juice, and, secondly, in preventing inversion in boiling? Is this liming fully done? Usually it is very incomplete because it detracts from the value of the jaggery in the local market. At the same time incomplete liming is the main cause of the unsuitability of *gur* for refining purposes.

What method is adopted for marking the correct point at which boiling should cease? Are cooling pans used? Into what form of receptacle is the boiled mass thrown and what is the resulting form as placed upon the market? Are any processes known for preserving the jaggery, or has it to be sold at once?

What is the average price obtained for good *gur*? There are fluctuations of some magnitude in the bazaar prices, dependent on the difficulty in keeping, on local festivals and so forth. A consideration of these largely influences the native practice and calculations and sometimes makes considerable difference in the profits obtained. Is the *gur* manufactured sufficient for the local demand, and if in excess or defect what local movements are there of this substance? Is *gur* made for the foreign market, and if so, are any special precautions taken in its manufacture? Lastly, what are the relations between jaggery made from the sugarcane and that obtained from other sources?

38. *Profit and loss on sugarcane cultivation.*—A brief statement of the cost of sugarcane cultivation in different parts of the province should be made and the average profits obtained by the cultivator.

Such statements have frequently been drawn up, but, for various reasons, they are not of much value. One of most weight is that it is almost impossible to state the real value of the labour employed. A special account should therefore be drawn up as to the usual best practice of the district, from the preparation of the land and the purchase of the seed to the placing of the finished product on the market. And where the cane roots have to be removed to prepare the ground for the next crop, this item of expense should be included in the account. It is well known locally how many men are needed for each and every operation. This should be recorded and their pay calculated at the current rate for that class of work. The outturn should similarly be calculated from a good average crop of the district. Thus only can we form an idea of the real cost of cultivation and the profits derived therefrom. It is certain that if any great extension or improvement were to take place, the labour would have to be paid for in this manner.

The sugarcane industry is usually considered to be one of the most profitable in India, and in many places it is regarded as a sign of increasing wealth for a ryot to embark on its cultivation. But the statements of profit and loss available vary in the most extraordinary manner, even in the same locality, from a dead loss in some parts of the country to a clear profit of several hundreds of rupees per acre in others. It would be well to insist on some common basis of valuation such as that mentioned above.

39. *Character and richness of the juice.*—It is frequently asserted in the "trade" that for sugar-making the native jaggery is of insufficient purity to ensure profitable working, that obtained from palms being in many ways preferable to that of the cane. This is, of course, partly due to the character of the cane grown. Varieties, which will satisfy native demands, are not the best for sugar-making. The native jaggery canes have frequently much juice of inferior sucrose content.

It becomes necessary, therefore, for analyses to be made of the existing local canes in different parts. This has already been done to a considerable extent, although the analyses are not always comparable because of differences in ripeness at the time of crushing. Existing analyses should be carefully collected. A general idea of the richness of the juice of canes in the various provinces can thus be obtained.

The known inferiority in the canes of certain tracts may be due to inherent poverty, to the climate or soil or to their recent introduction. These points should be held in view, and special attention paid to the alleged deterioration of introduced kinds. This again may be due to unsuitability of soil or climate for their growth and maturing or to the mere fact of the change. In the latter case a subsequent change for the better has been noted in certain canes.

In judging the comparative richness of the juice it would be well to fix upon some standard method of expressing the results. This has not hitherto been attended to, and the analyses of Indian canes are not easy to compare with those of the canes of most other countries, at any rate in terms readily understood by the majority of those interested in their cultivation.

The following are the main points of importance in the analysis of sugar-canes :—The quantity of juice in the cane and the percentage of sucrose and glucose, organic matter other than sugar and mineral matter, in this juice. A good cane in the West Indies will give juice with 81 per cent. of water, 17.5 per cent. of sucrose, not more than 5 per cent. of glucose and 1 per cent. of other organic substances and mineral matter. It has been ascertained that many of the Indian canes have juice as good in quality as this, but when they are not up to this standard the matter should receive very careful attention and the causes should be ascertained.

40. *Sugar-making.*—Besides the jaggery or *gur* referred to above, a great deal of what may be called sugar is also prepared by the natives of India. An examination of the processes of manufacture employed and character of the sugar produced should be made. But a detailed study of this part of the subject (which is extremely complicated) is perhaps of less importance, because in this field of work the native methods are generally wasteful and cannot compete with the improved machinery of other countries. The study of native methods of refining is perhaps more useful as indicating what demand there is for a better product than jaggery and whether any change is taking place in the

native taste. Every effort should be made to encourage such a change, for the production of sugar on a large scale for the local market in place of *gur* would pave the way for India to become a large sugar-producing country, and the question of export would naturally follow.

The nature of the native refined or partially refined sugars should be noted and the processes for getting rid of the molasses and other impurities. The subject is far too intricate to be fully dealt with in this summary, but some idea may be obtained as to the class of information required by a reference to the article on "Saccharum" in Watt's Dictionary of Economic Products and the publications of the Department of Agriculture in the United Provinces. In the latter it will be noted that the question of the profitability of the various methods is exhaustively dealt with. This is an important aspect of the case, from the comparison of the improved plants there suggested with those of modern factories, it is quite possible that something between the two may be found most suitable in the present Indian conditions.

It will be well to note the relative price paid for *gur* and the different qualities of sugar in the local bazaar, and especially the trade movements of these products in the different parts of the province. There will be considerable difficulty in altering the local market to suit the purposes of the projectors of factories. The native cultivator will, obviously, dispose of his canes so as to obtain the best return for his labour. At present he has, in most parts of the country, a sufficient local market for his jaggery. He thoroughly understands its manufacture, has his mills and cattle and employs a large body of labour. Besides this, there is the known power of his conservatism, and, even in its absence, there is the inertia which naturally sets its face against any change. Very distinct advantages must, therefore, be offered at the beginning before any such change as that here suggested can take place, and the most complete system of agencies will probably have to be planned to demonstrate the advantages of the new product and to ensure its punctual supply.

In considering the establishment of modern machinery in the country, it must be determined, as far as possible, what price the ryot will be willing to accept for his canes placed at the factory door, and what price the factor will be able to pay for the canes of the locality in order successfully to run his mill. At present there is little doubt that it is more profitable in the majority of cases for the cultivator to produce the time-honoured jaggery.

Factories with improved machinery have been built in India for many years. Most of these have, it is true, failed, but it is chiefly in this direction that any real advance in the industry as a whole should be looked for. It will be of interest to record the past history of such experiments. Have any factories been started in the province? Which of these have ceased to exist and what has been the cause of their failure? What factories are there at present working and what are the chances of success? How far is such success dependent on the making of spirit and what likelihood is there of successful companies being started without the aid of this allied industry? The whole question will be greatly complicated if it is found that any improvement in the sugarcane industry is inseparably connected with the manufacture of spirit.

A carefully compiled statement of the capital and working expenses of installations of different capacity is much needed. A brief description of the "plant" used in existing factories will be of interest together with the cost of erection and upkeep, the classes of sugar at present turned out, the capacity of the mills and the period during which they must be worked to ensure success, together with the amount of local material available.

Which of these factories deal directly with the cane and which are dependent on jaggery wholly or in part for their raw materials? Are there any or have there been any imports of raw sugar for refining from Java or Mauritius or other parts of India? What factories depend for their raw material on sources other than the sugarcane?

However long the period of cane-crushing may last, the mills cannot be kept fully working for a very long time. Are there any subsidiary industries which can be added to that of the production of raw or refined sugars?

A brief statement should be made of the state of the import trade. Every year a large quantity of sugar is introduced into India from abroad, both from beet growing countries, such as Austria and Germany and from cane-growing countries, such as Mauritius and Java. The conditions regulating this import trade are not clearly understood, and it will be of interest to trace the course of such sugars to their place of consumption. It may be thus possible to determine how far they may be replaced by sugars refined by superior plants in the country itself. The cost of transport will play an important part in such considerations.

Much of this imported sugar is made from the beet. An interesting series of experiments has been made by the Government of India during recent years in the form of protecting the indigenous sugar industry from bounty-fed beet sugar, and the results of these experiments have been eagerly followed all over the country. Sufficient time has perhaps elapsed for definite conclusions to be drawn. Hitherto considerable divergence of opinion has been evident. A brief statement showing the extent of importations of foreign sugars during recent years would be of interest. What influence was exercised upon this import by the restrictions placed on sugar favoured by bounties whether direct or indirect, and what has been the result of the total abolition of bounties by the Brussels Convention? One of the main difficulties regarding the installation of improved "plant" is uncertainty as to the future of the sugar market and any information throwing light on this difficult subject will be of the greatest value.

The question as to whether India is capable of entering the markets of the world and developing a large export trade in sugar cannot at present be entered upon. If we are unable to keep out foreign sugars coming from distant countries, it is idle to dream of competing with those sugars in the great European markets. On the other hand, India has definite advantages, such as its cheap labour and abundant irrigation, and it is not easy to understand the lack of success hitherto experienced.

It will greatly facilitate the discussion of the different classes of jaggery or *gur* and sugar, raw and refined, if samples are brought to the next meeting of the Agricultural Board. These should be as uniform as possible, and might be collected under instructions from the Imperial Agricultural Chemist. Such a collection should include sugars and jaggeries made from plants other than sugarcane and also samples of the imported sugars obtained from the local bazaars.

PART IV.

IMPROVEMENTS.

41. On considering the question carefully, it will probably be found that the lines, along which improvement is most likely to take place, will be different in the different provinces. It will be useful if the particular needs of each province are clearly set forth, so that the experience gained elsewhere may be rendered available.

Improvements may be effected in the following directions:—

Introduction of new varieties of canes, those of many tracts being admittedly inferior. This will require some care, but the dangers have already been sufficiently indicated.

More careful attention to the details of cultivation. Sugarcane is an expensive crop and readily responds to careful cultivation and manuring. The procedure in many parts is of the crudest description. In most places alteration for the better means considerable outlay of capital, and the economy of intensive cultivation is doubtful in some of these.

Increased facilities for irrigation. This is a large question. Deficiency of water may be to some extent met by the raising of early ripening canes. There is no doubt that in many parts of India there are large stores of underground water at moderate depth which are at present out of the reach of the ryot, but may be raised at small cost by pumps worked by oil-engines.

Improvements in the manufacture of jaggery or *gur*. The purpose for which such jaggery is designed must be held in view. A taste for a better

product might be fostered, so that sugar could be prepared on a large scale for the local market and a profitable raw material be made available for refining.

The introduction of small plants for sugar-making. There are many difficulties in the way of the successful introduction of large up-to-date factories, and in many parts of the country a better result is likely to be obtained at present by the installation of numerous small factories dealing with 100 to 200 acres than of those requiring as many thousands to keep them profitably employed. The risk of failure would be proportionately diminished in the smaller concerns. On the other hand, in some places, where the land is available, successful sugar-making can only be carried out by the largest factories with the best modern machinery. A statement of the class of factory needed in each tract would be of use.

The question of refineries should be considered, and whether it is more profitable for one factory to pass the cane through all its stages or for refineries to work up the material of numerous smaller concerns. Here, as elsewhere, the question of transport is likely to be a predominant factor. A suitable market for molasses should be obtained, whether as food for cattle, for use in tobacco curing or the distillation of spirit.

The question as to whether and how far Government aid could be justifiably employed might be considered. This aid could be given in the establishment of gardens for the production of better classes of cane or for series of manurial experiments on a large scale. Small Government factories might be opened for demonstration purposes or, perhaps better, subventions might be given to private concerns worked under Government advice. In considering this question special reference should be made to past action, both private and official, and the results obtained.

Before launching on the latter action, however, a thorough study should be made of the local markets, the internal movements of the various classes of sugar in India and the recent attempts by foreign makers to capture the trade.

Some difficulties in sugarcane experiments.

The difficulties of carrying out all field experiments are well known. With ordinary crops, like the cereals for example, in which the produce of seed and straw can be weighed without much trouble, fairly reliable results can be obtained, provided all due care is taken. In the case of sugarcane, however, the matter is by no means so simple. Here the crop must be passed through the mill and the juice must be manufactured into sugar before the results of an experiment can be known. It is proposed in the present note to draw attention to some of the difficulties which beset those concerned with field experiments designed for the improvement of the sugarcane.

One of the first difficulties encountered is the sampling of a plot of sugarcane, especially where numerous small plots have to be dealt with. It is not always possible to reap and turn each plot into sugar separately. The usual practice in such cases is the following:—The plot is cut, the total weight of canes determined and a sample (say 100 lb.) is selected by some mechanical method and crushed in a small mill. The juice is then analysed with the polariscope. A calculation is now made by which the result is given in tons of sugar per acre. This method is not without its disadvantages, as will be evident when it is remembered that the weight of canes per acre is anything between 20,000 and 100,000 lb. Any error, therefore, in selecting a sample of 100 lb. will be multiplied by a factor varying from 200 to 1,000, when the results are expressed in tons of sugar per acre.

That unreliable and misleading results are obtained when canes are grown in small plots, and when the produce has not been made into sugar, has been clearly proved by Harrison* in British Guiana, who states: "No trustworthy way has yet been found to get the returns of plot experiments to conform with the results of field cultivation. We have often had results from plots that were simply astonishing. On paper a cane might yield six tons to the acre and yet we know well that tried on a larger scale the yield would only be about $1\frac{1}{2}$ tons.

* Harrison.—"Sugarcane Experiments at British Guiana"—*International Sugar Journal*, Volume 6, page 173, 1908.

Apart from the tonnage of canes, there are many points that can only be settled by experiments on a large scale. The defective milling qualities and the deficiency of megass of some varieties cannot be discovered on small plots. For decision as to the economic value of a new variety of sugarcane, it is essential that results be recorded as on canes grown on estates' scale and treated under factory conditions. We have in British Guiana at the present time (1902) 27,000 acres under strict chemical control as perfect as exists in any part of the world. At all the plantations, experiments with seedling and other varieties are being carried on as a continuation of the experiments with varieties begun in small plots in the Botanic Gardens, and after careful selection, gradually extended to larger areas." It is interesting to compare the results calculated from the juice of small samples of the plots grown at the Botanical Gardens, British Guiana, with those obtained where the varieties were planted on a large scale on the estates and actually made into sugar. Some of these results are given in the following table:—

Number of canes.	625		145		B 147		78		74	
	Estates.	Botanical gardens.	Estates.	Botanical gardens.	Estates.	Botanical gardens.	Estates.	Botanical gardens.	Estates.	Botanical gardens.
Tons of sucrose in the juice per acre.	3.50	5.05	2.48	4.94	2.40	5.64	1.70	2.63	2.18	4.28

It will be seen from these figures that the results calculated from samples taken from the small plots are in many cases nearly twice those obtained from large plots where the canes were actually made into sugar. It is clear, therefore, that before a new cane can be recommended to the cultivators or to planters trials on a fairly large scale must be undertaken and the crop must be manufactured into sugar.

There must be some reason why a sample from a plot does not actually represent the crop of canes. *Do the individual plants of the same variety vary as sugar producers and do the canes of each stool vary in the same manner?* If they do, then we have at once one reason why a sample gives such misleading results. The recent researches of Kobus* in Java have shown that there is considerable variation in the same variety of sugarcane. It was found that well developed canes of equal age from the same plant show great differences in sugar-content, e.g.—

	Sugar content per cent.
Mother stalk	9.2
Principal side shoot	13.5
Ditto	12.1
Ditto	6.9

Further, individual plants of the same variety were found to vary widely in sugar-content. In some cases these differences amounted to as much as 20 per cent. In view of the variation which is possible in a plot of canes both between individual plants and also between the canes of each stool, it is clear that no reliable results can be obtained if everything is based on the composition of the juice of a small sample such as 100 lb.

A second difficulty encountered in sugarcane work is to determine the proper time to reap the plots; in other words, to say when the cane is ripe and at its best. This difficulty applies not only to experiments with one variety, but also to a greater extent when several kinds of canes are tried one against the other. In manurial experiments, for example, it would be quite possible to find that nitrogenous manures delayed ripening to an appreciable extent. In such a case unless all the plots were cut and ground at their best, it is easy to see that the error due to cutting too early or too late might be greater than the difference due to the manurial treatment. Where varieties are grown one against the other, it is most necessary that all the kinds should be cut

*Kobus—“The chemical selection of the sugarcane.”—*International Sugar Journal*, Volume 8, page 299, 1906. (The detailed papers dealing with the work have appeared in the *Java Archief* since 1895)

when they are first ripe, for otherwise it will be impossible to say that one variety is better than another. It is possible that the contradictory results sometimes obtained in variety trials in different years may be due to the difficulty in knowing when the cane is ripe. Since Went's investigations in Java in 1896,* I have been unable to find any more recent work on the changes in the composition of the cane before and after ripeness. Went found that at the period when the cane is ripe, the amount of sucrose is at its maximum, while the quantity of glucose is least. After this period is past, inversion takes place, the sucrose decreasing and the glucose increasing. The purity of overripe canes, therefore, falls. From the point of view of sugar-making, unripe and overripe canes are alike bad. Went also showed that inversion and loss of sugar takes place when aerial roots develop at the upper nodes and when the side buds grow out before the crop is ripe. Such varieties are, therefore, to be avoided as likely to yield an impure juice.

It is not easy to see how to overcome the possible error due to the difficulty of knowing when the cane is ripe. One obvious method of obtaining a more accurate result would be to cut the plots a third or a fourth part at a time. In this way it would be possible to see how long the canes remain at their best, and also to see what kind of error creeps into the result through the difficulty of knowing when the crop is ripe.

Another minor difficulty in experimenting with sugarcane, and indeed with all crops in India, is the question of keeping the varieties pure and preventing admixture. It seems to be the exception in India to find any crop of one variety only; mixture of types is the rule. In experiments where varieties are grown next to each other, it is often very difficult at cutting time to be sure that some mixture does not occur at the line of junction of the plots. To avoid this, the plots might be separated by a row of canes of a different colour or by a row of some striped variety. Such a method seems better than to separate the plots by open spaces, as this introduces the error of end plants.

It is naturally far easier to point out possible errors than to devise means for overcoming them. At the same time nothing is gained by carrying out experiments in the field in which fundamental errors are apparent. Workers on the improvement of the sugarcane in India must have the means at hand of getting their canes cut and made into sugar without delay. This naturally involves much time, trouble and expense. But if work is to be done in India of the same high class as that which has been done in Java for many years past, the workers in India must be provided with facilities such as are to be found there. Whether the sugarcane industry in India would justify such an outlay is another question.

A. HOWARD,

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THE IMPROVEMENT OF THE SUGARCANE BY SELECTION AND HYBRIDIZATION.

There are many references in the literature to the improvement of the sugarcane by selection, and experiments have been made on the subject from time to time. The general idea is to propagate the variety by using only the richest canes. In this way it is hoped to increase the yield of sugar in a similar manner to that so successfully adopted, by Vilmorin in the case of the sugar beet.

None of the experiments on this point, however, seem to have been so thoroughly and successfully carried out as those of Kobus in Java during the last ten years. The details of this work are to be found in the *Java Archief* since 1897. Recently this Investigator has contributed a summary of the results to the International Congress of Applied Chemistry at Rome in 1906 and a translation in English of the paper was published in the *International Sugar Journal* for June and July of that year (1906).

Starting from the variation in sugar-content between individual plants of the same variety, Kobus gradually developed a method of selection which

*Went — "Onder Zakenen omtrent de chemische phymologie van het Suikerriet" — *Archief voor de Java Suikerindustrie*. 4th Jaarvang 1906, S. 524.

was at once successful and practicable. He sums up his conclusions as follows :—

1. Different stalks of the same sugarcane plant vary widely in sugar percentage even when they are of the same age. Consequently we founded the chemical selection on the analysis of the juice of the whole plant, not on that of single cane stalks.

2. The variability in sugar-percentage of various sugarcane varieties is very different. Those grown from cane-seeds do not vary so much as the old varieties.

3. The juice of the heavier plants is richer in sugar than of the lighter ones, and those plants that have the richest juice are the heaviest.

4. Plants grown from cuttings derived from canes rich in sugar are heavier and contain more sugar than those grown from average plants or from plants poor in sugar.

5. When we select the richest canes from the descendants of canes that were already rich in sugar, and also the poorest canes from the descendants of poor canes, and go on in this way for some years, we very soon arrive at a considerable improvement of the rich canes (40 per cent. in five years) and a heavy depression in the descendants of the poor ones (60 per cent. in five years).

6. The descendants grown from cutting of once-selected canes remain richer in sugar for at least four generations, and show, as an average of 40 experiments, only a very small decrease.

7. The correlation of a high sugar-percentage in the juice and a heavy weight of the cane plant simplifies the method of selection in a remarkable way. It is sufficient to select those 20 per cent. that are the heaviest, *i. e.*, the strongest tillered plants of the cane field, and plant the cuttings of one-half of these, *viz.*, of those richest in sugar.

8. We proved that differences in the juice of the descendants of rich and poor canes are already visible at an age of 30 weeks and that it is possible to perform the selection at that age in the fields we use in Java for the propagation of cane cuttings. Highly selected canes of 20 weeks did not show any difference in the juice of the rich and the poor plots.

In spite, however, of the success of the method employed, it appears that selection is only employed to a limited extent in the Java Sugar Factories. The reason of this lies in the fact that within the last few years the varieties raised from crossed seed have given distinctly larger yields. Further, these seedlings remain more constant in their sugar-content and do not vary so much as the older varieties. The parents selected for seed raising are, specially selected, only those plants, richest in sugar, being employed.

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BOMBAY.

Introduction :—Mr. Barber's scheme for provincial enquiry into the sugarcane industry has been followed.

2. *Climate* :—Bombay Presidency is a long narrow tract extending from the extreme south of the Collectorate of Kanara, N. L. 13° 53' to the most Northerly point of Sind N. L. 28° 47'. It ranges in altitude from sea level to nearly 5,000 feet. As would naturally be expected, a great variety of climate is found. The rainfall within the sugarcane growing parts varies from 6" or less in Sind to 140" in Honávar Taluka of Kanara; but in the cane growing parts of the Deccan wherever 2/3 of the cane of the Presidency is cultivated, the average rainfall is from 22" to 35". The rainfall in Gujarat and Northern Deccan and Konkan is confined mostly to the five months, June to October, but the Southern Deccan and Konkan get late rains as well.

The mean daily temperature varies also quite widely, and the widest variations are found in Sind from 55° in January to 109° in July. In the principal cane growing districts of the Deccan the mean of the cold season

is 70°, the hot season 87°, and the rains 77°. The greatest extremes of this region in the last five years are 42° to 109°.

Further information is given in the statement in paragraph 4.

4. *Extent and character of cultivation*:—The average area for the last 20 years is 67,696. The area has fluctuated somewhat; but throwing out the famine year of 1900-01, when the area was less than 40,000 acres there have been no considerable variations, the largest area was in 1888-89 of 85,000 acres. The fluctuations follow the rainfall very largely as is seen in the appended statement.

Statement showing the climate and average acreage of principal sugarcane districts in the Bombay Presidency.

District.	Acreage under sugarcane.	Average rainfall.	Season of rainfall.	MEAN TEMPERATURE.			
				January.	April.	July.	October.
SIND.							
Karachi . . .	880	7-66	June to March .	64°	80°	89°	83°
Hyderabad . .	991	7-22	Ditto	65°	88°	90°	86°
GUJARAT.							
Ahmedabad . .	901	31-39	June to October .	73°	88°	87°	85°
Surat	3,208	39-58	Ditto	71°	86°	83°	82°
DECCAN.							
Khandesh . . .	East Khandesh 544 West " 548	22-40	June to October .	73°	89°	85°	82°
Nasik	4,378	29-19	Ditto	87°	87°	78°	77°
Ahmednagar . .	1,698	22-68	Ditto	69°	85°	77°	75°
Poona	13,075	31-92	Ditto	77°	86°	78°	80°
Sholapur . . .	1,923	25-99	Ditto	73°	90°	79°	78°
Satara	11,104	40-65	May to November	67°	86°	76°	77°
KARNATAK.							
Belgaum	10,606	51-88	April to January .	70°	81°	71°	78°
Dharwar	8,765	34-11	Ditto	72°	82°	78°	74°
KONKAN.							
Thana	570	100-84	June to October .	72°	86°	80°	80°
Kanara	3,221	118-81	April to January .	77°	82°	79°	79°

Irrigation.—Nearly all the sugarcane of the Presidency is grown under irrigation.

In Sind, this like most other cultivation is irrigated largely from canals.

In Gujarat and Southern Deccan wells are the principal source of irrigation, while in other parts of the Deccan canals and tanks furnish most of the water.

Except in the canals of the Deccan the cane is raised in small areas very much scattered and is rotated with other garden crops. Along the canals of the Deccan it is the main crop and only rotated with other crops because it is found that the soil of this region cannot stand continual perennial irrigation. The soil of Sind and Gujarat is alluvial while that of the Deccan is from the decomposition of the basalt. In the Southern part of the Presidency the debris from primitive rocks is mixed with basaltic material.

5. *Varieties of Cane grown*:—

18 Varieties have been described by Mr. Mollison and Dr. Leather from this Presidency one of which is a reed cane "Hullu Kabbu," and I have had no opportunity of adding to this list. (*Vide* Text Book on Indian Agriculture, Vol. III, pp. 159—171). I believe no wild cane is found in the Presidency.

Our canes are divided into hard and soft canes. The various colours are all represented and can be seen from Mr. Mollison's description.

The percentage of juice as extracted by the bullock power iron mills under the ordinary conditions is put down by Mr. Mollison at 73 per cent. for soft canes, and 60 per cent. for hard canes. But in the case of Pundhia at the Sugarcane Farm at Manjri 79 per cent. of juice has been obtained with the same mill.

Juice:—Dr. Leather has made analysis of the juice of several of the varieties of the Presidency; they show sugar percentages of 13 to 17.

6. *Recorded Introduction of new varieties*:—Mr. Mollison imported two varieties—Green and Red—from Mauritius in 1893. At first these were very poor in sugar, but they have been improving until now they are nearly equal to the local Pundhia. They give considerably higher yield per acre of stripped canes than Pundhia, but not so much sugar. In 1903-04 yield of 52.8 tons was obtained from an acre, but some plots yielded at the rate of 57 tons, but the average yield of *gur* or jaggery was only 4½ tons.

Pundhia the same year gave an yield of 42.7 tons of stripped canes but produced 5½ tons of *gur*.

A close study of the origin of many of our soft canes would probably show that they were of exotic origin.

7. *"Sports" and seedling canes*:—Stripped canes are often seen amongst Red varieties, but I know of no authentic record of any variety being so formed.

8. *Other sources of sugar and spirits*:—Sugarcane is the sole source of sugar. Spirits and intoxicating beverages are made from juice of the wild date or toddy palm (*Borassus flabellifer*) and the flowers of the Mowra tree (*Bassia latifolia*), etc.

The American sugar sorghum was tried by Mr. Mollison in the year 1894-95 as a sugar crop but was a failure (For more details and results of these experiments, *vide* Annual Report of the Experimental Farm at Poona for the year 1894-95).

9. *Planting and reaping seasons*:—The planting season varies in the different divisions of the Presidency and is shown in the statement below:—

Name of the District.	Time of planting.	Time of harvesting.
SIND.		
Karachi	January to April	December to March.
Hyderabad	(i) December to February	November to January.
Shikarpur	(ii) February to June	January to April.
Thar and Parkar	January to March	September to January.
	November to February	August to November.
GUJARAT.		
Ahmedabad	April to May	February to May.
Kaira	Ditto	February to April.
Panch Mahals	(i) April	Ditto.
Surat	(ii) January to February	December to January.
	October to January	September to January.
DECCAN.		
Khandesh	January to April	December to April.
Nasik	January to March	February to April.
Poona	January to May	November to May.
Ahmadanagar	(i) January to February	December to February.
	(ii) March to April	February to March.
Sholapur	January to May	December to May.
Satara	(i) January to May	Ditto.
	(ii) November to March	November to February.

Name of the District.	Time of Planting.	Time of Harvesting.
KONKAN.		
Thana	(j) May to June (ii) November	March to May. December.
Ratnagiri	January to March	December to January.
Kanara	December to January	December to February.
KARNATAK.		
Belgaum	February to May	February to May.
Bijapur	April	March to April.
Dharwar	January to March	January to March.

10. *Rotations and mixed cropping*:—The rotations adopted in different parts of the Presidency vary very much and are given below:—

Sugar cane is grown continuously in Sind.

In Northern Gujarat, Ahmadabad, there are two systems according to the nature of the land used for cane.

(a) Land which is unirrigated for several years, and has been cropped with such dry crops as cotton, *jowar*, *lat*, etc., is preferred for cane. Then a crop of sugarcane is taken which is followed by chillies, brinjals, etc., but not by cane again for several years to come.

(b) The second system is adopted on garden land. Cane follows a preparatory dry crop like *bajri* or fallow and the cane in its turn is followed by brinjals, chillies, and vegetables and later by dry cropping. No cane is afterwards taken for five or ten years. The rotation crops do not, however, follow a definite system.

In Surat district, there are again two systems.

1. Cane.

Jowar.

Cotton and dry rice or mixture of rice and *jowar*.

2. Plantains for 2 years.

Ginger.

Cane.

Instead of ginger, turmeric and yams, groundnut or other vegetables may be taken.

In the Deccan and Khandesh the kind of irrigation whether well or canal determines the system followed.

Well-cultivation:—Sugarcane is ratooned once or twice and is rotated with any of the following crops:—

Groundnut, chillies, onion, Khapli wheat, fodder, *jowar*, gram, vegetables.

No exact order of rotation is followed, but cane is not planted again for four years.

Canal cultivation:—Under this style of cultivation the ryots endeavour to get as much land under cane as possible and rotate only when obliged to do so to keep the physical condition of the soil right.

Fodder *jowar*, Khapli wheat, gram, groundnut, chillies, turmeric, onion are used as crops for rotation. Only one such crop followed by a year of fallow or green manure or even without such preparatory treatment is taken between each planting of cane.

In Karnatak there are two systems as follows:—

1. On rice land:—

Cane.

Garden crops like chillies, sweet-potato, onion, and cabbage for two years.

Rice for one or two years.

2. Other lands:—

Cane (ratooned sometimes).

Potatoes and wheat ;
Garden crops chillies, onion, sweet-potato and cucurbits *jowar*.

In Knokan

1. Basein and Mahim (Thana) :—

Betel vine

Ginger

Cane

Plantains.

2. In other parts :—

Cane rotates with other vegetables about once in 3 or 4 years.

11. *Ratoons*.—In Gujarat and Konkan the cane is never ratooned. It is ratooned once in Sind and Karnatak and some times twice in the former division. In the Deccan, one, two or sometimes even 4 to 6 ratoon crops are taken.

12. *Preparation of the land for planting* :—In Sind, when the land is first irrigated, 4 or 5 ploughings with a light two-bullock plough are given to a depth of 4 to 6 inches ; after every ploughing a heavy plank is drawn over.

In Ahmedabad, 15 to 20 ploughings with a light wooden two-bullock plough are given. Three acres can be ploughed in a day. All ploughings are given after the monsoon breaks. This operation continues throughout the year from the break of monsoon to the time of planting in April. The land is harrowed with a plank harrow between each ploughing. The blade harrow is used when weeds are to be eradicated. The plough goes 4 to 6 inches.

In Surat, the land is prepared with 4 to 8 ploughings with a medium sized two-bullock plough. Last ploughing is followed by the plank. Thus the soil is stirred to a depth of 6 to 8 inches.

In Khandesh the operation of ploughing begins after the rains are over. Two ploughings with a two-bullock heavy plough are given with a turn of harrow between each ploughing. The clods are broken by mallets.

In the Deccan, 6 to 10 bullocks are required to draw the heavy plough that is used and 3 ploughings are given. A long-harrow—a heavy *babul* log squared and drawn by two pairs of bullocks—is used between each ploughing. After second ploughing harrowing with bladeharrow is resorted to. Clods are broken by hand. The plough generally goes 9 inches deep. The corners and sometimes the whole land when it is very foul is hand-dug.

In Karnatak, the plough used is a heavy one and drawn by 4 to 6 bullocks. 4 to 6 ploughings are given. The plough goes 4 to 6 inches deep. The after treatment is the same as in the Deccan.

In Konkan, two ploughings and eight harrowings are considered necessary for sugarcane.

13, 14, 15, 16.—*Planting. The source from which the seed is obtained. The part of the cane used for planting. The actual preparation of the sets for planting* :—

Special " Stand-overs " are only seen in Sind.

The sets used for planting have generally three buds and are cut from the whole canes in Sind, Northern Gujarat, Karnatak, parts of Khandesh and Satara and Sholapur.

The practice of propagating from the tops only is common in parts of Khandesh, Satara and Sholapur and in Konkan except Thana.

In the Surat district the whole cane is planted.

No steeping is practised in this Presidency.

17. *The number of sets per acre*.—The average number of sets required to plant an acre is 16,000 to 18,000 ; Ahmedabad requires more, from 20,000 to 24,000 sets while the exact number of Sind is not available, but probably a very large number (40,000) is necessary.

18. *Mode of planting*.—In Sind, beds are prepared 10 by 12 feet and sets are stuck obliquely into the soil about half their length at a distance of from 6 to 10 inches or they are pressed into the soil horizontally in line one foot apart, the sets being end to end. The beds are dry at the time of planting but water is immediately let in.

In Ahmedabad, furrows are made 9 inches to 12 inches apart with cross-furrows for every 9 feet. Beds are then completed by hand 9 feet by 6 feet.

Sets are pressed into dry earth horizontally at a distance of 2 to 4 inches between each set and water is let in.

In Baroda beds are made and one set 15 inches long planted in pits 4 inches deep. The pits are in rows 4 inches to 6 inches and the rows are 2 feet.

In Surat, the whole canes are passed top-foremost through a heavy plough which buries the cane 4 to 6 inches. A man follows the plough and tramples the earth. The surface is smoothed and turned into shallow beds for watering. As soon as the water dries the soil is turned to a depth of 3 inches with a shallow plough. When germination takes place regular irrigation beds are formed.

In the Deccan, the land is ridged up with the plough into ridges 24 to 28 inches apart, the furrows being as deep as possible. The plough is then run across the line of the ridges to form parallel water-channels 10 feet apart. Finally the field is laid out into beds 10 feet square. The sets are laid on the ridges of each compartment. Water is turned into each bed in turn. When the water has partially soaked into the soil and softened it, the planter begins to lay the sets carefully in the bottom of the furrow trampling each set down to 2 or 4 inches into the soft mud. The distance between sets is about 4 inches.

In Khandesh the process varies in that the sets are not placed on ridges, but are carried in a basket by the planter.

In Karnatak no beds are formed; sets are put in furrows made by a plough 3 to 6 inches deep and trampled in and water let in.

In Konkan furrows 2 feet apart and 8 feet long are dug by hand-hoe and 8 sets are planted in each furrow. In July the ridges are split up.

19. *Supplying vacancies*.—Sometimes sets are put in at the time of watering after germination to fill up blanks.

20. *Seed bed and Nursery*.—In some places in the Western Deccan the sets are germinated in beds with irrigation and transplanted in the rains and grown without irrigation.

21. *Stool-planting*.—The practice of stool planting is unknown in this Presidency.

22. *Irrigation and Drainage*.—Only soils naturally well drained are usually selected for sugarcane. No artificial drainage is resorted to except that open trenches are kept in canal irrigated region in low places to take away surplus irrigation water.

In Sind, the irrigation is from perennial canals and wells to supplement the inundation canals.

In Gujarat, the water for cane is from wells of varying depths from 25 to 50 feet.

In the Deccan wells from 20 to 40 feet and canals leading from artificial reservoirs supply water for sugarcane.

In Karnatak, from wells and tanks.

In Konkan, from streams and wells.

From 2,000 to 4,000 acres are grown without irrigation but in some cases when first put into ground plants are watered.

23. *After Cultivation*.—The after cultivation depends upon the weeds. Usually from 3 to 5 hand-weedings are given, a small sickle-shaped weeder being used.

In Surat, the crust is broken up after every watering with a small pick.

In the Deccan and parts of Karnatak and Konkan when cane is 4 or 5 months old, the earth is dug up with a pick and hoed up against the cane.

Mulching is practised in parts of Karnatak with newly planted cane for semi-dry cultivation.

24. *Manuring*.—In Sind, 25 to 30 cartloads of farm yard manure and a small dressing of goat manure form the principal manure. Earth from old village sites is also sometimes given.

In Northern Gujarat, 60 to 100 loads of farm yard manure as also sheep-folding is resorted to; a dressing of castor cake is given.

In Surat, 30 loads of farm yard manure is given, but the land is often prepared with a crop of *sann* (*Crotolaria juncea*) as green manure.

In the Deccan, under the well-irrigation, 30 to 40 loads of farm yard manure with about 1,000 lbs. of castor (*Bicinus communis*) cake or *Karanj*

(*Pongamia glabra*) cake are the chief sources of manure. Sheep-folding is also resorted to.

In the canal areas 30 to 80 loads of farm yard manure or poudrette are used. These are supplemented by heavy dressings of the oil-cakes-Castor (*Ricinus communis*) *Karanj* (*Pongamia glabra*), Niger (*Guizotia abyssinica*) and Safflower (*Carthamus tinctorius*) as high as 3,000 lbs. being given. A preparatory crop of *San* (*Crotalaria juncea*) as green manure is grown.

In Karnatak, sheep-folding, Niger (*Guizotia abyssinica*) for green manure and farm yard manure at the rate of 40 to 60 loads are used.

In Konkan, a small dressing of farm yard manure is given at planting and three dressings of castor cake making a total of 1½ tons are applied.

In other parts of Konkan fish-manure is the principal manure.

The farm yard manure is always ploughed in. The dressings are worked into the soil at the time of weeding or earthing up. The trash, when not required for fuel, is burnt on the land.

Statement below shows analysis and average number of lbs. per Rupee, and area under crop from which the cake is obtained with approximate yield.

Name of Cake.	PERCENTAGE COMP.			lbs per rupee.	Area of crop (1904-05)	Approximate cake per acre.
	N.	K ₂ O.	P ₂ O ₂ .			
						lbs.
Safflower	4.9	1.2	.8	60 to 80	704,459	750
Bassia	2.6	..	.9	80	Not available	...
Cotton seed	2.5	2.1	1.2	40	3,605,985	250
Castor cake	3.8	...	1.7	45 to 60	72,599	300
Karanj	3.5	...	.65	60	Not available	5
Groundnut	7.8	...	1.5	80	76,892	1,200
Sesamum	5.0	...	1.9	35 to 45	382,372	250
Nigerseed	4.47	0.7	1.6	35 to 45	177,642	180

In addition to these, cake is brought into the Presidency from other parts of India.

The results of Manjri experiment were summarised by the writer in a note compiled in 1904, an extract from which appears below:—

These experiments were conducted in two plantings in different years with two successive crops grown in each of them, and the following facts have been more or less satisfactorily demonstrated from the same.

(a) That at Poona the amount of nitrogen present in the sugarcane soils determines the yield.

(b) That the most economical quantity of nitrogen to be applied is between 350 to 400 lbs. per acre, although the amount actually consumed is much less.

This crop receives so much irrigation that much of this above soluble plant food is lost by leaching into the sub-soil.

- (c) That if the above quantity of nitrogen is supplied in two dressings, it will give better results than when used as a single dressing.
- (d) That the nitrogen found in oil cakes is more available, and acts more quickly than that found in farm yard manure.
- (e) That in Poona the safflower cake and cotton seed furnish the nitrogen cheaper than other forms of manure, containing that element.

NOTE.—The price of farm yard manure around Poona is abnormally high.

- (f) That phosphatic manures, such as bone meal or superphosphates gave unsatisfactory results even when reinforced by crude nitre.

Details of these experiments appear in Mr. Mollison's Text Book on Indian Agriculture, Vol. III (Pages 136 to 141) and Agricultural Ledger No. 8 of 1898.

The value of the ashes from the sugar making is known in several places but they are not considered as valuable as they ought to be.

25. *Treatment of the canes during growth :—*

In Gujarat, the canes are usually tied up for convenience of work. In Konkan the leaves are stripped and the cane wrapped and tied. Whenever lodging appears troublesome tying is commonly resorted into all parts of the Presidency.

The hard canes are sometimes planted around the border of the soft canes to discourage jackals and pigs.

26. *Treatment of the fields preparatory to reaping the cane :—*

In Deccan, Karnatak and Konkan heavy irrigation is applied just previous to reaping.

In Gujarat and Sind no special irrigation is given.

27. *Disease phenomena.*—Fungus diseases are uncommon, and their attacks are usually insignificant.

Of the insect pests the moth-borer and white ants are the most serious.

28. *Diseases affecting the sets after planting.*—Only jackals and pigs do harm to the sets.

29. *Diseases affecting the whole plant.*—Ustilago is sometimes seen ; but is not a serious trouble.

Moth-borer is very injurious to newly planted cane especially when planted late.

30. *Disease confined to the underground parts of cane plants.*—Striga exists but its attacks are not of great consequence. White ants are very troublesome in the sandy tract. In fact they make cane cultivation impossible in some localities.

31 and 32. *Diseases affecting the stem. Diseases affecting the leaves.*—Except moth-borer mentioned in paragraph 29 inconsequential and not worked out.

33. *Reaping. Time of cutting the cane.*—Ripening in the Deccan is ascertained by small trial boilings. In Gujarat the time is found out by appearance and by taking the age into account.

For dates of harvesting please see paragraph 9.

34. *Deterioration after cutting.*—Cane is always milled as soon as possible after cutting.

35. *Mode of cutting the canes.*—In Sind, cane is cut as closely as possible with a sickle.

In Gujarat it is uprooted, sometimes with the assistance of a sickle.

In Deccan, Karnatak and Konkan when ratoon is to be obtained it is cut with a sickle, when no ratoon is to be kept it is up-rooted. Only one cutting is given. The canes are stripped of the dry leaves in the field, but the tops are cut off at the mill and the cane cut into pieces suitable for feeding the mill.

6. *Yield per acre in canes.*—The statement below shows the yield in canes per acre in different parts of the Presidency as given by crop experiments:—

District	No. of canes per acre in lbs.	Total weight per acre in lbs.	Weight of stripped canes per acre in lbs.	Weight of tops per acre in lbs.	Weight of juice per acre.	Weight of gur per acre in lbs.
SIND.						
Karachi	35,090	..	42,340		..	...
GUZERAT						
Ahmedabad . . . . .	..	76,620	59,900	16,720	...	...
Surat—						
(Soft canes)	25,870	.	108,654	..	...	..
(Hard canes)	46,530	...	69,790	..	...	...
KONKAN.						
Thana . . . . .	...	70,495	62,440	8,055	..	...
Kanara	26,760	...	...	...	..	...
DROCAN						
Nasik	31,024	...	..	.	...	..
Poona . . . . .	...	65,480	...	.	..	...
Do. . . . .	...	88,450	77,980	10,470	55,400	10,180
MANJRI FARM.						
Experimental plots, 1906	39,712	114,128	97,088	17,040	76,000	13,044
Do. Manjri plots, 1904 . . . . .	...	...	1,28,000	...	78,080	10,600
Satara	25,430	39,051	80,034	9,017	..	...
Do.	25,700	...	49,460	19,980	..	.
Do.	22,600	...	30,940	13,620	...	..
KARNATAK.						
Dharwar . . . . .	...	19,200	12,960	6,240	...	3,590

37. *Manufacture of Jaggery or gur.*—Mr. Mollison's Book on Indian Agriculture, Volume III, pages 123 to 132, may be referred to.

In Sind they have a very cumbersome wooden mill, the camel drawing the mill by walking around on a platform built above the mill. The pans are larger than in other parts of the Presidency.

38. *Profit and loss on sugarcane cultivation:—*

The following data will furnish useful information regarding the cost of cultivation and net realisations from sugarcane per acre.

DETAILS.	Ru. As. P.
Cost of cultivating an acre of sugarcane in Poona District :—	
Ploughing by contract 3 times in October, November and December	22 0 0
Breaking clods, 20 women (first time)	1 14 0
" " 12 women (second time)	1 2 0
Levelling with maund	0 10 0
50 cartloads of farm yard manure including cartage expenses after the second ploughing	75 0 0
Spreading manure	2 0 0
Digging and cleaning corners and headlands	2 0 0
Levelling second time	0 6 0
Ridging and making furrows for water course	0 12 0
Making beds by contract	2 0 0
Cost of 16,000 sets (Price varies according to price of <i>gur</i>)	50 0 0
Carting sugarcane sets	2 0 0
Carrying, spreading, watering and planting sugarcane sets	2 0 0
Hand-Weeding 5 times from June to May	12 0 0
Top-dressing with castor cake in July with 20 <i>pullas</i> (4,800 lbs.) at Rs. 4 per <i>pulla</i>	80 0 0
Crushing and spreading castor cake	3 12 0
Earthing up by contract	8 0 0
Watering and watering, 1 man on Rs. 7 per month for two acres	42 0 0
Erecting a shed near the boiling pan	5 0 0
Castor oil for mills and kerosing oil for lamps and sweet oil for boiling pan	5 0 0
Cutting, carting and crushing cane by contract 64 boiling pans at 14 annas each	56 0 0
Cloth	2 0 0
Sugarcane mill hire for 16 days at 8 annas per day	8 0 0
Assessment	1 4 0
Canal charges	40 0 0
TOTAL	424 12 0
 Cost of cultivating an acre of sugarcane in Surat :—	
Two ploughings in October and November	10 8 0
Carrying and planting sets	2 8 0
15 to 20 tons (45 cartloads) manure at 12 annas a cart before planting	33 12 0
Watering from a well 6 to 9 times, each time 4 bullocks and 3 men for 5 days	45 0 0
Hand-hoeing 4 times, each time 10 men	5 0 0
Half value of <i>kos</i> (bag) and ropes	8 0 0
Fencing	5 0 0
Castor cake 25 maunds (1,000 lbs.) at 8 annas per maund applied in July	12 8 0
Crushing cake and applying the same, 16 men	2 0 0
Cutting cane and making <i>gur</i> , 12 men at 4 annas and 12 bullocks for 7 days	32 0 0
Fuel for boiling	35 0 0
Hire of wooden mill at Rs. 1-8-0 per day for 7 days worked night and day	10 8 0
Earthen pots at Rs. 4 per 100 including cartage	9 0 0
1,800 seed canes (price depends upon price of <i>gur</i>)	50 0 0
Sundry expenses	10 0 0
Land assessment 2 years	20 0 0
TOTAL	283 12 0

A crop which is not properly manured and attended to yields above 8,000 lbs. of *gur* per acre. An average good crop produces about 9,500 lbs. The yield, under suitable manuring, goes as high as 13,500 lbs. The price of *gur* varies from Rs. 3-8-0 to Rs. 5 and more per maund of 80 lbs.

39. *Character and richness of the Juice* :—

Statement showing the analysis of the varieties of cane made by Dr. Leather are given below :—

Name of Cane.	Sample grown at	Year of analysis.	Acclimatized for years.	Percentage of juice to cane.	Percentage of sugar to juice.	Percentage of glucose to juice.
REED CANES.						
Hullu Kabbu (S M. C.)	Poona Farm	1896	Fresh importation	52.60	16.06	trace
Do. do.	Do.	1897	One year	56.17	16.90	0.70
Do. do.	Belgaum	1898	Local	55.90	14.27	trace
			to	59.80	14.92	to
						0.74
HARD CANES						
Surat Vansu	Poona Farm	1896	Fresh importation	57.70	9.53	1.54
Do.	Do.	1897	One year	59.09	14.50	1.0
Do.	Belgaum	1896	Local	60.0	12.64	0.95
Rafnagiri Deogadi	Poona Farm	1896	Fresh importation	70.50	11.46	1.87
Do. do.	Do.	1897	One year	68.0	14.9	.9
Belgaum Sannabile	Do.	1896	Fresh importation	60.0	17.38	.6
	Do.	1897	One year	58.20	16.0	.90
	Khanapur	1896	Local	58.29	13.31	1.09
SOFT CANES.						
Surat Khajuria	Poona Farm	1896	Fresh importation	59.15	10.98	1.40
	Do.	1897	One year	67.25	14.80	1.0
Mahim Yellow Green	Do.	1896	Fresh importation	71.0	12.88	1.87
Do. do.	Do.	1897	One year	70.58	14.80	.80
Pundhia	Do.	1896	Local	68 to	16	1.2
			to	73	to	to
					17.4	1.6
Do.	Belgaum	1896	Local	68 to	13.71	.83
			to	73	to	to
					17.49	1.57
Bijapur Purple Cane	Poona Farm	1896	Fresh importation	68.0	13.27	1.33
Do. do.	Do.	1897	One year	62.50	13.80	1.00
Bassein Purple cane	Do.	1896	Fresh importation	57.10	13.31	1.22
Do. do.	Do.	1897	One year	64.80	13.60	1.70
Belgaum and Ranebennur Kare Kabhu (Belgaum cane).	Do.	1896	Fresh importation	60.70	11.67	1.54
Do. (Khanapur cane)	Do.	1896	Do.	63.00	6.13	2.57
Do. (Ranebennur)	Do.	1896	Do.	54.40	10.27	1.60
Do. (Belgaum, Khana pur and Ranebennur).	Belgaum, Khana pur and Ranebennur.	1896	Local	60.70	13.32	0.85
			to	66.0	16.67	1.17
Ramrasdali (Kanara)	Poona Farm	1896	Fresh importation	70.10	8.22	2.41
Do.	Do.	1897	One year	63.70	14.50	.80
Yellow Green (Chickodi)	Do.	1896	Fresh importation	65.50	11.35	1.80
Do.	Do.	1897	One year	68.47	14.90	1.90
Do. (Ranebennur)	Do.	1896	Fresh importation	64.10	12.04	1.48
Do. (Bijapur)	Do.	1896	Fresh importation	70.40	14.30	1.57
Do.	Do.	1897	One year	70.62	16.60	1.10
Do. (Bagalkot)	Do.	1896	Fresh importation	68.40	12.34	1.94
Do.	Do.	1897	One year	68.75	16.20	1.40
Halyal Rasdali	Do.	1896	Fresh importation	60.40	13.18	1.49
Do.	Do.	1897	One year	62.14	15.30	1.00
Streaked (Gadag)	Do.	1896	Fresh importation	70.20	8.87	2.12
Do.	Do.	1897	One year	69.86	14.50	0.50
Streaked	Belgaum, Khana pur and Gadag.	1896	Local	71.	14.55	0.79
			to	to	17.37	1.39
Green Mauritius	Poona Farm	1896	Three years	65.70	14.71	0.99
Do.	Do.	1897	Four years	63.75	14.10	1.40
Red or Purple Mauritius	Do.	1896	Three years	66.75	12.88	1.62
Do. do.	Do.	1897	Four years	65.47	12.50	1.20

40. *Sugar making*.—Formerly sugar was made in Bassein (near Bombay) in considerable quantities but the importation of Mauritius sugar has killed this.

The juice is boiled over a very slow fire and the syrup in a semifluid condition is poured into earthen jars. This syrup is called *raḍ*. These pots are kept in slated benches or upon pots similar to those used for potting rose and other large plants. Small holes are made in the pots that contain the *raḍ* and another pot is placed below to collect the treacle. A plug of moss is put over the mouth of the *raḍ* vessel and water is sprinkled over it. The treacle leaches off and leaves the crystalline sugar into the pot, the top layer of which is white sugar and is called in vernacular "Flowers of Sugars," the lower layer is darker and is called "Grain Sugar."

One-third is of the first sort and the remainder is "Grain Sugar." The two sorts are separated and pulverised.

Second method :—

There are two boiling pans on the same furnace one large and the other small. Scum is removed as it appears and 10 to 20 tolas of lime is added to every 100 gallons of juice. When the juice has become somewhat thick it is transferred through a strainer to the second pan.

The boiling is continued slowly till the syrup has reached a state that upon cooling, granules of sugar are formed; the pan is taken off the fire and when almost cooled the mass is transferred to earthen pots and the mouth covered with paper and plastered tightly with mud. The pot is put on benches as in the first method. The bottom is perforated the next day with one or more small holes. Six weeks are required for a complete draining.

Some variations of the above processes exist.

Rock candy or sugar candy is also manufactured.

No large factory exists in this Presidency. Two refineries one at Mundhwa (near Poona) and the other at Gandevi (near Navasary) exist. An account of them will be sent in near future when further information is expected, as also some information from the Chamber of Commerce.

41. Improvements in Bombay should be along the developement of the Deccan Irrigation Canals; more extended use of artificial manure better cultivation in Sind and investigation of white ants question in Gujarat.

In closing I wish to acknowledge the valuable assistance rendered to me by Mr. G. K. Kelkar, Inspector of Farms, and Messrs. Fatachand, Sant, Kolhatkar and Ranade, Agricultural Training College teachers.

J. B. KNIGHT, M.Sc. B.Sc.,

*Professor of Agriculture,
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POONA;

1st February 1907.

STATEMENT SHOWING THE AVERAGE RAINFALL IN INCHES IN THE PRINCIPAL SUGARCANE GROWING DISTRICTS OF BOMBAY AND THE AREA UNDER SUGARCANE IN ACRES DURING THE YEARS 1885-1886 TO 1905-1906.

Year.	Rainfall.	Area under sugarcane	Year.	Rainfall.	Area under sugarcane.
1885-1886	31.25	66,000	1896-1897	33.50	67,000
1886-1887	33.00	71,000	1897-1898	30.25	55,000
1887-1888	32.00	80,000	1898-1899	30.25	59,000
1888-1889	28.50	88,000	1899-1900	14.25	71,000
1889-1890	31.50	68,000	1900-1901	28.50	39,000
1890-1891	30.25	63,000	1901-1902	26.25	52,000
1891-1892	24.25	76,000	1902-1903	27.50	56,000
1892-1893	39.50	69,000	1903-1904	26.25	59,000
1893-1894	35.50	86,000	1904-1905	16.00	59,000
1894-1895	33.00	87,000	1905-1906	28.00	58,000
1895-1896	32.75	79,000			

Note.—The rainfall represents the average rainfall of Satara, Belgaum, Poona and Nasik; while the sugarcane area is for the whole Presidency.

LETTER FROM THE BOMBAY CHAMBER OF COMMERCE, DATED THE 13TH FEBRUARY 1907, REGARDING THE IMPORT TRADE IN SUGAR IN BOMBAY.

I am directed to acknowledge receipt of your No. 191 of the 31st ultimo, and to submit the following information in reply to the queries contained therein :—

(1) The Import Trade in sugar is in a somewhat abnormal state at present, as contrary to what has been the case for several years past, imports of Continental beet sugar have lately fallen off to a very great extent. White Javas have come into favour and these are largely replacing beet sugars. A fair amount of White Java has recently been put through Bombay at about 9d. under the rate ruling at home for Austrian beet; and as the Bazar difference between Austrian and Javas is only one anna per cwt. in favour of Austrian, business in the latter description is impossible.

The demand of the native consumers largely influences this trade. Nowadays the better classes of natives prefer the white sugars to the usual locally produced "jaggery", or to the Brown Mauritius, and for such white sugars they have to look to the countries producing white qualities such as Austria, Germany and Java. These white sugars, imported through Bombay, find their way to Guzerat Districts, *viz.*, Surat, Ahmedabad, etc., and on the Great Indian Peninsula line they go as far north as Delhi.

As to the chance of replacing imported sugars by sugars manufactured from superior plants in this country, this is a question my Committee are not prepared to give an opinion on, as it is one that would more appropriately be decided by an agricultural expert. However, allowing that conditions for growing canes are as favourable in India as they are in Mauritius and Java, the utilization of superior machinery for the manufacture of White Sugars in this country, would, it is believed, prove a profitable investment. Such sugars when compared with Java and Mauritius sugars would have the advantage of saving the ocean-freight (from 12 to 15 shillings per ton), as well as the 5 per cent. Imperial duty. There would also be the further advantage of cheap labour, compared with that of Austria and other Continental Countries.

(2) The imports of foreign sugars into the Bombay Presidency (excluding Sind), during the past 5 years, are herewith given on a separate sheet.

(3) The restrictions placed on sugars favoured by Bounties, whether direct or indirect, are believed not to have proved beneficial to India. The only countries that benefitted by Bounties were Mauritius and Java, and to a lesser degree the United Kingdom through a few of her refiners. It is not thought that the restrictions on imported sugar had any appreciable effect on the refineries in this country, nor on its sugar cultivation. Broadly speaking the countervailing duty of something over a rupee had practically no effect on imports of any sugar. An additional duty of about Rs. 3 was subsequently imposed to meet the sugar refined under the Cartel system in Austria, and this had the effect of making the sugar in question too expensive as compared with cane sugar shipped from the United Kingdom and some other beet sugars which replaced it.

Some further information on the subject will be found in the Report of the First Conference of Indian and Ceylon Chambers of Commerce, January 1905, in pages 52 to 59.

Sugar (Refined).—The following table shows the quantities and sources of supply of the Imports of this article during the past five years:—

Whence Imported.	1901-02.		1902-03.		1903-04.		1904-05.		1905-06.	
	Cwt.	s.	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.	Cwt.	Rs.
United Kingdom	1,840	23,756	75,108	7,36,580	63,546	6,60,373	1,613	24,281	108,955	10,46,114
Austria-Hungary	555,648	60,33,859	353,227	35,03,044	112,786	21,00,189	411,440	45,53,184	517,149	46,01,083
Belgium	1,000	12,860	44,849	4,45,197	397	4,188	...	...	67,770	6,09,777
France	69	664	20	231	121	1,654	39,502	4,94,167	86,214	7,96,611
Germany	111,463	12,57,158	20,259	2,02,581	4,864	49,070	58,672	1,49,457	202,731	18,16,550
Holland . . . . .	...	...	34,077	3,44,032	14,525	1,47,263	...	...	...	...
Mauritius	1,535,791	1,60,73,254	1,514,762	1,49,29,644	2,001,013	1,94,47,275	1,527,364	1,61,29,538	1,633,120	1,65,59,027
Reunion . . . . .	...	...	...	...	3,641	36,415	20,974	2,31,068	35,133	3,42,133
Egypt	17,124	1,71,627	6,315	68,927	67,321	7,00,391	165,737	20,32,947	65,940	7,57,531
Hongkong	109,379	12,93,878	224,468	23,24,272	143,854	15,51,930	114,889	13,65,479	67,014	8,33,133
Java . . . . .	...	...	50,512	4,78,838	156,065	14,81,732	254,106	27,12,347	217,617	21,84,104
Straits Settlements . . . . .	...	1	53,550	4,90,148	3,273	33,035	73,198	7,81,040	8,158	86,280
Other Places	5,902	69,498	1,126	10,763	87	1,175	122	1,899	438	3,024
TOTAL	2,338,206	2,49,33,840	2,377,271	2,35,34,202	2,571,338	2,52,24,640	2,667,617	2,90,25,457	2,062,239	2,38,73,416
Re-Export	52,033	6,14,671	21,119	2,27,619	29,291	3,02,591	40,023	4,23,505	139,976	15,19,425
Exports in Coasting Trade	411,373	47,16,860	380,144	37,70,195	569,740	57,47,553	433,304	47,24,436	605,150	64,74,027

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J. B. LESLIE ROGERS,
Secretary, Bombay Chamber of Commerce.

Bombay, 13th February 1907.

UNITED PROVINCES OF AGRA AND OUDH.

So much literature on this subject is in the possession of the Agricultural Departments that it would be a waste of labour to all concerned to repeat the available information in a new form. The indigenous methods of cultivation and manufacture are detailed in *The Sugar Industry of the United Provinces*, by Mr. Muhammad Hadi, published in 1922; some results of the attempts to improve native methods will be found in Bulletin, No. 19, issued by this department: experiments with sugar-beet are described in Bulletin, No. 13; and a discussion of the prospects of the industry has recently been contributed by me for publication in *The Agricultural Journal of India*. The following notes are supplementary to the information already available. The numbers of the paragraphs refer to Mr. Barber's scheme of enquiry.

PART I.—INTRODUCTION.

2. *Climate*.—Table I gives the monthly and annual mean temperatures recorded at the four observatories situated in the principal cane tracts:—

Month.	Meerut.	Bareilly.	Benares.	Gorakhpur.
January	57·8	58·4	61·8	61·2
February	61·5	62·4	66·8	65·3
March	72·2	73·3	77·4	76·5
April	83·3	84·1	87·5	86·4
May	89·5	89·8	92·8	89·2
June	90·5	89·7	91·0	88·4
July	86·1	85·2	85·5	85·3
August	84·6	84·0	84·2	84·3
September	83·3	83·2	84·2	84·1
October	79·5	77·5	79·1	79·4
November	68·0	67·0	69·1	70·0
December	58·3	59·4	61·7	62·4
Annual	75·9	76·2	78·3	77·7

Table II shows the mean number of wet days and the mean rainfall at the same observatories:—

MONTH.	NAMES OF OBSERVATORIES.								REMARKS.
	MEERUT.		BAREILLY.		BENARES.		GORAKHPUR.		
	Number of rainy days.	Rainfall.	Number of rainy days.	Rainfall.	Number of rainy days.	Rainfall.	Number of rainy days.	Rainfall.	
January	2·30	1·85	2·88	1·05	1·40	·67	1·50	·76	
February	1·60	·90	1·18	·74	1·20	·46	1·30	·49	
March	1·40	·63	1·33	·76	·80	·25	·70	·33	
April	·90	·19	·45	·17	·40	·18	·50	·45	
May	1·50	·60	2·27	·76	1·00	·64	2·40	1·24	
June	4·00	3·43	4·91	5·08	6·80	6·23	7·70	9·09	
July	9·40	9·35	13·45	15·47	14·60	11·45	14·70	13·75	
August	9·40	9·30	12·13	14·43	13·40	12·06	14·10	13·24	
September	5·00	5·30	6·73	7·01	3·40	6·08	6·50	8·08	
October	·30	·85	·31	1·00	2·20	2·50	2·10	4·19	
November	·20	·13	·27	·13	·30	·31	·40	·15	
December	·30	·43	·34	·33	·40	·21	·40	·24	
Total	37·00	32·07	47·17	47·83	50·90	40·93	54·10	52·01	

3. *History*.—I have nothing to add to the facts stated in Chapter I of Mr. Hadi's Monograph.

4. *Area*.—The cane area in these provinces fluctuates with the nature of the sowing-season, the price of food-grains, and the prosperity of the

community; it shows no tendency to advance or decline during the last twenty years. The following figures indicate the extent of the fluctuations:—

	Area.	
10 years 1886—1896	Maximum	1,889,000
	Minimum	1,060,000
	Average	1,230,000
1901		1,212,000
1902		1,229,000
1903		1,152,000
1904		1,090,000
1905		1,218,000
1906		1,221,000

The crop now in the ground has not yet been measured, but it is reported to be the largest on record.

Cane is practically confined to the Gangetic alluvium: it is very rarely grown on the Central Indian alluvium and still more rarely on the rock-soils further south.

5. *Classification*.—See Chapter II of Mr. Hadi's Manual. No botanical classification has been made: the classes given are agriculturally distinct:—

I.—Thick canes (*paunda*) are grown only for fruit.

II.—Medium canes (*ganna*) mainly for fruit but also for manufacture.

III.—Thin canes (*ukh*), grown for manufacture.

The thick canes need very high cultivation, and especially nitrogenous manure, in order to pay at all. They are therefore grown only within a carting-radius of the poudrette grounds near towns and cities*; and as the canes fetch from one to three pice each in the neighbourhood of populous centres, and are in almost unlimited demand for fruit, there is no question of using them for manufacture. The thin canes on the other hand cannot stand heavy nitrogenous manuring; when it is applied they grow rank, fall over, and yield juice with such a small proportion of crystals that it can hardly be made to set as *gur*, and in any case the *gur* is of very bad quality.

The intermediate canes are being largely abandoned owing to their liability to fungus disease.

The thin canes are particularly adapted to a country such as this, where the supply of manure is strictly limited; with good field-cultivation, such as they always receive, they pay well and leave the land in good condition for the next crop. Such attempts as have been made to force them to a higher stage of productivity have resulted in loss. Growth of the thick canes as field crops is out of the question as they will not pay at all with the small quantities of manure that are available. The movement towards growing the intermediate canes was a distinct effort towards improvement; its growth and decline are described from the statements of cultivators on page 52 of Mr. Hadi's Monograph.

Successful (*i.e.*, profitable) cane-growing is the recognized stamp of the good farmer all over those parts of the provinces where cane is grown, and the adaptation of variety to locality is very close: there is a certain amount of evidence that varieties are interchanged between different localities, and the adaptation is probably in part the result of long-continued experiments by the people themselves.

6. *New varieties*.—We have no record of new varieties being introduced into general use for manufacture. The thick fruit-canes are mostly believed to be recent introductions, but their history is not definitely known.

7. *Sports and seedlings*.—No record exists of new races arising from these causes. The local canes flower very seldom, but occasionally one or two races flower to an exceptional extent. This happened three years ago and endeavours were then made to raise seedlings, but the seed was in every instance infertile.

Mr. Hadi, who has been studying cane for many years past, has never heard of a seedling in these provinces.

8. *Other sources*.—Sugar is not obtained from other sources in these provinces. For experiments with sugar-beet see Provincial Bulletin, No. 13.

* Thick canes are grown to a very small extent for manufacture in Dehra Dun, where the land has been recently reclaimed from forest, and is in no way comparable with the old cultivated lands of the rest of the province.

Country spirits are made largely from *mahua* flowers, which in some parts of the provinces are used in preference to molasses, but relative prices determine the raw material used in any particular season. The single English distillery uses only molasses obtained from the sugar factory of which it forms part.

PART II.—CULTIVATION.

There is little to add to what is said in Chapter III of Mr. Hadi's Monograph.

9. *The time of planting* is governed partly by moisture conditions and partly by the time of the spring harvest. In the north, where irrigation before sowing is usually unnecessary, and in the west where canal water is available, the planting is usually finished in March before the spring harvest begins. But in the east where the spring harvest is earlier, and where the fields have to be prepared by the more laborious well-irrigation, planting is usually done after the spring harvest, *i.e.*, in the end of March and in April.

16. *Preparation of sets*.—There appear to be no effective local practices. For Mr. Hayman's experiments see the reports of the Cawnpore Farm for 1903-04 and 1904-05.

Paragraph 17.—The thin canes tiller comparatively little, and have to be planted close together; about 4,000 to 5,000 canes are used per acre, or 20,000 to 25,000 tops where tops alone are planted.

Paragraph 20 ²⁰/₂₁—^{Transplanting}/_{stool planting} do not appear to be practised in these provinces.

Paragraph 22.—Irrigation is needed primarily from March to June, when all natural sources are at their lowest. Whenever therefore irrigation is needed, it must be done from perennial canals or from wells. The strain that well irrigation throws on the cattle during the hottest months of the year is undoubtedly one of the obstacles to an increased acreage: the question of substituting power (such as oil-engines) is at present the subject of study. The question that has to be settled is how to adapt the power to the conditions of wells in the alluvium, which fall in and are ruined (whether hired or not) if the discharge rises above a maximum which varies from well to well. It is a matter of engineering in the first instance.

Nearly all the thin *red* canes stand immersion for considerable periods; these are grown in lowlands and along the edges of swamps. The red canes are enumerated on pages 18 *sqq.* of Mr. Hadi's Monograph. *Chin* stands immersion best of all. These canes are comparatively poor in sugar, but they often pay exceedingly well because they can be grown in places where the low situation renders irrigation unnecessary.

24. *Manuring*.—It is worth noting that the cultivators much prefer dung, poudrette, or similar manure to castor-cake, the only cake that is available locally in quantities; the latter they say leaves nothing in the soil, and this is entirely opposed to the best farming tradition of these parts, where manuring is looked on as a *quasi*-permanent improvement. (The results of residue trials in the standard experiments at Cawnpore show that continued manuring with dung has in fact a residual effect for a considerable period, while there are indications in other experiments that castor-cake is used up by the first crop).

No very definite conclusions have been drawn from the manurial experiments on cane at Cawnpore: the conditions of the experiments were such as to throw much light on other fundamental questions connected with the crop, but it is not easy to infer from them the best kind, or the most paying quantity of manure.

Paragraphs 27—32.—Such information as had been recorded up to 1901 is contained in Chapter IV of Mr. Hadi's Monograph; but the paragraphs relating to the borers have been rendered obsolete by Mr. Hayman's subsequent researches. These are detailed in the Report of the Cawnpore Farm for 1902-03 (Chapter III).

34. *Deterioration after cutting*.—Mr. Barber's statement, that delay is of comparatively little moment in the manufacture of *gur*, would not be accepted by those engaged in the industry in these provinces. The value of *gur* in the local markets depends partly on colour and partly on grain. If cane lies over

for much more than 24 hours, it is common experience that the *gur* will not solidify at all, or if it does, it shows little or no grain and fetches a very poor price. Deterioration is said by the manufacturers to be accelerated by wet and cloudy weather, and retarded by dry winds and sunshine.

Some results of deterioration tests at Rosa (Shahjahanpur District) are given in Agricultural Ledger, No. 6 of 1903. Mr. Weinberg there found that the weather was comparatively immaterial, and that deterioration became serious on the third day; but in common practice the deterioration is felt on the second day as noted above.

36. *Yield of canes per acre.*—The information available will be found on page 32 of Mr. Hadi's Monograph.

PART III.—MANUFACTURE.

37. *Manufacture of gur.*—See Chapters V and VI of Mr. Hadi's Monograph. For suggested modification see Bulletin No. 19.

Price of gur.—Hardly any substance in local markets varies more in price according to quality; and as Revenue Officials have little practical knowledge of the minute grades, the prices returned in the ordinary course are of little use for comparative purposes. About Rs. 3 per maund may be taken as the standard price received by the cultivator.

Trade.—It is not desirable to treat the trade in *gur* separately from that in sugar: the lower grade sugars are to some extent interchangeable with *gur* and the market moves as a whole. The following figures show the net trade in maunds in the different classes for the last three years. (+ shows net export):—

	1903-04.	1904-05	1905 06.
	Mds.	Mds.	Mds.
Refined sugar	-333,700	-159,200	-527,900
Unrefined sugar	+960,500	+1,068,800	+928,600
Gur, etc.	+4,126,100	+5,036,600	+4,920,900

Refined sugars.—There is a large local production of refined sugars (*chini*, etc., *vide* Chapter IX of Mr. Hadi's Monograph). Until the last few years there has been a balance of exports, but this trade has been hit by the cheapness of imported sugars and we now import on balance. The imports are exclusively from the seaports; exports go to Bengal, the Punjab and Rajputana and Central India.

Unrefined sugars.—These include *polli*, etc. (Chapter VI of Mr. Hadi's Monograph). Low grade imported sugars compete with these to an increasing extent, but we still expect to export a million maunds on balance. The Punjab, Rajputana and Central India take almost the whole of this.

Gur, etc.—Net exports vary from four to five million maunds; there is practically no import; the chief markets are the Punjab and Rajputana and Central India; and second to these Bombay and the Central Provinces.

38. *Profit and loss.*—I must dissent from Mr. Barber's conclusion that an extension of cultivation would involve payment of cash-wages on a large scale; with the ordinary systems of labour co-operation in vogue in these provinces an additional half million acres could be cultivated under present arrangements if it were worth the people's while. The most trustworthy figures for profit and loss in these provinces are those deduced from enquiries regarding the value of canal water to the cultivator, and I extract the following from my note on the subject.

" Assuming that everything, including labour and hire of cattle, is paid for in cash, the figures are :—

	Upper Duab.	Middle Duab.	Bhilkhand.
	Rs.	Rs.	Rs.
Value of crop	115	100	114
Cost.			
	Rs. A.	Rs. A.	Rs. A.
Water rate	6 8	6 8	2 12
Rent, seed and manure	23 8	18 8	33 4
Cultivation and manufacture	52 0	56 0	58 0
Total	82 0	81 0	94 0
Profit	33 0	19 0	20 0

"The assumption that all labour is paid for is not of course in accordance with the facts, but it has always been realized that the data collected could be brought together for comparison only on this assumption. The more difficult task remains of eliminating the error so introduced. What we want to know is the income which the family derives from cultivation after paying out whatever has to be paid in cash or grain during the period when the crop is being got ready for the market; and to learn this we have to analyse the cost of cultivation into what has been paid out and what has not. My figures in this connection do not rest on a wide statistical basis, and are therefore liable to error of considerable magnitude, but what I give is the best conclusion I can draw from my personal knowledge and from such enquiries as I have been able to make.

"To begin with we must class the cattle, and also the implement-maker as members of the family for our present purpose. The ordinary feed of the cattle is properly regarded as part of the living expenses of the family, though if they are given extra food for especially hard work on a particular crop, that extra food must be taken into account: their depreciation is a charge which in fact is met out of the family property, whether part of the surplus laid away is devoted to buying new animals or the money is borrowed and gradually paid off. The implement-maker is paid mainly so far as my knowledge goes by a small share in the family income, a yearly or seasonal dole.

"Then as regards labour, we must deduct the cost of all the labour that is rendered by members of the family. This varies greatly in individual cases, and the estimate must necessarily be rough. We have to allow too for the common practice of labour exchange under which A works for B in the expectation that B will work for A when wanted. This system enables each cultivator to employ his labour fully, for when he has nothing to do at home, he works on some one else's land and is thereby enabled to concentrate work on his own land when there is a hurry: but A and B do not pay each other.

"Taking all these things into consideration I put the maximum expenditure at one-half of the cost of production as determined by experimenting officers. Making these adjustments the immediate outlay and the addition to the family income is shown in the following table: I have no doubt that so far as the cultivator forecasts his cost and profit, these figures are much nearer his estimate than those already given: he will think of his out-of-pocket expenses and he will think of the cash income which may be expected. I may be wrong as to the proportions of actual outlay to calculated cost of production,

but any one whose views on this point differ from mine can recalculate the table to suit the estimate which he prefers :—

	Upper Duab.	Middle Duab.	Bohikhau.
	Rs.	Rs.	Rs.
Gross income	115	100	114
OUTLAY.			
	Rs. A.	Rs. A.	Rs. A.
Rate	6 8	6 8	2 12
Rent, seed and manure	23 8	18 8	33 4
Cultivation	26 0	28 0	29 0
Total outlay	56 0	53 0	65 0
Net income	59 0	47 0	49 0 "

39. *Richness of juice.*—No systematic analyses have been made of the richness of the juice of different varieties. This matter awaits the appointment of an Agricultural Chemist to the Department. Dr. Leather's results reported in Agricultural Ledger No. 3 of 1897 were obtained on canes grown experimentally.

40. *Sugar-making.*—The indigenous processes are described in full detail in Mr. Hadi's Monograph. Only two factories are at work on European lines in the provinces; none are known to have failed. The managers of these factories were requested to supply so much of the information asked for as they are prepared to publish: their replies are as follows :—

Rosa factory, worked by Carew and Company, Limited. Rosa crushes cane grown in the vicinity: the Company have also extensive forest estates which are gradually being developed; they hope eventually to set up a second factory in these, but for the present the supply of cane there is not sufficient, and what is grown is made into *gur* and sent to Rosa for refining. The present plant can deal with 6 to 8 lakhs of maunds of cane: it is "similar to that used in Java and other places." Distillation has always been carried on and the factory is organized with this object, but the managers think that with a sufficient supply of good cane, a sugar factory could get on without this adjunct. The managers are opposed to the practice of refining *gur* as wasteful and expensive. They have occasionally imported raw sugar from Java and Mauritius when stocks were low, but it is not their usual practice.

The Cawnpore Sugar Works have two factories, one at Cawnpore and one in Bihar. The latter is a new venture for which success is hoped: the former has been worked successfully for several years without distillation, but a distillery is now contemplated in connection with it. The Cawnpore factory deals entirely with *gur* as its raw material; and has never imported raw sugar from abroad or used sugar from sources other than the cane. It declines to give any information as to its processes. The Bihar factory starts with cane grown on the Company's estates or purchased from planters.

Two factories are being erected for the ensuing season: one at Unao (12 miles from Cawnpore), the other a few yards from the boundary of the Cawnpore Agricultural station. Both, it is understood, intend to refine *gur*; they are in the hands of some of the acutest members of the Indian mercantile community of Cawnpore.

Countervailing duties.—The effect of these was to allay a panic among the manufacturers. Capital was going rapidly out of the industry, but the news of the duties checked this movement; manufacturers held on, and gradually adapted themselves to the lower range of prices instead of throwing up their business in despair. The object of the department has been steadily to show how the cost of manufacturing native sugars can be reduced, and their quality improved, so as to enable them to meet foreign sugar on equal terms, if not with a differential advantage.

The question of the direct effect of these duties on prices is practically insoluble; it is not whether they raised prices, but whether they prevented a further fall, and if so the extent to which they acted, and from the nature of the case this cannot be demonstrated by figures. Informed Indian opinion in these provinces is unanimous as to the benefits they have conferred, and such opinion is by no means an unsafe guide; but the prevention of panic and disorganization of the industry is beyond dispute.

PART IV.—IMPROVEMENTS.

The programme contemplated for these provinces is as follows :—

- (1) *Varieties*.—The local varieties of each cane-tract to be valued and good varieties of other tracts tried with the object of introducing those that are better. The agricultural stations in the cane regions have been located with this object. Hitherto our experience has been that the character of the varieties changes very suddenly with changed environment, some deteriorating and others improving; there is therefore every hope of securing valuable improvements, but much detailed experimenting is necessary.
- (2) *Cultivation*.—No defects have hitherto been observed except such as require a large economic change for their removal; but they will be looked for as the local staff gains experience.
- (3) *Irrigation*.—The question of using engines is under examination, but as has been explained there are considerable preliminary difficulties to be surmounted.
- (4) *Manufacture*.—From what has been said above, it will be seen that the Cawnpore mercantile community are looking at the present time to refining *gur* by European methods as a profitable development; they are by no means incompetent judges of commercial possibilities. The fact that the amount of grain is a controlling factor in the price of *gur* ensures that the *gur* makers will do their best to secure it; *gur* making moreover is essentially a domestic industry, and it is difficult to influence it except through the market. Factories dealing with the cane have to face serious difficulties of organization where the growers are numerous and each plot is small—the usual conditions in the provinces. The methods of making unrefined sugar described in Bulletin No. 19 are beginning to be adopted; and improved methods of refining this produce are being worked out. These developments have had to be engineered without the control of constant analysis, a condition which it is hoped will soon be remedied.*

I believe myself that in these provinces there is room for all three methods, European factories working from the cane, European refineries working on *gur*, and small installation working up sugar by improved native methods; while finally the great bulk of the produce will for many years to come be consumed as *gur* by our numerous and conservative population.

Government aid must be given (a) by experiment with varieties and issue of seed-canes when success has been attained; (b) by demonstrations of improvement on native methods; that is by the ordinary methods of Government action. I can see no useful opening for subsidies to private factories.

Crushing mills.—If as is suggested above the initial processes of manufacture are likely to remain in the hands of the cultivators and small manufacturers, the most urgent need is the provision of efficient crushing mills; this would probably raise the outturn of raw sugar by at least 10 per cent. without the cultivation of an additional acre. I have indicated elsewhere that the best hope of this improvement lies in the supply of mills being taken up by responsible capitalists; it is very difficult to see what Government can do in the matter and any suggestions on this point will be most welcome.

W. H. MORELAND, O.I.B., I.C.S.,

Director of Agriculture.

* A recent analysis by Dr. Lehmann showed that a sample of semi-refined sugar (*ktand*) made by Mr. Hadi contained 98.75 per cent. of sucrose, and a refined sugar (*gand*) 99.80 per cent.

BENGAL.

PART I.

INTRODUCTORY.

1. *Introductory.*—This report refers to the Province of Bengal as constituted after the partition, comprising an area of 115,787 square miles, of which 39,115,100 acres are under cultivation.

2. *Climate.*—Statement, showing the normal rainfall, month by month, in the Province and the normal mean temperature will be found appended, (*vide* Appendices I and II.)

3. *The age of sugarcane cultivation in India.*—Reference is made to the cultivation of sugarcane in India in many ancient writings, which go back as far as the Institutes of Manu. In several parts of Bengal, the cultivation of sugarcane is of comparatively recent growth, *e.g.*, in Chota Nagpur and Orissa, where it has spread after the establishment of irrigation facilities. In Champaran, sugarcane is supposed to have been introduced by immigrant *raiyats* from Azamgarh and Gorakhpur (neighbouring districts of the United Provinces) about a century ago.

4. (a) *Extent of cultivation.*—For the quinquennial period ending 1904-05, the area under sugarcane in the whole of India has been estimated at 2,404,000 acres and in Bengal at 457,200 acres, so that the sugarcane area in this Province is 19.02 per cent. of the total sugarcane area of India. In the Province itself, it comprises 1.77 per cent. of the total cultivated area. The figures given in the following statement will show at a glance the extent and distribution of the cultivation:—

Area under Sugarcane.

Name of tract.	Total area of tract.	Area in 1890-91.	Average of five years 1890-95.	Average of five years 1895-1900.	Average of five years 1900-05.	Area in 1905-06.	Area in 1906-07.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Deltaic tracts	20,108,102	245,800	182,500	180,800	128,000	128,800	120,700
South Bihar	7,142,400	79,800	118,100	66,800	80,400	84,800	90,800
North Bihar	6,056,216	97,200	162,800	147,400	77,800	87,100	83,900
Bhagalpur	12,656,633	97,700	96,200	100,200	98,600	66,100	61,200
Orissa	8,795,488	23,200	19,600	17,700	16,200	15,200	14,300
Chota Nagpur	17,344,640	211,500	113,800	115,400	66,400	62,100	63,100
Total	74,103,479	755,000	662,500	578,400	457,200	449,100	428,500

The areas shown for the Deltaic tracts and for Chota Nagpur for the year 1890-91 appear to be open to doubt. Bihar, comprising North and South Bihar and Bhagalpur, is the most important sugarcane growing tract of this Province, and there can be no doubt that the sugarcane industry is being revived here consequent upon the decline of indigo.

(b) *Character of cultivation.*—Sugarcane cultivation is for the most part undertaken in Bengal wherever water is available. In certain parts of North Bihar, it is grown without irrigation. Rotation is practised as a rule, and the crop is grown generally in small plots of land by *raiyats*. Among planters, large blocks, extending over several acres, are now being put down under the crop.

(c) *Soils.*—Nearly all kinds of soil answer for growing sugarcane, from the Sedentary Achaean soils of the Chota Nagpur Division to the old alluvium of Bihar and the new alluvium of Eastern Bengal. The best canes grow at the junction of old and new alluvia, on the sides of streams and rivulets. These are clay loams, which are rich in mineral matter. Sugarcane is to be found on all kinds of soils, having an admixture of clay and loam in different proportions, and also on *diara* lands situated above the inundation level.

5. *Varieties of cane grown.*—Sugarcane in Bengal may conveniently be divided into two classes, *viz.*, (i) thick canes with much juice but with soft rinds, generally delicate and liable to be attacked by wild animals, and (ii) thin canes with hard rinds, not so liable to disease and not as easily attacked by wild animals.

(i) The chief canes which come under the first class are:—

- (a) *Bombai*.—A large-sized red cane, rind soft, juice abundant, rich in sugar, but delicate, and specially liable to disease. Cannot stand effects of flood and excessive rainfall. For these reasons its cultivation is dying out in some districts.
- (b) *Samshara*.—A large-sized cane; a great favourite in the deltaic area; rind of a pale yellowish-white colour, fairly soft; produces a light-coloured *rab*, which is much prized by confectioners.
- (c) *Kajli or Kali*.—A fairly large-sized and hardy cane with a purple colour; an early variety. Yields *gur* of an inferior quality, and therefore cultivated on a small scale; but its *gur* is reputed to contain some medicinal properties.
- (d) *Kantari*.—A yellowish cane resembling *Samshara*, much used for chewing, and commonly grown in Orissa.
- (e) *Paunda*.—A favourite chewing variety, thin-skinned and thicker than *Samshara*.
- (f) *Puri or Koori*.—A softer but thinner cane than *Samshara*, which it resembles in colour. It is said to be one of the richest in sugar of all the Bengal varieties, and to produce a better-coloured *rab* even than *Samshara*, but it is liable to break readily and hence is not much cultivated. It is first of a more or less reddish colour, and it then becomes yellow with brownish spots.
- (g) *Dhalsunder or Dholi*.—A moderately soft cane of reddish green colour. It is thinner and harder than *Samshara*, is not so easily damaged by water-logging as other soft canes, and is cultivated largely in East Bengal.
- (h) *White Bombai*.—A large-sized cane, but grown, like the red *Bombai*, only to a limited extent; liable to disease.
- (i) *Ruppa*.—A soft-rinded cane of a yellowish-white colour, showing red stripes when ripe.
- (j) *Bangla*.—Very much like *Samshara*. The rind is soft and thin; canes are rich in juice and much used for chewing.

(ii) Among canes, coming under the second class, may be mentioned the following:—

- (a) *Mango*.—A very popular variety in Bihar; a short and thick-skinned cane, colour green when young, but changing to a reddish-yellow colour when ripe; resists drought, but is damaged by water-logging. Good *rab* is produced from this cane. Its percentage of sugar to juice is large.
- (b) *Bhurli*.—Another common variety of Bihar, somewhat similar to *Mango* in appearance, though a little thicker.
- (c) *Pansahi*.—A whitish-yellow cane, thinner than the above varieties, largely cultivated in Bihar and appreciated as a chewing cane. Colour whitish-yellow.
- (d) *Barukha*.—A greenish cane, very similar to *Pansahi*, grown largely in Bihar, and appreciated for chewing. It ripens early in November.
- (e) *Shaori*.—A tall, rather thin cane; yellowish-green in colour changing to reddish-brown when ripe. Grows in low lands, and can stand water-logging.
- (f) *Beora*.—Supposed among thin hard-rinded varieties to be second only to *Mango* in the richness of its sugar.
Rab and *gur* are made from this cane; colour yellow changing to a grey when ripe; not suited to heavy soils and cannot stand water-logging.
- (g) *Ketari or Chinia*.—A thin small cane, with decidedly long nodes; fairly hardy, yellowish colour, early variety; gets brownish-red when ripe.
- (A) *Hemja*.—Very similar to *Mango*; of a greenish colour, and short.
- (i) *Poraich*.—A yellow cane, thinner than *Mango*; stands water and is grown generally on low lands.

- (f) *Ikri*.—A tall thin cane, yellowish in colour, found in East Bengal; endures submersion in water.
- (k) *Khari*.—A thin, very hardy variety, can resist drought to some extent. Being very hard and thick-skinned, it is not much destroyed by white-ants. Yields good sugar.
- (i) *Khagri*.—This cane is also found in East Bengal and, like the *Ikri*, stands prolonged submersion. It is reported that it can thrive even in six feet of standing water for about three months. The *gur* is of inferior quality and the outturn is poor. In this, as in the *Ikri* cane, it is said that the amount of crystallised sugar is very small.
- (m) *Pachmahî*.—A rather thin cane found in Bihar; can stand water-logging to some extent.

In the above lists, it is possible, if not probable, that a difference of name does not always indicate a distinct variety. The Bengal canes still require systematic identification and classification.

A wild cane is reported from Orissa, which is known locally as *anakhû*, *bahya* or *kusari*. The plant looks like *juwar* (*Sorghum andropogon*); the stems are slightly sweetish. The juice is used in the treatment of insanity (hence called commonly "mad" sugarcane), and of brain and eye diseases. It is also sometimes given to cattle as fodder.

6. *Recorded introduction of new varieties*.—Striped Mauritius, Otahete and Bourbon pink-coloured canes have been introduced by some planters. They are said to be very liable to disease and are very delicate, and therefore not popular with *raiyats*. It is reported that the *Samshara* variety of Bengal has been introduced into the West Indies. Some cuttings were taken also to Java some years ago.

7. "*Sports*" and *seedling canes*.—Instances of *sports* and of canes raised from seedlings are not common in Bengal. There is reported to be in some districts of Western Bengal a hardy cane, locally known as *Uri*, which seeds freely. Should a cane flower, it is considered a bad omen by the *raiyat*, who generally cuts off the flowers, as soon as they appear. From Sambalpur, it is also reported that a variety locally known as *Kihana Busari* is grown from seed.* It is a very poor variety and resembles *juwar* in appearance.

8. (a) *Other sources of sugar and spirit*.—Besides cane, the other sources of sugar are the date palm (*Phoenix sylvestris*) and the palmyra palm (*Borassus flabelliformis*). Date sugar is largely made in the district of Jessore.

Country spirit is manufactured from *Mahua* (*Bassia latifolia*), from *gur* or *molasses*, from *Mahua* and *gur* mixed, from rice, from the date palm and the palmyra palm.

(b) *Experiments with beet and sorghums*.—Some experiments have been carried out on a small scale by private individuals from time to time, but no recorded results are forthcoming.

PART II.

CULTIVATION.

9. *Planting and reaping seasons*.—Sugarcane harvesting and sugarcane planting can proceed for eight months in the year, *viz.*, from September to April, but the best time for harvesting is from December to February, and this is also the best time for planting. The early varieties, which as a rule are not important, are planted in November and December, and reaped about the same time the following year. When irrigation facilities are scanty, sowings are generally postponed to April. The crop occupies the ground as a rule from 8 to 12 months.

From Sambalpur, it is reported that when canes are grown from seed, the sowing takes place in June and the harvesting comes on late in March or April.

* This report requires verification.

10. *Rotations and mixed cropping.*—Sugarcane is considered an exhausting crop, and is therefore not grown on the same field in two successive years. Some of the common rotations adopted are as follows:—

- (i) Sugarcane comes after any of the following crops—(a) pulse crops, (b) potatoes, (c) *aus* paddy, (d) wheat or barley, (e) mustard, and is then followed by *aus* paddy.
- (ii) First year sugarcane, second a *bhadvi* crop, after which a cold-weather crop follows; third year a fallow.

Very frequently, sugarcane follows *aus* paddy. The alternation with pulse crops is also common. In factories, indigo forms a good rotation with sugarcane. From Lohardaga, however, it is reported that sometimes sugarcane is grown for three successive seasons on the same land, after which some inferior crops are taken, e.g., *sarguja* (*Guizotia abyssinica*), for a year to enable the soil to recoup its lost fertility. In Bihar, peas are sometimes grown with sugarcane. When sugarcane follows pulses, the latter are often grown as catch-crops following autumn paddy. After the harvesting of the catch-crops, the land is prepared for sugarcane. *Birhi* or *urid* (*Phaseolus radiatus*) is a favourite catch-crop. Turmeric and potherbs are also used as catch-crops.

The borders and fringes of cane-fields are sown in many places with *Patua* (*Hibiscus cannabinus*), *dhainche* (*Sebania aculeata*), *arhar* (*Cajanus Indicus*), *juwar* (*Sorghum andropogon*). Chillies are also sometimes seen on the outskirts.

Green manuring for sugarcane is practically unknown in Bengal. In some places, however, during the rains the field is surrounded with low *bunds* and allowed to remain in that state till August or September, when advantage is taken of a heavy shower to plough and harrow the field and thus destroy the weeds, which, after rotting serve as green manure.

11. *Ratooning.*—*Ratooning* is not largely carried on in Bengal, as *ratooned* canes are said by the *raiya*s to be more liable to fungoidal diseases and insect pests than annual canes, and to exhaust the soil. Where practised, the stools are generally allowed to grow for the second year. But *ratooning* for two, or sometimes three crops is not unknown. It is practised with some varieties in deltaic Bengal and in Bihar. From Dacca, it is reported that after the crop has been harvested, the fields are covered with virgin earth taken from the bottom of the creek below, and the shoots allowed to grow, this system being carried on for two years.

Ratooning experiments made by the Department of Agriculture on the Burdwan and Sibpur Farms with the variety known as *khari* disclosed the following results:—

BURDWAN FARM.

STATEMENT I.

Year.	Outturn of gur per acre.
	lbs.
1887-88	5,727
1888-89	7,109
1889-90	7,837
1890-91	10,294
1891-92	8,072
1892-93	7,875
1893-94	3,333
1894-95	1,419

SIBPUR FARM.

STATEMENT II.

Year.	Outturn of gur per acre.
	lbs.
1891-92	4,169
1892-93	5,878
1893-94	4,555
1894-95	4,742
1895-96	3,733
1896-97	1,468

12. *Preparation of the land.*—When sugarcane follows a *bhadvi* crop, the preparation of the land commences after the harvesting of the *bhadvi* crop. The *raiya*s believe in thoroughly pulverizing the soil, and so the land is repeatedly ploughed and exposed to the sun. The implements used generally are the ordinary country plough and the country harrow (a ladder made of bamboo or a beam of wood). The number of ploughings vary a great deal according to the nature of the soil and the skill of cultivators. From five up to sixteen ploughings and cross-ploughings are given in different places with three or four or more harrowings. Hand hoeing with the *kodali* is also done in many districts.

When sugarcane follows potatoes, the land is almost ready for the reception of the cuttings without any further preparation. Two or three ploughings and harrowings are all that are necessary. When fallowing is adopted in the rainy season, the land is ploughed, manured and weeded till the end of the rains, the frequency of ploughing depending a great deal on the leisure of the cultivator, whose hands remain more or less full of other work during this period. Then after a rest, the land is again ploughed at intervals up to the time of planting. If the weather, before the planting takes place, has been particularly dry, the field is irrigated and then ploughed and levelled before sowing. When the ploughings are going on, the fields are manured, the commonest manures used being cowdung, pigdung, horsedung, sweepings, ashes, and mud from old tanks. Sheep folding is also practised in some places. *Seet* or indigo refuse is used by planters. When cowdung is used, the ordinary rate amounts to about 100 maunds per acre. Manure is also applied at the time of sowing, and in some places at the time of earthing up. Oilcakes are generally used during earthing. In some places on the banks of the Brahmaputra, it is reported that when it is intended to grow sugarcane on land that is too sandy for this crop, or that has been exhausted by repeated cropping, the fertility of the land is first restored by laying it down in *Ulu* grass (*Saccharum cylindricum*). The *Ulu* is harvested in November, and immediately after, the field is ploughed and manured, and the land is got ready by February.

13 to 18. (a) *Planting.*—In some of the more advanced sugar districts in Bengal, the beds in which sugarcane is planted are so arranged as to serve a double purpose, *viz*, to give facility for irrigation and to remove the rain water from the field as speedily as possible. This is done first by dividing the field into a number of long strips by broad trenches or channels drawn from the top to the bottom of the field at intervals of some 40 feet. A number of smaller water-channels are now drawn across the field, all parallel to one another and about 7 or 8 feet apart from each other. The whole field, in this way is divided into a number of small beds, each 40 feet by 7 feet. The water-channels are all made by the *kodali*. Next, with a good plough and a pair of steady bullocks, parallel furrows are drawn across these beds at intervals of about 22 inches. Finely-powdered oilcake is spread at the bottom of these furrows. Water is then poured from an earthen vessel into them, and in the mud thus made, the cane cuttings are placed lengthwise, leaving an empty space of about 9 inches between each. The cuttings are then covered with a layer of earth of about 3 inches thick. In some places, after the water-channels have been made, holes are dug in parallel lines at intervals of about 24 inches and at a distance of about 18 inches from one another in the line. Outtings are put into these holes, one in each, with a little oilcake and water, and covered with earth.

A very common practice, and one largely followed in Behar, is to plant the cuttings of cane behind the plough. One plough goes in front of a second in the same furrow, which is thus made deeper. A man follows the plough with cane cuttings, which he lays flat over the bed of the furrows, allowing about 6 to 9 inches of ground between every two cuttings, and presses down as he walks along. The fields are then levelled with a beam. In some places, ridges and furrows are made. For this purpose, a third plough sometimes follows and makes a furrow a little on one side and covers up the cutting in the preceding furrow with a layer of soil about 6 inches deep. The *kodali* is also used for making ridges and furrows. The cuttings are planted in the furrows, and as the plants grow up, they are earthed till the furrows become ridges and the ridges furrows.

The mode of planting known as the Mauritius system, which has been strongly recommended by Messrs. Thomson and Mylne of Beheea, is not unknown in Bengal.

Among Bihar planters, the trenching system is commonly adopted.

In the case of ordinary cultivators, the depth at which the sets are placed varies from 2 to 6 inches generally, and the distance at which the sets are placed, from 6 to 12 inches: while the distance of the rows apart ranges from 9 to 24 inches.

(b) *The source from which the seed is obtained.*—It is a very common practice to separate the "tops" while the crop is being harvested, and to use them for sowing the following season's crop. This is done both with annual and ratooned canes. Generally, a part of the crop is left standing on the ground, and reserved for sowing later on, after the main harvesting is completed. In such cases, the plants intended for sowing are left untouched for a month and more. They are then cut into small lengths, which are usually kept in a pit covered with mud and straw for three or four days before sowing.

The practice of bringing sets from a distance is not general among *raiya*s, but it finds favour with planters.

(c) *The part of the cane used for planting.*—As a rule, the top portion of the cane is used for cuttings. It is the opinion of many *raiya*s that more than a foot of the stem from the top end should be cut into sets, as the buds lower down do not produce healthy plants. The whole cane is also cut up into sets. In this case, the lower end of the rooting portion of the cane is rejected. To a limited extent, the whole cane, without being cut, is sown in shallow trenches.

(d) *The actual preparation of the sets for planting.*—There are three methods of preparing sets for planting.

The first process consists of putting in sets, pell mell into a small pit in three or four layers with rich earth or pond mud between the layers. The top layer is covered with earth and straw. The cuttings are watered regularly at intervals of three or four days and are ready for planting in about 10 or 12 days. Sometimes, the layers of soil between the cuttings are done away with, and ashes are only put above and below the cuttings, which are covered with a layer of earth.

The second system is more elaborate, being followed generally when the cuttings are to be kept for a longer time before sowing. Under this system, the lower end of the cuttings is buried vertically about two inches deep into a muddy layer of earth, and then covered with straw. Watering is necessary when the mud gets dry. Sprouting is generally slow in this case, and cuttings may be kept buried for nearly two months.

A third way of preparing sets is to keep them buried in moist sand for about a week.

No pickling is done by *raiya*s.

The number of nodes in a set varies from two to five.

(e) *The number of sets per acre.*—Among cultivators, as a rule, the number varies from 12,000 to 16,000. But in many places 20,000 to 30,000 cuttings are used, and in some places even a larger number is said to be used for planting, under the erroneous idea that the more the cuttings, the more will be the number of canes produced, and the greater the quantity of juice and *gur* obtained.

The sets are ordinarily about 6 inches long.

(f) *The mode of planting.*—This has already been described in a previous paragraph.

19. *Supplying vacancies.*—In many places, especially where thick sowing is done, vacancies are not filled in. In other places, extra sets are kept in pits for filling up gaps, as soon as they are disclosed—generally after three weeks or so. Sometimes even a month and a half elapses before fresh sets are put into the gaps.

20. *Seedbed and Nursery.*—No such practice is followed in Bengal.

21. *Stool planting.*—No such practice is known.

22. *Irrigation and Drainage.*—The advantages of these two operations are well known to Bengal *raiya*s, who, as a rule, select soils where there are means of irrigation, e.g., canals, tanks, streams and wells. In some parts of North

Bihar, no artificial irrigation is resorted to, especially in soils which are highly retentive of moisture and where the rainfall itself is considered to be quite sufficient for the crops.

23. *Cultivation*.—The number of weedings and hoeings has a wide range. In some places, only two or three weedings and as many hoeings are given, and in others, three or four weedings and as much as 10 or 12 hoeings are found necessary. The weeding is generally done with the hand hoe or *khurpi*, and the hoeing with the hand spade or *kodali*. It is a common practice, soon after planting, to remove the earth on either side of the cuttings with an iron hook or small piece of bamboo, then with the fingers to remove the earth round the little sprouts, and thus expose them to the sun and air for a couple of days and then to earth them up. At the time of earthing, manure is often applied.

The practice of preventing evaporation by laying a mulch of grass on the land has not been reported.

24. *Manuring*.—The practice of manuring with oilcake when the plants are being earthed up has already been referred to. It is a common practice in Lower Bengal to apply half of this manure at the time of sowing and half when the plants have attained a height of about 1 to 3 feet. The amount of oilcake applied is about 20 to 30 maunds per acre, and this is in addition to the cowdung already applied at the time of preparing the land.

The oilcakes chiefly used are mustard, castor, linseed and gingelly. A statement will be found in the appendix (Appendix III) showing the different kinds available in Bengal and their prices. The prices quoted are for Bihar, but they may be taken as more or less representative of Bengal. Samples of cakes numbered (1) to (4) have been analysed by the Agricultural Chemist to the Government of India, and the results of his analyses are given in the statement.

No statistics are forthcoming regarding the available supply of oilcakes. A collection of these cakes is being made, and will be placed before the Conference at Cawnpur.

Burning the dead leaves and using the ashes for manure is practised, but almost always, the leaves are utilized, in the first instance, for boiling the juice.

From Bihar, it is reported that a prejudice exists against the use of cowdung, as it is supposed to deteriorate the quality of the *gur*. Oilcakes are often said to make the colour of the *gur* dark.

The results of manurial experiments conducted by the Department are given below:—

BURDWAN FARM.

STATEMENT I.

Manure and quantity per acre.		OUTPUT OF GUR PER ACRE.					
		1888-89.	1889-90.	1890-91.	1891-92.	1892-93.	1893-94.
	Mds.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Super	7 5	...	...	...	3,784	3,579	2,092
Castor-cake	11 2	...	...	...	3,784	3,579	2,092
Castor-cake	42	3,877	4,083	6,372	6,788	6,542	3,576
Saltpetre	3 1	...	...	...	4,448	4,196	4,551
Super	9	...	...	...	4,448	4,196	4,551
Gypsum	3	...	...	...	4,448	4,196	4,551
Bonemeal	9	...	...	...	4,448	4,196	4,551
Saltpetre	3 1	...	...	...	5,184	4,937	4,838
Super	3	...	...	...	5,184	4,937	4,838
Cowdung	300	...	...	...	3,950	3,703	4,326
Bonemeal	21	...	...	...	3,950	3,703	4,326
Saltpetre	3 1	...	...	...	4,566	4,448	3,394
Super	30	...	...	...	4,566	4,448	3,394
Castor-cake	80	5,454	3,951	7,26 6	6,912	6,665	5,239
Bonemeal	15	5,454	3,951	7,26 6	6,912	6,665	5,239
Bonemeal	45	4,190	2,224	6,152	4,699	4,319	2,086
Unmanured	...	3,021	789	2,462	1,320	failed.	...

STATEMENT II.

Manure and quantity per acre.	OUTTURN OF <i>GUR</i> PER ACRE.				
	1896-97.	1897-98	1898-99.	1899-1900.	1900-01.
Mds.	lbs.	lbs.	lbs.	lbs.	lbs.
Cowdung 607 6	5,148	3,924	2,694	2,784	3,006
Bonemeal 89 4	4,966	3,783	3,693	3,714	3,624
Cowdung 303 8	4,821	3,990	3,072	3,199	3,690
Bonemeal 44 7					
Cowdung 303 8	5,436	3,648	3,603	3,636	3,030
Super 59 3					

STATEMENT III.

Manure and quantity per acre	Outturn of <i>gur</i> per acre.	
	Mds.	lbs
Cowdung	288	4,746
Cowdung	192	6,372
Castor-cake	9	
Cowdung	192	5,308
Rape-cake	12	
Castor-cake	31	6,180
Rape-cake	36	5,664
Castor-cake	24	6,444
Saltpetre	8	
Rape-cake	24	5,762
Saltpetre	8	
Bonemeal	49	6,564
Saltpetre	8	

DUMRAON FARM.

STATEMENT IV.

Manure applied.	Quantity of manure per acre.	OUTTURN OF <i>GUR</i> PER ACRE.	
		1900-01.	1901-02.
	Mds.	lbs.	lbs.
Cowdung	90 6	1,645	2,600
Cowdung	45 3	1,725	3,300
Bonemeal	30 4		
Cowdung	45 3	1,845	3,715
Castor-cake	4 7		
Castor-cake	9 4	1,905	3,005
Town sweepings	2,337 1	1,680	2,065
Cowdung	45 3	2,046	2,695
Super	13 0		
No manure . . . . .	.....	1,476	1,940

25. *Treatment of the canes during growth.*—The operation of tying up a number of plants with the mature leaves is more generally adopted in Lower Bengal than in Bihar, and more commonly with thick and tall canes than with thin and short canes. When this operation is first undertaken, the dead leaves

are stripped off. This practice is not only a protection against high winds, against the sun's rays and against ravages of wild animals, but it lets in more air and is said to induce more vigorous growth and to increase the amount of sugar. A few days after the single leaves are tied up, groups of canes of 5, 10 or 15 are tied together in the same way. This same process is repeated from time to time as fresh leaves make their appearance. Bamboo supports are also frequently used.

Fences of bamboos or of thorny jungly plants are sometimes to be seen round sugarcane fields, but as a rule very little care is taken by the Bengali *raiya*t to protect his crop against wild animals.

26. *Treatment of the fields preparatory to reaping the canes.*—In some places, especially in Bihar, the field is irrigated a week or fortnight before reaping, and this is supposed to increase the quantity of *gur*. In Lower Bengal, on the other hand, water is withheld before harvesting, as watering at this stage is said to increase the amount of juice in the cane at the expense of sugar.

27 and 28. *Diseases, etc., affecting the sets after planting.*—Most damage is probably done by white-ants and jackals.

29 to 32. *Diseases, etc.*—The only scientific investigations, in respect of sugarcane diseases in Bengal hitherto published are contained in the Bengal Department of Land Records and Agriculture Bulletin, No. 7 of 1900, the Agricultural Ledger No. 5 of 1901, and the memoirs of the Department of Agriculture in India, Vol. I, No. 3 "Fungus Diseases of sugarcane in Bengal," to which reference is invited.

Out of a total of 79 sets of diseased canes from 22 districts of Bengal (as it stood before the Partition) examined by Captain A. T. Gage in 1900, in only 10 was *Collectotrichum falcatum*, alone found. In seven, *Xyleborus* alone was found. In three, nothing definite was discovered. One showed the effects evidently of the grub of some moth. The remainder showed *Collectotrichum falcatum*, and *Xyleborus* associated with the distinctive effects on the tissues peculiar to each in varying degrees. The disease percentages given varied from 1 to 75. The average was about 23.5. The soil, in most cases, was described as sandy clay. The cane, in all cases, was reported to be propagated either from tops or cuttings.

33. *Reaping.—Time of cutting the canes.*—After the Winter harvest is thoroughly complete, the *raiya*t generally turn their attention to the cutting of sugarcane. Many chew a cane or two before cutting to find out whether the crop is fully ripe or not. The condition of the leaves, and the colour and hardness of the stem are other tests. But the crop has often to remain on the ground after it is fully ripe owing to the difficulty of getting mills in proper time. There is an idea among cultivators that sugarcane does not become sweet before October.

34. *Deterioration after cutting.*—Among cultivators, no time intervenes between the cutting and crushing. The cane press is set up close to the cane field, and as soon as the canes are cut, they are brought to the press. In the case of large factories, considerable delay must often occur.

35. *Mode of cutting the canes.*—In this Province, the practice is to make only one cutting close to the ground with the spade. When there are ridges, the canes are cut just at the bottom of the ridges. No experiments have been made with cane cutting machines.

36. *Yield per acre in canes.*—From Bihar, it is reported that from 24,000 lbs. to 34,000 lbs. of cane are obtained from the thinner varieties, and about 40,000 lbs. from the thicker varieties.

PART III. MANUFACTURE.

37. *Manufacture of jaggery or gur.*—For the extraction of the juice four different forms of country mills are still to be seen, but they are being rapidly superseded by the Beheea sugarcane mills and by country mills made more or less after the pattern of the Beheea mill:—

(1) The first, called *chaki*, consists of two horizontal wooden rollers furnished with screws fitting into each other. This machine is worked by two men, sitting at either end, who turn the spokes attached to one of the ends of each of the rollers. A third man feeds it with canes, and a fourth man, sitting opposite to him, receives the half-crushed canes and gives them back to the

third man. The canes must be passed and repressed several times, and even when this is done, a large percentage of the juice escapes extraction.

(2) The second consists of two stout wooden rollers placed vertically with a lever attached as in the Beheea mill, and is worked by a pair of bullocks. Three men are required to work this mill—one to drive the bullocks, another to feed the mill with cane, and a third to assist him, as in case of (1). This mill seems to be copied from a Bombay pattern.

(3) The third form is the *kolhu* or *ghani*, and acts on the principle of a mortar and pestle, but instead of the up-and-down motion of an ordinary pestle, in the *kolhu*, the pestle is rolled against the sides of the mortar by a lever attached to it. In olden times these mills were made of stone.

The price of the Beheea mill is generally too high for the individual *raiyat*. Such mills are therefore generally purchased by *mahajans* who let them out on hire at rates varying from 6 annas to Re. 1 per day.

The number of men required to make *gur* by the country mill, and the arrangements necessary for the operations, are described below:—

- (a) Two men to cut the canes, to remove the tops and leaves and to carry the canes to where the mill is working.
- (b) Four men to work the *chaki* a whole day, two men working at a time.
- (c) One man to feed the mill with canes.
- (d) One man to receive the canes and give them to the feeder to pass them again through the mill.
- (e) Two men to attend to juice boiling.
- (f) One man to attend the furnace.

About three or four maunds of *gur* may be made in this way daily.

The boiling of the juice into *gur*, as conducted in Lower Bengal, is a cumbersome operation, and compares very unfavourably with the practice followed in Bihar. Both in making the *gur* and in refining it into sugar, the Bihar *raiyats* are far ahead of the cultivators of Lower Bengal. A plot of ground is selected as close to the field as possible, and in this a hole is dug out about 10 feet long, 4 feet broad, and 5 feet deep. Over this is placed a wooden or bamboo frame-work lined with earth for the reception of two series of pots. The hole is open at both ends, through one of which the furnace is fed with fuel, and through the other the ashes are removed from time to time. The fuel used consists of cane leaves and dried *begass* or cane stalks from which juice has been extracted. The number of pots used is generally twelve. The juice, as it begins to thicken, is brought from one pot to another, till it finds its way to the last two pots nearest to the furnace mouth. In these two pots, or, in some places, in one of them, the juice is allowed to attain the consistency of treacle, when it is removed to large earthen vessels capable of holding from two to three maunds of *gur* each. This is what is known as *râb*, which has only a semi-solid consistency.

The mode of pressing and of manufacturing *gur*, as given above, is dying out now. Roller mills are very common, and the round shallow evaporating pan is used for boiling. When *gur* is made, instead of *râb*, the boiling is continued a little longer, and when the thickened juice is taken off the furnace, it is stirred for a while and then poured into circular holes dug in the ground, which serve as moulds, the bottom and sides being lined with split bamboo. This is called *chaki gur*. It is quite solid. When not sold immediately, it is packed in gunny bags and kept inside *bhusa* (chaff) to prevent the draining of the molasses as much as possible. The exact time for taking the juice off the fire is determined by taking a little of the syrup between the first finger and the thumb, and then drawing them apart, so that the syrup is drawn out into a fine thread. When this thread can be drawn out to about an inch or so, the exact time for removing the juice is supposed to have been reached. The cultivators, as a rule, take no particular care with the manufacture. The juice is very rarely strained, as it leads to an ultimate diminution in the output. The scum also is not always wholly removed for the same reason. No wood is used in boiling.

For the first day or two, the *trash* is used as fuel, and when the *begass* is sufficiently dry, dead leaves are no further required. It is the custom in some places to give away the leaves as part of the wages to those that strip and prepare the canes for the mill. If any *trash* is left over, it is used as manure. Liming is sometimes resorted to, in order to neutralise the acidity

of the juice caused by the canes being in bad condition, or by the extraction of the juice or the boiling being delayed. Milk diluted with water is often added to the boiling juice to assist coagulation, and to bring the scum to the surface. A little castor emulsion, obtained by crushing the seeds with the pestle and mortar, is sometimes added to the half boiled juice when owing to the bad quality of the canes, the juice does not thicken quickly.

The price of *gur* varies from Rs. 3 to Rs. 5-8-0 per maund. The average may be taken as Rs. 4 per maund.

38. *Profit and loss on sugarcane cultivation.*—This must necessarily vary in different parts of the Province. About as full a balance sheet as possible is given below, representing the profit and loss worked out for the Burdwan District, which may be taken as representative of Lower Bengal. The figures are for a bigha of land which is one-third of a standard acre:—

Cost of Cultivation per bigha (one-third of a standard acre).

	Rs.	A.	P.
Hoeing, 8 men	2	0	0
Ploughing, 8 times	8	0	0
40 Loads of dung	2	8	0
To apply the same	1	8	0
To make the water channels, 4 men	1	0	0
To make the furrows, 1 plough	0	6	0
2½ <i>kahans</i> of sugarcane tops	10	0	0
Planting, 8 men	2	0	0
Watering twice, 4 men each time	2	9	0
Irrigation, 2 men	0	8	0
1st hoeing, 5 men	1	4	0
Irrigation, 2 men	0	8	0
2nd hoeing, 4 men	1	0	0
<i>Baisakh</i> { Irrigation, 2 men	0	8	0
{ Hoeing, 4 men	1	0	0
{ Irrigation, 2 men	0	8	0
<i>Jaistya</i> { Hoeing, 4 men	1	0	0
<i>Ashar</i> . . . { Hoeing, twice	2	0	0
<i>Shravan</i> { 2 Hoings	2	0	0
{ 4 maunds of oil-cake	4	8	0
<i>Bhadra</i> { Trimming the leaves 4 men	1	0	0
{ Hoeing, once	1	0	0
<i>Aswin</i> . . . { Trimming the leaves	2	0	0
{ Hoeing, once	1	0	0
<i>Karick</i> . . . { Trimming the leaves	1	0	0
<i>Agrahayan</i> { Hoeing	1	0	0
{ Irrigation	0	8	0
{ Hoeing	1	0	0
{ 4 maunds of oil cake at the time of planting	4	8	0
	53	2	0

i.e., Rs. 159-6 per acre.

	Rs.	A.	P.
<i>Gur</i> -making { 5 men to cut and strip canes	1	4	0
{ 1 man attends to the furnace	0	4	0
{ 1 man boils the juice	0	4	0
{ 1 feeds the mill	0	4	0
{ 1 man drives the bullock	0	4	0
{ 4 bullocks to drive the mill	1	0	0
{ The work is extended over 4 days	13	0	0
{ Fuel	0	8	0
{ Hire of the mill and a pan	4	0	0
{ Rent	4	9	0
	74	10	0

i.e., Rs. 223-14 per acre.

Outturn { 24 maunds of <i>gur</i>	96	0	0
{ Sugarcane tops	18	0	0
	114	0	0

i.e., Rs. 342 per acre.

Profit = Rs. 118-2 per acre.

In Bihar, Chota Nagpur and Orissa, where less manure is used, and where the cultivation is much less elaborate, and labour cheaper, the cost does not exceed Rs. 80 per acre. The average yield of *gur* amounts to 35 maunds per acre, which, taken at the rate of Rs. 4 per maund, would give a return of Rs. 140 per acre. It must be remembered that much of the labour employed both in cultivation and in the manufacture of *gur* is supplied by the cultivator's own family, and the net profit is really, therefore, greater than these figures indicate.

39. *Character and richness of the juice (a).*—The percentage amounts of cane sugar and of glucose found by Dr. Leather in the juice of the varieties of cane grown at Dumraon are given in the statement below :—

Six Varieties grown at Dumraon manured with 8,900 lbs. of City Sweepings and 6,560 lbs. Castor cake per acre.

	Mungo.	Khari.	Red Bombay.	Poona.	Samshara.	Bhurli.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Cane sugar . . .	9.55	11.55	13.70	12.99	13.91	13.01
Glucose . . .	1.06	.99	.95	1.16	1.13	.57

NOTE.—Regarding the methods of analysis employed, the cane-sugar was determined in one of Schmidt and Haensch's polariscopes; the glucose was determined by Fehling's volumetric method. Usually two samples of the juice of each plot of cane were analysed and the mean of the two taken.

(b) Analyses were made again in 1897 by Dr. Leather of the juice of canes grown on the Dumraon and Burdwan Farms, the results of which are shown in the following table :—

Composition of Juice and Gur of Varieties, Dumraon, 1897.

VARIETY.	MUNGO.		BHURLI.		SAMSHARA.		RED BOMBAY.		POONA.		KHARI.	
	Castor cake.	Cattle dung.	Castor cake.	Cattle dung.	Castor cake.	Cattle dung.	Castor cake.	Cattle dung.	Castor cake.	Cattle dung.	Castor cake.	Cattle dung.
Treatment. Manure 250lb nitrogen per acre.												
Cane sugar . . .	11.73	13.53	13.73	16.09	13.35	15.36	13.31	14.33	12.77	12.35	10.90	15.43
Glucose . . .	1.13	.46	.70	.23	1.34	.72	1.00	.85	.81	1.31	.31	.32
TOTAL SUGAR	12.91	13.99	14.43	16.32	13.69	16.08	14.31	15.18	13.58	13.66	11.61	15.75
Ratio: 100 parts of total sugar contain of glucose.	9.14	3.29	4.34	1.40	9.79	4.43	6.99	5.66	5.96	9.59	6.11	2.03

Analyses of the Juice of Varieties grown at the Burdwan Farm.

VARIETY.	SAMSHARA.	KHARI.
Manure applied.	Cattle dung N = 250lb per acre.	Cattle dung N = 250lb per acre.
Cane sugar . . .	14.78	16.59
Glucose . . .	1.33	1.03
TOTAL SUGAR	16.11	17.62

(c) Further analyses made of juice in Burdwan by Dr. Leather are shown in the subjoined statement :—

VARIETY.	KAZLI.	SHANSHARA.	SAMSHARA.	KHARI.	POONA.
Where grown.	Villages Banpata, Hartsimal, Kantalgachi.	Villages Banpata, Hartsimal, Kantalgachi.	Experimental Farm.	Experimental Farm.	Village.
Treatment (manure).	* (Average sample.)	* (Average sample.)	Castor cake plot. Cattle dung plot.	Cattle dung.	...
Juice—					
Specific gravity at 15.5°C.	1,080 : 1,088 : 1,080	1,079 : 1,078 : 1,078	1,075 : 1,075 :	1,078	1,088
Cane sugar	17.05	15.24	14.78	16.59	18.08
Glucose	1.54	1.86	1.83	1.08	.76
TOTAL SUGAR	18.59	17.10	16.11	17.67	18.78
Ratio: 100 parts of total sugar contain of glucose.	8.28	10.88	8.25	5.84	4.04

(d) Figures showing the specific gravity of juices of country canes grown at Dumraon, Burdwan and Bihia, at 15.5°C., with calculated per cent. total sugar and per cent. total sugar found are given below. They are the results of analyses made by Dr. Leather in 1897 :—

SAMPLES.	Specific gravity at 15.5°C.	Total sugar calculated from specific gravity.	Total sugar determined.	Difference.
<i>Varieties at Dumraon Farm.</i>				
Mungo, castor cake Plot	1,058	14.0	12.9	1.1
Do., cattle dung "	1,064	16.0	14.0	2.0
Bhurli, castor cake "	1,067	16.5	14.5	2.0
Do., cattle dung "	1,074	18	16.8	1.7
Red Banchay, castor cake "	1,066	16	14.8	1.7
Do., cattle dung "	1,067	16.5	15.2	1.8
Samshara, castor cake "	1,067	16.5	18.7	2.8
Do., cattle dung "	1,074	18.0	16.1	1.9
Khari, castor cake "	1,059	14.5	11.6	2.9
Do., cattle dung "	1,073	18.0	15.7	2.8
Poona, castor cake "	1,068	15.5	18.6	1.9
Do., cattle dung "	1,062	15.0	18.7	1.8
<i>Varieties at Burdwan.</i>				
Kajli (rayats)	1,081	19.5	18.6	.9
Samshara (rayats)	1,078	19.0	17.1	1.9
Do. (farm)	1,075	18.0	16.1	1.9
Khari (farm)	1,078	19.0	17.6	1.4
<i>Varieties at Bihia.</i>				
Pensabi (Bihia)	1,071	17.0	15.0	2.0
Mango (Bihia)	1,081	19.5	18.1	1.4

According to the length of time given to the process of boiling, two products may be obtained, *vis.*, *râb* or *gur*. The latter is a solid mass, and is not very liable to drainage; the former is liquid, but its crystals are larger than those of *gur* generally. *Chini* is made by draining off the molasses contained in *gur* and *râb*. In the central districts of Bengal both *gur* and *râb* are known as *gur*, of which two kinds are met with, one thinner than the other, and thus corresponding to *râb*.

40. *Sugar-making*.—There are several classes of drained sugar, *viz.*, (1) *dolo* or *kachcha chini*, made directly from *rāb*, as will be described later on, by draining off the uncrystallizable molasses; (2) *pakka chini*, made by refining *rāb* or *gur* by re-boiling it and with the assistance of defecants, and by draining off the molasses afterwards; (3) *pakka dolo*, an intermediate class of *chini* made in the date-growing districts by refining a mixture of juice and *gur* and subsequently draining off the molasses; (4) *dowārā chini* (literally *double refined*, so-called from refining *pakka* or *dolo* sugar over again; (5) *doem chini*, which is a second crop of sugar obtained by re-boiling the molasses, which are separated in the manufacture of *kachcha* and *pakka chini*; it is known as *gonr* or *khanr* in Central Bengal.

Kachcha sugar is made directly from *rāb*, which is a mixture of crystals of sugar and liquid molasses. As the *rāb* is not subjected to any refining process, the quality of the *chini* entirely depends upon that of the *rāb* itself. In Bihar the *rāb* is placed in a *gamla*, or *nād*, or earthen vessel, which is provided with a hole at the bottom. The liquid molasses are allowed to drain naturally through the hole for two or three days. The greater portion of the contained molasses is thus drained off. In Lower Bengal, where sugar refinery is carried on to a limited extent only, the *gur* being sold and consumed mostly in the raw state, the method adopted is very similar and is as follows:—When the *gur* or *rāb* in the earthen pots in which it is kept has become granular and has separated from a portion of the uncrystallizable sugar, it is put in gunny bags, which are pressed laterally by means of bamboo slips tied together. These bags are placed on earthen vessels, and when the greater part of the molasses has thus been got rid of, the *gur* is removed to baskets placed on *gamlas*. In order to carry the separation further, the top of the partially drained *rāb* is loosened with an iron hoe (*khurpi*) to the depth of 3 or 4 inches, and a quantity of an aquatic weed called *sewār* or *ganj* (*Vallisneria*) put over it. Two days after a crust of brownish white granular sugar is found to have been formed on the surface. The crust is scraped off with the hoe, and a fresh layer of *sewār* is put on the newly exposed surface. A second layer of sugar is scraped off on the third day following; the *sewār* is repeated, and so on, till the entire mass is worked off. In the native methods of manufacturing sugar of any kind, *kachcha*, *pakka*, *dowārā*, etc., the *sewār* is indispensable. The sugar is not taken off so long as there is any heat felt below the layer of *sewār*. In making *pakka* sugar, a small quantity of castor seed emulsion is added to the syrup immediately it is ladled out of the boiling pan into the cooling vats.

The proportion of *kachcha chini* to *rāb* out of which the *chini* is made varies from 35 to 50 per cent. The *rāb* made in the coldest weather contains, all other conditions remaining the same, the largest proportion of crystallized sugar, and hence yields a high percentage of *chini*; that made in comparatively hot weather, as in *Falgun* and *Chait*, contains the least proportion of crystallized sugar, and hence yields a low percentage of *chini*.

The following shows the profits derived from the manufacture of *kachcha* sugar by the native process:—

One hundred maunds of *rāb* would yield on the average 40 maunds of *kachcha* sugar, 8 maunds of *doem* sugar, and 42 maunds of sour molasses fit only for tobacco and distillation. The outturn would therefore be—

	Rs.
40 maunds <i>kachcha</i> sugar, at Rs. 8	320
8 „ <i>doem</i> „ „ 6	48
42 „ molasses, at Re. 1	42
TOTAL	410

Kachcha sugar is valued by *halwais* for making different kinds of sweetmeat. It is also consumed in the hot weather in the form of *sharbat*. In the Bengal districts both cane and date *kachcha* sugars are highly valued for making *sandesh*, which is the best kind of bazar sweetmeat made in Bengal.

Pakka sugar can be made both from *gur* and *rāb*. The manufacture of *pakka* sugar includes several stages, which are described in order below:—

A large iron pan, made by local blacksmiths, usually eight feet in diameter, and one foot deep at the centre, is permanently set over a

correspondingly large furnace. The charge of *gur* or *rāb* (ordinarily 25 maunds) is mixed with three or four times its bulk of water, to make the syrup of the same consistency as cane-juice. The clarification of the syrup takes about 6 hours, from 6 o'clock in the morning to 12 o'clock at noon. As the syrup boils in the pan, quantities of much diluted milk are added to it from time to time. The scum collects on the side of the pan and is removed with a perforated ladle (*ghanjhiri*). The solution of milk is added so long as the syrup continues to throw up any scum. The syrup, when fully defecated, is ladled out and strained through a strong country cloth placed over a basket. The strained syrup is received into earthen *nāds* or vats, which are embedded in a raised mud floor built round the furnace.

After the whole of the syrup has been baled out of the boiling pan, the latter is cleaned and rinsed with water. A portion of the clarified syrup (about two maunds at a time) is ladled back into the pan. On coming into contact with the heated surface of the pan, it boils up violently at once, and is continually stirred, in order to prevent burning against the bottom and sides of the pan. The syrup attains its proper consistency in about ten minutes. Immediately before being ladled out into the cooling *nāds* or vats, about 4 ounces of castor seed emulsion are added and stirred into the thickening syrup. It is supposed to have the power of inducing the molasses to run off the sugar with greater ease and speed.

As soon as one charge of the syrup is ladled out of the pan, a fresh charge of syrup is placed in it and treated in the same way as above.

The thickened syrup is ladled from the boiling pan into the first of a series of five cooling vats: of these the first, which is closest to the pan and the last which is furthest from it are larger in size than the intermediate ones. The syrup is stirred in the first vat for a minute or two, then ladled into the second vat, where it is stirred for a minute or two, then ladled into the third, and so on, into the fifth or the last one. When a sufficient quantity of syrup has been collected in the last vat, it is taken in pots to the draining house, and poured into deep earthen vessels to solidify and granulate. These vessels are buried in raised mud floors and ranged in parallel rows. They are provided with a hole at the bottom, which is kept plugged with a grass rope. In about a week's time the syrup fully solidifies and granulates; the plug is now taken off, and the molasses which have collected at the bottom of the *nād* are allowed to drain off. When they have ceased to run, the solidified syrup is broken up into large lumps with an iron shovel, and transferred to a second series of *nāds*, where the remainder of the contained molasses is drained off by means of *sewār* in the same way as in the manufacture of *kachcha* sugar.

The large lumps of the solidified material are broken by the hand into small pieces, which are now transferred to the second series of draining vats alluded to above. The bottoms of these vats are covered each with a grass mat and provided with a hole for the molasses to pass off. The latter drain to a certain extent for two or three days. When they have ceased to run, the upper layer of the solid matter is grubbed up with a *khurpi* or a hoe to the depth of three or four inches, and a layer of fresh wet *sewār* is placed over the surface. The removal of sugar and replacing of *sewār* are done in the same way as in the manufacture of *kachcha* sugar.

The sugar is removed from the *nād*, as a rule, in the afternoon; on the following morning it is spread out on a large mat to dry in the sun.

The molasses which drain off the solid matter are conveyed by gutters to a pit. They collect here during the season of the manufacture of *pakka* sugar, which extends up to the beginning of the rainy season. During the rainy season the manufacture of *pakka* sugar cannot be conveniently carried on on account of the difficulty of drying it in the sun. The molasses which have collected in the pit are now taken out, re-boiled and treated in the same fashion as *gur* or *rāb* in the manufacture of *pakka* sugar. They may yield from 10 to 16 per cent of second or *doem* sugar. The molasses drained off from *rāb* as a by-product in the manufacture of *kachcha* sugar are also treated in the same way, and yield a second crop of sugar. One hundred maunds of *gur* or *rāb* yield on an average 40 maunds of *pakka* sugar, 6 to 10 maunds of

doem sugar; the remainder, more or less diluted with water, forms the molasses.

The cost and outturn may be estimated as below :—

		Cost.
		Rs.
100 maunds of <i>gur</i> , at Rs. 3-8	. . . . .	350
Cost of labour . . . . .	. . . . .	50
Cost of fuel . . . . .	. . . . .	25
TOTAL		425
OUTTURN.		
40 maunds of <i>pakka</i> sugar, at Rs. 11	. . . . .	440
8 " of <i>doem</i> " " 6	. . . . .	48
52 " of molasses, at Re 1	. . . . .	52
TOTAL OUTTURN		540
Net profit		115

= 21 per cent. nearly on the outlay.

Dowārā sugar is made by subjecting *dolo* and *khanr* sugars to a second course of clarification, and boiling the reclarified syrup to a solidified form, and treating the latter with *sewār* in the same way as *pakka* sugar. *Dowārā* sugar is the dearest in Bengal, and its use is limited to the preparation of the best kinds of native sweets.

The Chandpore date sugar is made by an English firm at Chandpore in Jessore out of coarse sugar. Bones are not used for clarification, and the molasses are separated by means of a centrifugal turbine driven by steam power. The sugar turned out at the Chandpore Factory is much superior to native *dolo* or *pakka* sugar; and no bones or other impure matters being used, it is very popular in the district.

Mauritius sugar is the most formidable enemy against which the Bengal sugar has now to contend. The Mauritius sugar, like beet sugar and all other refined foreign sugars, is not adapted to the preparation of *sandesh*, a favourite sweetmeat of Bengal. The reason is that it does not contain a sufficient proportion of molasses which are required to produce adhesiveness between the sugar and the curd in *sandesh*. Nor are the Mauritius and other refined sugars fitted for the above reason for the preparation of *batasha*—a preparation of sugar largely eaten by the people. But for making various other kinds of bazar sweetmeats, Mauritius sugar answers as well as, if not better than, the best kind of native sugar. All foreign white sugars, as well as those from the Cossipore and Taherpore Factories, are known to the people as *kaler-chini* or machine sugar, and are, rightly or wrongly, generally associated in the minds of the people with bone-charcoal, and if it were not for the extreme low price at which Mauritius sugar is sold, it would have been avoided as much as the other kinds of machine sugar.

Beet sugar comes from Europe. It is not in favour with sweetmeat-makers, as it is considered much less sweet to the taste than the native and Mauritius sugars. Chinese sugar probably comes from Java and the Straits Settlements. Madras sugar is used to a small extent by sweetmeat-makers; it is the produce of the Aska and several other refineries in Madras.

According to the Annual Reports of the Indian Factories Act, the number of sugar works with improved machinery during the quinquennial period ending 1904 was as follows :—

Year.	No.
1900	5
1901	5
1902	6
1903	8
1904	5

No statistics of outturn at the above refineries are available.

Besides the above, there are very small native refineries where sugar is manufactured according to indigenous methods. Enquiries made in 1905 showed that, inclusive of the above refineries, there were altogether 124 refineries—European and Native—in 1905, as against 170 refineries in 1899. The decrease in the number of small refineries was chiefly noticeable in the district of Samu and Darbhanga in Bihar. Elsewhere the industry showed little or no change. Statistics of the output of these refineries is not available.

With the failure of indigo, sugar-making is now being taken up on a considerable scale in Bihar, and with good prospects of success. It may be asked, why former attempts at sugar manufacture in Bihar failed if present prospects are encouraging. The answer is given in a report on the cultivation of sugar by Indigo planters in Bihar (published by the Government of India in 1901), and runs as follows: "Conditions were radically different in the days—the last decade of the first-half of the century—when a sudden mania for the growth and manufacture of sugar took possession of the Bihar planters. Much of the machinery ordered out in haste was found unsuitable, the persons who were to work it did not know their business, there was no means of repairing broken machines, some parts of the machinery were lost in the long and laborious transit up the river which then formed practically the only means of communication, the sugar made was of a class for which, at that time, there was no demand in the country, and all of it was sent down in boats to Calcutta, suffering heavily from wastage by theft and leakage in ill-formed boats, while there was not infrequently complete loss of boat and cargo. When the sugar, or what was left of it, finally reached its destination after a very long journey, during which interest and other charges were accumulating, it could not find a profitable market in competition with sugar produced much nearer the market and more cheaply. Further, just as the industry was started, there occurred the failure in the Union Bank, and the planter found that it was hopeless to obtain funds to any extent."

In the same report, Mr. Ernest Mylne of Bihia in the Shahabad district, who made experiments some years ago, found that the chief difficulties to be contended against were —

- (1) Heavy cost of cultivation.
- (2) Want of sufficient and suitable land near the sugar works.
- (3) Want of cheap manure.
- (4) Heavy cost of carrying cane to the works.
- (5) Uncertain yield per acre owing to variable seasons.
- (6) Refusal of the *raiyat* to contract to grow cane for the sugar factory.
- (7) Refusal of *raiyats* to sell their standing crop of cane, or sell any portion of it at a fair valuation.

There is no reason why most of these difficulties should not be grappled with.

The statement below gives the results of analyses of semi-refined sugar and of *gur* made from the molasses. The analyses were made by Dr. Leather of samples obtained in Bihia in the year 1896:—

	Sugar obtained by the hand centrifugal.	<i>Gur</i> from the molasses of the same.	Sugar obtained by the hand centrifugal.	Sugar purified by wet weed.
Cane sugar	89.48	65.71	92.20	96.67
Glucose	3.54	13.81	1.95	.89
	92.82	79.52	94.15	97.56
Ratio: 100 parts of total sugar contain glucose.	3.6	17.3	2.0	.91

It will be seen that the *gur* which was prepared from the molasses was not of very poor quality: indeed, it was nearly as good as some of the *gurs* which were prepared from juice direct at the farms.

Analyses were again made by Dr. Leather with Bihia sugar in 1897. The composition of these sugars, which were manufactured with the hand turbine are given in the table below :—

Composition of the Turbine Sugar made from the Bab.

	Turbine Sugar No. 1.	Turbine Sugar No. 2.	Turbine Sugar No. 3.	Turbine Sugar No. 4.
Cane-sugar	95.10	94.02	95.22	90.31
Glucose . . . . .	.77	1.04	1.06	1.94
Insoluble mineral matter . . . . .	.29	.38	.17	.24
Lime . . . . .	.17	.26	.17	.12
Other soluble mineral matter . . . . .	.40	.63	.64	.75
Water . . . . .	.40	.76	.77	2.78
Other impurities	2.87	2.91	1.97	3.86
TOTAL	100.00	100.00	100.00	100.00
Percentage of glucose on total sugar . . . . .	.8	1.0	1.1	2.1

A brief statement is appended (Appendix IV) illustrating the course of the sugar trade in Bengal, during the last five years. Throughout the statement, Eastern Bengal is included with Bengal Proper, because separate figures are not available. The statement shows the imports and exports of sugar by land and sea into and from Bengal, and figures have been added to show the net imports into Bengal, the production in Bengal, and the presumptive consumption in Bengal. It will be seen from that statement that there has been a marked progressive increase in the imports from foreign countries since the year 1901, tending to show that the experiment of countervailing duties has not proved a success. The figures subjoined below also tend to show that the countervailing duties did not exercise any check on the decline in the cultivation of sugarcane. The area under this crop in Bengal fell from 518,500 acres in 1900-01 to 436,400 acres in 1903-04. There has been some extension of the area since, and it remains to be seen whether this revival is going to last :—

Acres under sugarcane.

Year.	Area in acres.
1900-01	518,500
1901-02	488,500
1902-03	446,100
1903-04	436,400
1904-05	449,400
1905-06	449,100

The legislation of 1899 does not appear to have had much effect upon the competition of bounty-fed beet sugar, which comes chiefly from Germany and Austria-Hungary, as will be seen from the following statement.

The imports reached their highest figures in 1901-02 and in 1905-06 ; and taking averages of the imports during and after the legislation, it will be seen that the level of the average after legislation has been above that of the average before legislation :—

Imports of the sugar from Germany and Austria-Hungary.

Year.	Amount in cwts.
1899-00	198,139
1900-01	507,677
1901-02	753,645
1902-03	214,088
1903-04	58,000
1904-05	355,997
1905-06	885,861

41. In reference to this paragraph, copy of a letter received from the Manager of the Ottur sugarworks in Bihar is appended for information (*vide* Appendix V). This is the only factory from which any definite information has been received.

N. N BANERJEE,
Agricultural Department, Bengal.

APPENDIX I.

Statement showing the normal rainfall of the different districts of Bengal.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	2	3	4	5	6	7	8	9	10	11	12	13
Burdwan	0 41	0 30	1 08	1 38	5 04	10 15	13 25	11 76	8 40	3 35	0 38	0 10
HirDhan	0 45	0 73	0 07	1 15	4 07	10 30	13 40	10 33	10 39	5 23	0 41	0 07
Bankura	0 30	0 65	1 00	1 33	4 33	10 33	13 23	11 38	8 70	3 15	0 54	0 11
Midnapore	0 24	0 38	1 13	1 54	5 33	10 23	13 43	13 33	9 31	4 41	0 54	0 13
Hoogly	0 33	1 15	1 23	3 07	5 50	10 23	13 03	13 33	8 33	3 33	0 33	0 13
Howrah	0 19	0 30	1 02	1 31	5 27	10 23	11 33	11 40	9 45	3 79	0 51	0 13
24-Parganas	0 33	1 13	1 30	1 73	5 40	10 30	13 30	13 30	10 04	3 21	0 33	0 17
Calcutta	0 20	1 02	1 14	1 54	5 50	11 04	13 31	13 30	10 40	3 37	0 33	0 21
Nadia	0 40	1 03	1 43	2 33	3 73	10 00	10 23	10 33	8 43	4 01	0 74	0 11
Murshidabad	0 45	0 73	0 30	1 35	5 13	10 13	10 30	10 43	9 35	3 75	0 40	0 03
Jessore	0 43	1 15	1 41	3 30	7 13	11 30	10 54	10 37	8 45	4 44	0 33	0 14
Khulna	0 34	1 07	1 40	3 31	6 43	12 77	13 10	13 23	9 35	3 31	0 33	0 13
Patna	0 77	0 33	0 33	0 23	1 75	7 71	13 40	11 21	7 30	3 03	0 19	0 10
Gaya	0 70	0 31	0 43	0 17	1 14	6 23	12 40	11 73	6 55	3 27	0 20	0 13
Shahabad	0 73	0 73	0 23	0 17	0 77	6 44	13 30	11 33	6 30	3 31	0 23	0 24
Baran	0 73	0 44	0 13	0 30	1 33	7 33	11 77	11 00	3 20	3 27	0 13	0 10
Champan	0 73	0 43	0 44	0 30	2 31	9 34	13 73	13 31	9 30	3 33	0 11	0 15
Mozaffarpur	0 77	0 47	0 33	0 35	2 20	7 41	13 33	11 00	3 17	3 31	0 11	0 03
Darbhanga	0 74	0 43	0 33	0 33	2 30	7 47	13 33	13 40	10 03	3 13	0 11	0 07
Monghyr	0 77	0 35	0 35	0 33	2 13	7 33	13 33	11 41	9 37	3 40	0 03	0 07
Bhagalpur	0 33	0 31	0 44	0 30	3 15	6 34	13 73	11 33	10 13	3 33	0 07	0 07
Darjeeling	0 23	0 33	1 73	4 23	9 23	23 23	23 03	24 33	13 23	4 23	0 21	0 23
Furnee	0 45	0 41	0 40	1 37	5 41	13 31	23 13	14 33	13 44	3 33	0 07	0 03
Southal Parganas	0 33	0 30	0 43	0 33	3 75	9 73	13 33	11 33	11 10	3 15	0 23	0 03
Sambalpur	0 43	0 45	0 33	0 43	1 23	10 40	13 37	13 13	9 31	1 33	0 43	0 25
Angul	0 23	0 33	0 30	1 30	3 43	9 73	13 17	13 43	9 37	4 33	1 03	0 20
Cuttack	0 30	0 74	1 17	1 27	4 23	9 71	11 30	13 77	10 13	3 13	1 07	0 20
Balasore	0 35	1 04	1 40	1 79	5 03	9 10	13 03	11 33	11 13	3 54	1 21	0 19
Puri	0 23	0 75	0 30	0 33	3 13	8 17	10 23	13 03	9 33	7 13	2 20	0 24
Hazaribagh	0 71	0 23	0 70	0 30	1 33	6 43	14 23	13 40	3 37	3 13	0 21	0 23
Ranchi	0 45	0 23	0 30	1 07	1 33	9 34	14 23	13 31	3 30	3 33	0 23	0 20
Palaman	0 23	0 33	0 31	0 23	0 34	6 30	13 33	13 43	7 33	3 30	0 20	0 23
Manbhum	0 47	0 74	0 23	1 03	2 21	9 23	13 30	13 73	3 33	3 70	0 21	0 13
Singbhum	0 24	0 77	0 73	1 43	3 23	10 27	13 07	14 54	3 13	3 30	0 43	0 13

APPENDIX II.

Normal mean temperature of Districts in Bengal.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.		
1	2	3	4	5	6	7	8	9	10	11	12	13		
Burdwan	66.9	71.2	81.1	88.2	88.2	86.5	84.8	84.2	84.3	81.7	79.7	67.1		
Baniganj	66.2	69.3	80.8	88.8	89.1	87.4	84.2	83.4	83.3	80.8	78.8	66.1		
Bankura	66.8	70.1	78.6	86.9	89.0	87.2	83.9	83.2	80.1	80.8	78.0	66.2		
Midnapore	66.2	72.1	82.2	89.2	88.5	87.0	84.0	83.2	83.2	80.8	78.1	67.2		
24 Parganas	67.9	73.4	81.2	88.4	88.4	86.1	84.2	83.5	83.9	81.9	74.4	67.7		
Calcutta	66.2	71.2	80.2	88.7	89.0	88.8	85.9	82.7	82.2	80.5	78.0	66.3		
Nadia	64.8	67.8	78.8	86.5	86.5	85.8	83.9	83.5	83.1	80.7	72.8	66.4		
Murshidabad	65.2	69.8	79.2	87.4	86.5	86.4	84.1	83.6	83.7	80.9	78.0	65.9		
Jessore	65.5	70.8	80.4	88.2	88.8	86.2	84.2	83.7	84.0	82.6	78.8	66.3		
Patna	61.5	65.9	76.5	87.1	89.0	88.2	85.0	84.3	84.6	80.4	71.1	63.0		
Gaya	63.8	68.8	79.8	89.2	89.2	86.9	85.1	84.2	84.4	80.3	71.5	63.9		
Shahabad	Dehri	64.0	68.1	77.8	89.2	89.1	86.9	84.4	83.2	83.1	79.9	71.5	64.5	
		Buxar	63.0	68.2	77.8	89.9	89.9	88.7	84.1	83.5	83.2	79.6	70.6	62.8
			Arrah	61.5	64.5	77.1	86.9	86.5	83.7	84.8	84.2	83.0	79.5	70.4	62.3
Saran	61.9	64.7	76.1	85.9	85.6	82.7	85.0	84.0	83.9	79.6	70.4	63.0		
Champaran	69.8	69.2	73.4	82.6	85.3	85.3	84.2	83.7	83.1	78.2	69.8	61.2		
Muzaffarpur	Normal not yet worked out.													
Darbhanga	63.5	65.7	75.4	84.0	86.6	85.8	84.7	84.0	83.6	79.9	71.7	64.2		
Bhagalpur	63.2	66.4	77.0	84.9	88.1	88.5	84.2	83.6	83.1	78.4	70.8	62.9		
Darjeeling	40.8	41.8	48.5	58.6	63.2	60.7	61.8	61.4	59.9	55.2	48.3	43.6		
Purnea	61.6	65.2	76.2	83.5	84.6	84.7	84.4	83.8	83.4	78.3	70.5	62.5		
Sonthal Parganas	68.6	67.0	78.6	87.8	87.9	86.4	83.1	83.4	83.2	79.0	70.4	63.5		
Bambalpur . . . . .	...	...	...	...	...	...	...	...	...	...	73.1	66.0
Cutlack	Cutlack	72.2	77.9	84.7	90.1	90.9	87.9	84.2	83.7	84.2	82.2	75.6	70.4	
		False Point	66.7	73.8	79.8	85.8	85.4	85.2	83.2	82.6	82.0	80.8	74.0	67.7
			Balasore	68.8	73.7	81.2	86.7	88.2	86.5	83.5	83.9	83.1	80.4	73.2	67.5
Puri	Normal not yet worked out.													
Hasaribagh	63.9	66.8	76.8	85.4	87.4	84.2	79.2	78.6	78.4	75.1	67.6	61.4		
Banohi	62.7	66.6	76.5	84.6	87.8	85.0	78.5	78.0	78.1	74.2	67.7	62.2		
Palamau	Normal not yet worked out.													
Manbhum	Normal not yet worked out.													
Singbhum	67.6	71.8	80.9	89.8	89.6	87.5	83.7	82.8	83.1	78.5	71.9	65.1		

APPENDIX III.

Statement showing the composition and ordinary prices of oil-cakes used as manure for sugarcane.

(1) Castor-cake, price R2 per maund—		
Moisture	.	11.01
* Organic matter	.	75.49
† Soluble mineral matter	.	8.27
Sand	.	5.23
		100.00
* Nitrogen	.	6.48
† Phosphoric acid	.	3.05
Potash	.	1.48
(2) Rape-cake, price R2 per maund—		
Moisture	.	12.58
* Organic matter	.	70.86
† Soluble mineral matter	.	9.01
Sand	.	7.57
		100.00
* Nitrogen	.	6.14
† Phosphoric acid	.	3.00
Potash	.	1.45
(3) Safflower-cake, price R2 per maund—		
Moisture	.	8.36
* Organic matter	.	83.74
† Soluble mineral matter	.	6.21
Sodium Chloride	.	1.89
		100.00
* Nitrogen	.	7.61
† Phosphoric acid	.	3.54
Potash	.	1.40
(4) Neem-cake, price R2-4 per maund—		
Moisture	.	5.68
* Organic matter	.	84.56
† Potassium nitrate	.	7.55
Potassium chloride	.	2.23
		100.00
* Nitrogen	.	6.61
† Phosphoric acid	.	1.90
Potash	.	2.89
		Price per maund
		R s.
(5) Linseed-cake	.	2 8
(6) Poppy-cake	.	3 0
(7) Sesamum-cake	.	3 0
(8) Mahua-cake	.	2 8

APPENDIX IV.

Statement showing the course of the trade in Sugar in Bengal during the five years 1901-02 to 1905-06.

	1901-02.	1902-03.	1903-04	1904-05	1905-06.	REMARKS.
IMPORTS.						
Refined sugar—						
From Foreign countries by sea* and land.	1,515,927	1,516,119	1,276,955	2,107,463	2,211,346	*Imports into Bengal by sea up to September 1905 included a certain amount of low-grade sugar as refined, which has been classed as unrefined from October 1906.
“ Indian ports and provinces . . .	434,112	383,603	308,404	614,438	251,849	
Total refined sugar . . .	1,950,039	1,872,925	1,585,359	2,721,901	2,463,195	
Unrefined sugar and molasses—						
Unrefined sugar—						
From Foreign countries by sea and land.	“	“	“	“	229,483	†Molasses—raw, gw, jaggery, shirs and treacle Molasses is not distinguished from other kinds of unrefined sugar when imported coastwise or from foreign countries by land. But the quantity in these cases is trifling.
“ Indian ports and provinces . . .	74,907	43,340	58,465	48,041	61,517	
Molasses†—						
From Foreign countries	415,918	447,296	257,677	333,851	533,071	
“ Indian provinces	599,356	554,252	504,265	577,024	533,058	
Total unrefined sugar and molasses . . .	1,080,960	1,024,898	855,946	959,916	1,407,070	
Total imports from foreign countries . . .	1,931,875	1,963,415	1,534,632	2,441,314	2,973,877	
“ Indian provinces	1,105,023	940,408	806,671	1,040,028	598,460	
GRAND TOTAL IMPORTS OF SUGAR . . .	3,036,928	2,808,223	3,100,835	3,461,107	3,870,267	
EXPORTS.						
Refined sugar—						
To Foreign countries by sea and land . . .	19,591	14,375	15,513	20,137	27,983	
“ Indian ports and provinces	154,319	154,021	275,245	439,438	427,491	
Total refined sugar	167,480	168,006	290,758	459,575	455,474	
Unrefined sugar and molasses—						
Unrefined sugar—						
To Foreign countries by sea and land . . .	81,116	49,181	43,575	43,347	83,948	
“ Indian ports and provinces	475,733	391,360	392,841	399,500	448,723	
Molasses—						
To Indian provinces (by rail and river only)	690,646	722,811	618,367	663,586	631,636	
Total unrefined sugar and molasses . . .	1,219,495	1,044,852	1,004,983	1,088,513	1,134,818	
Total exports to Foreign countries . . .	63,707	55,138	58,088	63,494	71,941	
Total exports to Indian ports and provinces . . .	16,226,208	1,179,269	1,850,653	1,485,054	1,497,639	
GRAND TOTAL EXPORTS OF SUGAR . . .	1,385,915	1,238,238	1,305,041	1,646,138	1,569,800	
Net imports of sugar	1,651,013	1,670,485	1,715,787	1,923,969	2,300,467	
Production of sugar	13,628,200	13,631,500	13,078,900	13,69,000	13,300,000	
Presumptive consumption	15,179,213	15,302,095	14,769,733	14,626,959	14,600,867	

APPENDIX V.

Dated Ottur, the 23th December 1906.

From—H. M. CARRY, Esq., Manager, Ottur Sugar Works, Silout Tirhut State Ry.,

To—The Director of Agriculture, Bengal.

I regret not having found time before to reply to your letter of the 5th ultimo No. 4623.

Prices ruling at present in Bihar for cane are Re. 0-4-6 and Re. 0-5 0 per maund which should always be a safe price for the manufacturer and gives the grower a good return. Seeing the great fluctuations in the price of sugar, these are high prices for a minimum rate, but when sugar exceeds a certain price, the grower should be allowed to participate in the high prices.

The *raiyat* has no statistics to know what pays him best, but I am sure, he would find the above rates for his cane would pay much better than making jaggery in the primitive and wasteful manner prevailing. It is a surprising fact, but the price of *gur* in this country seems to be in no way ruled by the world's price of sugar, but with the latter at its lowest and *gur* at its highest, I still think it would pay the *raiyat* to sell his canes.

Round these parts, eight small central factories have been erected in the last few years. Of these three are new and commence work this season; one is closed down as sufficient supplies of cane in the neighbourhood are unprocurable. With one exception, the others have all suffered up to date on the same account. Two small factories were erected for making jaggery of sorts, but were promptly closed as wasteful and unsatisfactory. A third since erected on the same lines seems to have done poorly so far. It is not likely in these parts, where so much tobacco is grown, it will ever be necessary or pay to make spirits. There is a good demand for molasses at prices that pay better than spirit-making would.

The size of the factory and the capital necessary entirely depends on the available cane lands within a practical distance. It appears to me, that in Bihar small central factories are most suitable as the cane plots are generally so scattered and small in size that light railways would hardly serve and with bullock cart transport only a factory to deal with 300 tons of cane a day would probably be quite large enough as, with 100 days' working, the total of 20,000 tons of cane required would represent the most that would be grown year in and year out within an area that could be suitably served by bullock carts. If 10,000 tons is more likely to be the figure, then let a factory for 100 tons per *diem* be selected.

Roughly speaking, a sum of ₹1,50,000 should cover the total cost of erection of a complete factory of the last-mentioned class, but I have not the time and sufficient data at my disposal to give a "carefully compiled statement."

Double crushing with or without shredding rolls preceding each mill of 3 rolls is the general type of crushing plant used in the factories here. Heaters, clarifiers, subsiding tanks, filters, and filter presses, are also general in varying forms. Triple effect evaporation, vacuum pan, centrifugals, dryers, and crushers, with large tank room for low grades and molasses roughly complete the outfit of the various factories here.

The capacity of the mills varies from 100-400 tons cane per *diem* and should work 3 to 4 months at least for a full crop, but so far few have had a sufficiently liberal supply of cane. All the above-mentioned factories deal with cane, some continuing work after the cane season refining native sugars. I have heard of no one so far importing foreign sugars for refining purposes. One factory alone not included in the above-mentioned deals with jaggery only for its raw material.

The general machinery in use is not suited to any other industrial purposes than sugar refining.

Small factories had much better make a raw refining sugar to feed a big refinery. The cost of manufacture is much reduced and expensive, skilled supervision almost dispensed with, the latter being concentrated in the refinery though advising and checking results of the small raw sugar factories. One sales department and a limited number and regular grades of sugar also tends to economy. Small factories making only raw sugar could be run entirely by natives, visited by experts from time to time to check waste.

MADRAS.

Proceedings of the Board of Revenue (Revenue Settlement, Survey, Land Records and Agriculture), dated the 21st January 1907. 372-Misc.

The Hon'ble Mr. A. E. CASTLESTUART STUART, I.C.S., Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.

Read the following letter from the Director of Agriculture, No. 39--Dis., dated the 16th January 1907.

With reference to paragraph 3 of B. P. No. * 236-Misc., of the 11th instant, calling on the Government Botanist to submit the result of the enquiry into the sugarcane industry in this Presidency, I have the honour to inform you that the Government Botanist, who is just proceeding on leave on medical certificate, informs me that he has not prepared any report. The Agricultural Inspector deputed by the Government Botanist to make enquiries on the subject in various districts has not yet completed them. It will not therefore be practicable to send in any report on sugarcane-growing in this Presidency in time for the next meeting at Cawnpore.

RESOLUTION.

Communicated to the Inspector-General of Agriculture, in continuation of the correspondence ending with B. P. No. † 324-Misc., dated the 18th January 1907.

(True extract.)

L. W. SWAMIKANNU,

Secretary.

PUNJAB.

1. Owing to the very limited acquaintance of the writer with the cultivation

Introductory.

of sugarcane and manufacture of its products, this note does not aim at any exhaustive treatment of the subject, but is intended merely to give a general idea of the status of the sugarcane industry in the Province. Some day, and it is to be hoped at no distant date, the subject will be fully dealt with. The note follows Mr. Barber's suggested form of inquiry and forms indeed as far as possible replies to his queries, and it is hoped may be of some use to him. It is to be regretted that little has been done in the way of experimental work with regard to the crop, the only Experimental Station in the Province being at present situated at some distance from the cane-growing tracts. This, however, will be soon rectified by the establishment of a second station at Jullunder in the heart of the cane-growing districts.

The writer has omitted any attempt to describe or classify the varieties of sugarcane and to make any definite suggestions as to lines on which improvements may be made. His acquaintance with the crop has been too limited for that.

It is, however, an undisputed fact that the valuable crops, such as sugarcane, form the backbone of the agriculture of the country. The growing of such crops can only be accomplished by much labour and good husbandry. The former factor admits of the land supporting a greater number of people; the latter tends to the upholding of the fertility of the soil.

An extension of the area under the crop means an extension of the land under good cultivation. But it also means more; for the subject includes both the cultivation of the crop and the industry of the manufacture of its products.

2. Table I gives the average rainfall and its distribution throughout the year for the Punjab. The figures for the

Climate.

hill stations, which can easily be recognised, are retained.

A glance at the table at once shows the scant rainfall during the winter and spring months and the late arrival of the monsoon, also the small annual rainfall in the western, southern and south-western parts of the Province. The principal falls occur on the submontane tracts which will be found further on to correspond to the chief sugarcane districts. The climate of the Province may be briefly described as hot and very dry—intensely hot by day and night from May to August in the tracts which receive more or less of the monsoon, the heat continuing up to the end of September where the annual rainfall is low. The daily maximum temperatures generally run from 105° to 110° and above in all the stations in the plains before the rains. The winter months are cool with low temperatures at night and occasional frost. From the agricultural point of view the climate is a severe one and tests the hardihood and vitality of plants to the uttermost.

The eastern part of the Province has a more moderate climate than the western, having a shorter hot weather and a milder cold weather.

3. As far as I am able to say, there are no historical references of any antiquity on the subject in this Province.

History of the crops in the Punjab.

The crop seems to have been in cultivation in the time of Alexander the Great. There is a legend that it was brought into the Punjab by "a great King who brought three things from the sea which required too much water—rice, sugarcane and the buffalo."

There seems to be some evidence that sugarcane cultivation spread originally from the United Provinces to the Punjab. It is quite certain that many of the Punjab varieties have been brought from Meerut and Rohilkhand. The *paunda* varieties are supposed to have come originally from Saharanpur, where they came to from Ceylon. It is believed by some cultivators that the *chan* variety has descended from the wild grass cane (*kahi*) which is occasionally to be met with in the jungle. Whether indigenous or exotic, there exists no information to indicate even roughly at what period cultivation of the plant arose.

The new canal colonies present a field for the study of the crop under new conditions, and a comparison of the figures from 1896 to 1904 gives some indica-

tion of the gradual increase of area during colonization where the colonists brought their own seed and methods of cultivation. A special study of the behaviour of the various varieties under the new conditions of soil and climate, which differ considerably from those of the eastern part of the Province, has not been made, but would be no doubt useful. Special modifications of the cultivation and treatment of the crop will in time probably arise, and its whole history will be interesting to follow.

4. Table II gives the acreage under sugarcane in each district of the Province from 1896 to 1905 inclusive, the figures for 1906 not being at present available.

Extent of the cultivation of sugarcane in the Punjab.

The most striking feature is the great decrease in area for the year 1905. This was probably entirely due to the fact that most of the canes set aside for seed were destroyed by frost. The average area for the five years 1896 to 1900 was roughly 346,900 and for the four years 1901 to 1904 (leaving out 1905 as abnormal) 334,900, which shows a decrease of $3\frac{1}{2}$ per cent in spite of an increase of nearly 20,000 acres in Lyallpur District. The percentage of decrease is perhaps too small to admit of any definite explanation. There are, however, influences which doubtless have some effect on the crop area. Perhaps the chief are the increasing popularity of wheat and cotton in the Province.

A counteracting tendency may be found in the high prices of *gur* and *shakar*. Perhaps a fair estimate of the figures in Table I would be that there is a slight tendency to decrease of area in the older districts and a possibility of expansion in the colonies.

5. Broadly speaking, although sugarcane is cultivated in every district, it does not assume any relative importance except in those districts which have a fairly plentiful and secure supply of water in some form or other. The reason of course is obvious: the crop requires a great deal of water for its successful growth and this supply must be fairly secure as the capital outlay is great and failure cannot be lightly risked.

The character of the cultivation of the Province.

The chief cane-growing districts are, as we might expect,—

- (1) Those which have a plentiful supply of irrigation water from canal or wells.
- (2) Those having a moderate supply but a relatively higher rainfall.
- (3) Those which have a sufficient rainfall for the full growth of the crop. This class of cultivation is in the Punjab confined to those lands which lie close to the hills.

Relatively speaking, the first-mentioned class of land is the most important for sugarcane, security in this case being much greater. Representative tracts are the northern part of Jullunder Division and part of Lahore Division.

The second class of land is represented mainly by the Delhi Division in its southern districts. The third class or *barani* cultivation is mainly carried on and successfully too in the Gurdaspur and Hoshiarpur Districts. Table III has been compiled to shew the relative importance of the crop in each district which is indicated by the percentage of sugarcane to the total area cropped.

The figures used are the total average cultivated areas for the last five years and the average sugarcane area for 1901 to 1904, the year 1905, as before being eliminated.

The more important sugarcane districts may be broadly stated to be those lying in the submontane tract between the Chenab and Jumna rivers. Generally speaking, the crop forms part of the regular rotation. In those parts where it does not assume any relative importance it is to be found in isolated patches round about wells on land which is intensively cultivated.

There are of course other factors which influence the extent and character of the cultivation. Labour must be plentiful and cheap, the land must be of good quality, and manure must be available. The quality of land is perhaps not so much a determining factor as it might appear, as good land is to be found all over the Province. The scarcity of labour and supply of manure is no doubt one of the reasons why the sugarcane crop is relatively not of so much importance in the canal colonies where land is good and irrigation water cheap.

6. It is impossible for the writer to attempt any classification of the Punjab varieties at present until he has a collection of fully developed specimens beside him. For the same reason nothing but a very general description can be given. As far as possible, a complete collection of the varieties will be submitted at the next meeting of the Board of Agriculture at Cawnpore.

The following is as complete a list as can be given at present. Some of the varieties mentioned are rare and found only as admixtures amongst others. Many of the varieties mentioned appear to be exactly similar and will probably turn out to be the same variety under a different name.

A.—Chewing canes—

These are generally known under the name of "*paunda*" and are thick and succulent.

1. *Paunda*.—Greenish, soft, hard and juicy; the thickest of all varieties.
2. *Pauni* or *Poni*.—Soft skin—thinner than *paunda*—lighter green colour—corresponds with "*mairti*" of Saharanpur (?)
3. *Kinara*.—White, soft, juicy. This cane is also used for *gur*-making but is not at all common.
4. *Saharni*.—A *paunda* variety which has been imported from Saharanpur.

B.—Gur-making canes—

5. *Chan*.—The most important and most extensively cultivated in the Province, red in colour, thin to medium thickness, skin softish to hard, largish joints, yields small quantity of juice but good percentage of sugar.
6. *Dhau* or *Dholu*.—This is a good variety—whitish resembling *pauni*—smooth soft skin—thicker than *chan* but thinner than *pauni*.
7. *Ekar*.—Resembles *dhau*, somewhat thicker when ripe, said to have black lines.
8. Hissar reports give the name *Ganna* to some variety. This however is a general name for medium varieties.
9. *Dohb*.—{ *Ikh*, also reported from Hissar. *Ikh* seems to be a
10. *Lat*. — { general name for thin varieties.
11. *Tereru*.—Resembles *dhau*, but has a hard, coarse rind.
12. *Kahu*.—A thickish greenish white variety with a soft skin—is said to be a good ratooner.
13. *Kahta*.—A very thin reddish variety—very narrow leaves, hard rind—juice of good quality.
14. *Mendhin*.—Said to be American and found at Sialkot.
15. *Desi of Shahpur*.—Probably *chan*.
16. *Desi of Rohtak*.—Also probably *chan*.
17. *Sortha*.—A soft rinded variety whitish in colour.
18. *Lalri of Karnal*.—Description like *chan*, probably the same variety.
19. *Chinki*.—A poor thin fodder cane (found at Gujrat).
20. *Ghorru*.—A poor, dry, hard cane, found in Ludhiana District; when growing looks well but a poor yielder, tall, suitable for dry sandy tracts.

7. Generally speaking, the soils of the Province are alluvial in origin and a section reveals successive layers of sand, clay and loam. As a rule the land is

Sugarcane soils.
fertile where the clay or loam outcrops, or where, when the surface is sandy, the clay or loam is not too far down to prevent the roots of plants from reaching it. A seemingly sandy soil may be seen producing excellent crops, but the reason is that the clay is near the surface. In sandy soils where the clay is too far removed from the surface the land is either barren or inferior. The clay is, as a rule, fairly pervious to water and drains readily.

In general character the typical sugarcane soil may be said to be an alluvial loam, naturally deficient in organic matter but fairly well supplied with mineral substances.

A shallow layer of sand overlying a stratum of clay is advantageous, the land being easily worked, any caking after irrigation being easily broken up and the moisture conserved.

8. As stated above, it is almost certain that most, if not all, of the Punjab varieties of sugarcane are exotic. Definite and recorded introductions of new varieties, however, are difficult to trace.

Recorded introduction of new varieties.

The *paunda* variety is said to have come from Shaharanpur and at the time of its introduction was said to have been "as tall as a bamboo and as thick as a man's thigh. At that time it was said to have been very hard." It certainly must have degenerated sadly since those days. Whether any further decline is going on at present, it would be difficult to say.

The only recorded introductions of exotics as an experiment were at the Agri-Horticultural Gardens at Lahore and the Lyallpur Agricultural Station. At the former place a number of new varieties were planted, but the result was a failure, while at the Lyallpur station two Poona varieties, *Bansl* and *Sanabali*, were grown but produced only 1,944 lbs. of *gur* each per acre against 5,008 lbs. per acre of the local *katha* variety. Neither of the two experiments were persisted in.

There is little doubt but that exotics from more humid climates undergo deterioration in the Punjab. The plant which seems to thrive best in this Province is a thin hardy variety which requires less water and manure than the more succulent varieties, and under present conditions it is questionable if any other type of cane would be popular with the cultivator, who complains that even his own species of cane requires too much water and manure.

9. The appearance of any new variety by sports or otherwise is unknown to the cultivators. Whether such have arisen it is impossible at present to state as there is no record of any scientific observation on the point.

Sports and seedlings.

No cases of any canes having been raised from seed are on record although unsuccessful attempts have been made by local officers to do so. The cultivator on the other hand is always on his guard against his canes producing seed.

10. As far as I am aware, sugar and spirit are produced only from sugarcane in the Province. The following experiment with the object of obtaining *gur* from *juar* was conducted at the Lyallpur Agricultural Station in the years 1901-02 and 1902-03 :—

Other sources of sugar.

Variety.	Years.	OUTPUT PER ACRE.					PERCENTAGES OF		
		Green tops and leaves.	Stalks.	Juice	<i>Gur</i> .	Grain.	Juice to stalks.	<i>Gur</i> to Juice.	<i>Gur</i> to stalks.
Sweet	1901-02	5,024	18,969	6,816	816	...	48.79	11.97	5.84
Local	1902-03	7,896	6,072	8,572	584	644	58.82	15.76	9.28
Sweet	1902-03	4,164	4,140	1,836	276	592	44.84	15.03	6.66
Quatha . . . .	...	..	...	...	...	...	.	...	...

The Annual Report says :— "This year the *gur* was made when the crop was fully matured and this accounts for the higher percentage of *gur* to juice and stalk and of juice to stalk. The *gur* made was of very bad quality like a thick mass of black syrup. The *gur* made last year presented the same characteristics. This syrup sometimes turns into a black hard brittle and solid mass, but it produces no crystals. There appears to be an unduly large proportion of glucose. The results are not encouraging and the experiment will be discontinued.

11. The time of planting and reaping vary very little throughout the Province. Sowing is usually done from the 25th of February to the end of March,

Planting and reaping seasons.

The first cuttings as a rule being about nine months after sowing time (that is from the end of November to the end of December). It is recognised by cultivators that the best time for cutting is about the new year, but the work has to be begun earlier in order to get the whole area cut in time before the planting of the next crop. Cutting goes on into February, occupying usually about two months.

12. Probably in no other respect do the practices of the province vary more than in rotations. It is quite

Rotations

universally understood that sugarcane must not follow sugarcane in the rotation, and hence the practice is rarely met with except on those lands which are renovated annually by silt deposits.

The chief crops in the alternative are wheat, cotton and maize. As a rule sugarcane is preceded by a *rabi* crop, but it is not uncommon to find it grown after a *kharif* crop. Where this practice prevails the usual crop is cotton followed by a catch crop of *sengi*, which is immediately grazed off and the land ploughed up.

Where the preceding crop is a *rabi* crop, it is usually wheat, but as a rule cotton forms part of the rotation at some time or other.

After sugarcane it is usual to follow on with a *kharif* crop, which may be maize, cotton, etc.

There seems to be no hard and fast rule in any district with regard to rotations, but the above principles are generally adhered to.

The ploughing in of *san* (hemp) and grazing of *sengi* are really manurial practices and will be further noted under that heading, but it may be here mentioned that such practices are chiefly confined to the Jullundur District, where the manurial value of leguminous crops is well understood and the knowledge acted upon.

Catch crops with cane seem to be rarely attempted, but melons are sometimes grown along with the *paunder* varieties.

13. The usual protective crop for sugarcane where such are grown is *san* hemp. This practice is also most common in the Jullundur District.

Protective crops.

14. Ratooning is not at all common, and, as a rule, finds little favour amongst cultivators. It is carried on

Ratooning.

mostly in the Gurdaspur and Hoshiarpur Districts, on the land which receives an annual deposit of silt. The usual practice is to plough the land a few times to loosen the earth about the roots. Little or no manure is supplied for the ratoon crop. The after cultivation is the same as for ordinary set planted cane.

Sometimes it may be necessary to have recourse to ratooning owing to scarcity of seed, but generally speaking, ratooning is not common.

The *kahu* cane of Gurdaspur is said to be specially suitable for ratooning.

Cultivation.

15. Cultivation may be broadly classified into three types:—

- (1) Where the sugarcane crop follows a *rabi* crop allowing a year's fallow.
- (2) Where it follows a *kharif* crop (e. g., maize).
- (3) Where it immediately follows a *rabi* catch crop.

The procedure in (1) is described below; in (2) it is identical except that there are fewer ploughings. (3) This is usually brought about by *sengi* being sown amongst the cotton crop. When the latter is cut down the *sengi* is grazed off by cattle and the land ploughed in February. In this case (usually in Jullundur District) little or no manure is given.

16. Where the crop is preceded by a *rabi* crop ploughing begins as a rule after the wheat harvest, i. e., in June and goes on up to sowing time. As many ploughings as possible are given. In some districts it is said that the land is ploughed about 40, 60 or even 100 times. The general rule seems to be to plough as often as possible and probably the average will be about 15. The fallow then is complete in one sense, that the land is frequently stirred. It is questionable, however, if the ploughings are deep enough, and whether it would not be better economy to give one or two very deep ploughings, reducing the

Preparatory Tillage.

number. The usual depth of ploughing is not above from 6 to 7 inches and it would be well worth experimenting with deeper stirrings of the soil. Weeding and hoeing are, as a rule, carefully carried out and persisted in until the crop has fairly prevented further operations. The usual amount considered quite necessary is 4 times, but it is done as often as possible. The only implements necessary for the preparation of the soil are the plough and the *sohaga* or leveller.

17. There is practically only one method of planting, *viz.*, behind the plough. The procedure is as follows.

Planting.

The ploughman proceeds in the usual way and the planters, 6 or 7 for each plough, follow up and lay the cut sets in the furrow pressing them down with their feet as they proceed. The plough comes round again at a distance of about 8 inches making a new furrow and covering the sets in the preceding one. The sets are usually covered with about 3—4 inches of earth. The field is then levelled with the *sohaga* which finishes the operation.

18. As a rule the cultivator in the Punjab does not bring his sets from a distance, although in some parts of the Delhi Division it is recognised as good

Change of seed.

practice to bring seed from Meerut. There is no dependable information with regard to the effect of this practice on the growth of the plant and the richness of the juice.

The usual practice is for each cultivator to grow and select his own sets and where these may prove insufficient to purchase new sets locally.

Generally speaking, with the exception of the case mentioned above, the cultivator is averse to using seed brought from a distance, his usual answer being that the outturn is less and the juice poorer, but it is possible that this belief is due to prejudice.

19. The seed canes, except in the case of the *paunda* and soft skinned varieties, are often allowed to stand over till the last, and cut just before sowing. This practice, however, proved disastrous in the winter of 1904 when the standing canes were destroyed by frost, and is likely to go out of fashion.

20. The whole cane as a rule is used for cutting into sets except the "tops" and rooting joints. The Punjab canes, especially the *dholu* and *chan* varieties, which form the bulk of the crop, appear to be quite suitable for this practice. The sets get no special treatment in the way of pickling, etc.

The thick or hard-rinded varieties are usually buried for some time before planting, if they have not been stored in pits, to hasten germination. Care is taken to shelter the sets from the sun before planting by covering them up.

The number of joints in a set, varies from two to four. Two, I think, is the more common number.

21. The number of sets per acre is not usually calculated. An acre of cane is supposed to require from 5,000 to 6,000 whole canes and as from 5 to 6 sets

Number of sets per acre.

per cane are the usual numbers, 25,000 to 36,000 may be said to be the usual number per acre, although I believe the latter figure is often exceeded. The mode of planting has been mentioned above.

22. The sets are usually planted from 8—12 inches apart in the furrows which are about 8 inches distant from each other. Owing to irregularity of ploughing

Distance between sets

the sets are not all planted at an equal depth, but after levelling the usual amount of covering they have is from 3—4 inches.

23. It is not the custom in the Punjab to fill up blanks in the crop, and on the whole considering the large amount of sets planted it is seldom necessary to do so.

Vacancies

24. Transplanting from seed beds seems also to be unknown, but might be very useful as the cane often suffers in its early stages from drought and the ravages of white-ants.

Transplanting

25. Stool planting is of very rare occurrence in the Province, but was attempted in some places last year along with ratooning owing to the scarcity of

Stool planting.

sets. The effect is reported to have been similar to ratooning, and cultivator say they would not attempt it except under similar circumstances.

26. The two main sources of irrigation water are by wells and canals.

Irrigation.

Tank irrigation is of limited extent and unimportant in the Province. The canals give on the whole a good and regular supply of water. Well irrigation is effected by means of the Persian wheel and bucket systems. From the point of view of sugarcane cultivation, well water is most scarce during the early days of the crop, but as most of the *khariif* crops require little water before the rains, the sugarcane crop gets the greater bulk of the water and on the whole this is sufficient. After the rains break the critical time is past and water is more abundant in the wells. No doubt a more plentiful and cheaper supply of irrigation water in the cane districts would lead to an increase of area under the crop. Everywhere one is met by the cry that "sugarcane requires too much water." In some tracts unfortunately the water level is sinking and this is bound to affect, if it is not now already affecting, the area under sugarcane. The crop is bound to be the first to be affected through diminution of the water supply. The supplanting of the sugarcane crop by others in some districts has probably as its ultimate cause the increasing scarcity of water. The use of oil engine pumps might possibly lead to an increase of area under the crop, but until definite experiments have been carried out to determine their economic value in the Province as compared with present methods of water-lifting, no opinion can be expressed. It will be interesting to observe the results of the canal irrigation extension schemes at present being carried out on the sugarcane area in the Province. "Cheap water and plenty of it" is the main stay of the crop.

27. Drainage, as mentioned before, is, generally speaking, good throughout the Province, and as it is the custom to plough up all fallow land after the rains conservation of moisture is fairly well secured.

Drainage.

28. Although it is recognised that the sugarcane crop requires a special manuring of its own, the whole question is so involved with that of the general

Manuring.

fertility of the soil that it is impossible to compare the various practices of cultivators without reference to the treatment of the land throughout the rotation. Where sugarcane forms part of the usual crop rotation, as it does in all the important cane districts, the practice is to consider it the most important crop of the series and to give it the first consideration with regard to manure, the other crops being considered subsidiary in their manurial requirements. We thus find that in the majority of places most of the available manure goes to the sugarcane crop. Further, the crop as a rule is given the benefit of a fallow of not less than ten months.

29. Where the cane crop follows a *khariif* crop, it is the practice in some places as mentioned above to grow a catch crop of *sengi*, which is subsequently

Sengi as a fertiliser.

grazed off for manurial purposes. It is important to observe that in this case cultivators hold that no other manure is required. This practice would seem to indicate a great power of expansion of the manurial supply of the Province if necessary. At the same time it must be noticed that such land probably gets some manure at some stage of the rotation or other. But the point is well worthy of consideration, as in the cane-growing districts the area under the crop is probably mainly influenced by the supply of manure and water. This practice also admits of the abolition of the long fallow and the possibility of cane following cotton (a *khariif* crop), which would doubtless add to the economic value of the crop in the rotation.

The chief source of manure is of course farm-yard manure. Cakes as far as I know are not used, but occasionally crude saltpetre and nitrous earth, where available, are applied.

30. The amount of manure supplied varies considerably and depends on local circumstances. Close to the hills some land receives an annual supply of

Quantity of manure.

river silt and requires no manure. But these cases are exceptional and the crop in general receives from 150—300 maunds (82lbs.) per acre of farm-yard

manure. Some cultivators hold that an excess of manure spoils the quality of the juice. This may be probably explained by the tendency of an overdose of manure to retard the ripening of the crop.

31. Manure is generally applied when the final preparation of the land before planting is begun, say a month before. It is customary in some cases,

Time of application.

where the supply at that time is deficient, to apply a second dose after the cane has appeared above the ground. The manure is generally in this case worked into the soil in the process of weeding. As a general rule, however, all the manure is applied before sowing.

32. In discussing the quantity and quality of the available manure in the Province it is worth while considering the influence of climate. It is quite probable

Available manure in the Province

that owing to the colder winter climate and the short duration of the monsoon both the quantity and quality will compare unfavourably with other Provinces. It is probable that more cattle-dung is used during the cold weather in this Province than in others. The rains prevent the use of cattle-dung as fuel to a large extent during their duration and the comparative dryness of the Province must act adversely to the accumulation of manure.

The trash and leaves of the cane are all lost to the manure heaps as it is required for *gur*-making. The stools, too, are often burnt and this residue is thus lost to the soil.

33. The practice of ploughing leguminous crops into the land under fallow in the hot weather, although not necessarily before sugarcane, comes under the

Residue of leguminous crops.

heading of manuring. This practice is met with mainly, I think, in Jullundur where the cultivation is, generally speaking, excellent. The usual crop used for this purpose is *san* hemp. The great drawback the cultivators experience is the difficulty of ploughing in such crop properly with their *desi* ploughs. A shallow draught furrow-turning plough would be very useful for this purpose.

It must also be taken into consideration that in the sugarcane-growing tracts the leguminous crops—*san*, *mash* and *mung*—are widely grown and the value of their manurial residue must be considerable.

34. Regarding the supply of oil-cakes for manure in the Province I have not been able up to the time of writing, to

Oil-cakes.

obtain any figures dealing with the total amounts. The oil seed crops form an important item in the *rabi* crop of the Province. *Sarson* (rape) and *toria* (mustard) are the two chief varieties grown, others being rockel (*taramira*), sesamum (*til*) and castor. An analysis of the cakes from these crops is given in Table IX.

35. Unfortunately no manurial experiment dealing with sugarcane of any value has hitherto been carried out in the

Manurial experiments.

Punjab. In 1904 the Lyallpur Station took up one experiment, but its value was lost owing to the attack of borers. The result is given in the Station Report for that year, but must be largely discounted.

36. It may be said that the Province in one way and another has considerable manurial resources capable of expansion. The most valuable and probably

Expansion of manure supply.

the cheapest sources lie in the possibility of growing leguminous catch crops, the development of which has not been attempted.

37. Any attempt to increase the area under sugarcane by manurial expansion ought to take into consideration the possibility of working out a scientific

Value of suitable rotations.

rotation of crops culminating in sugarcane. Such a series ought to include if possible at least one other paying crop such as cotton, at least one leguminous crop, and finish up with a catch crop of, say, *sengi*, before sugarcane. This is practically the practice of many of the best Jullundur cultivators, but whether it would prove suitable for other districts remains to be seen. It is just possible that the land of other districts, where the *kharif* fallow system is carried out, may not be able to do without the fallow, but where possible it certainly *prima facie* looks like good economy.

38. After cultivation consists mainly of weeding and hoeing and it is generally recognised that the more often this can be done the better for the crop.

After cultivation.

Four hoeings and weedings are considered quite necessary and as many more as possible. In good cultivation an average will possibly be six weedings and two hoeings.

Weedings for the purpose of cleaning and loosening the soil are performed by means of the trowel-like hand implement called the "baguri" or "kharpa." Hoeings for the purpose of breaking up the hard surface are done with the *kahi* which consists of a broadish iron blade fastened at an angle of about 60° to a wooden handle.

Improved cultivators are unknown.

The land is seldom protected from the rays of the sun during the early days of the life of the crop, but this is sometimes done, especially at Hoshiarpur, by laying down the leaves of the *Chhachra* (*Butea frondosa*). After the canes attain a height of a few feet it is impossible to penetrate into the plots and all cultivation ceases.

39. The only treatment during the growth of the crop is tying which although more commonly done in the Delhi Division is known all over the Province.

After treatment.

As far as I know bamboos are seldom used for this purpose, although it is usually done for the sake of supporting the crop. The common practice is to tie two or three canes together by their leaves. Nothing is done in the way of treating the canes to keep off jackals, etc., watching and making noise by night being the only attempts to guard against their attacks.

40. It is the usual custom to irrigate up to the time of cutting. This practice is believed by cultivators to increase the amount of juice and to be a protection against frost.

41. Very little is known in this Province about the sugarcane diseases.

Diseases and insect attacks.

What is known is merely the knowledge of the cultivators themselves. The chief

insect pests are the moth-borer and white-ants, more especially the latter, which are responsible for a good deal of the damage done to the crop.

Cultivators say that *tela* (*aphis*) does some damage, but I find that the term *tela* is very often used to denote any form of disease. *Red smut* is known, but I doubt if the damage done by this disease is fully appreciated.

Black smut occurs occasionally but is rare.

Arrested growth is said to occur sometimes, but I have not seen it. It is said to be due to drought which is doubtful as it is confined to a few plants in a whole field.

As a rule fungoid diseases are, I think, comparatively rare, soil and weather conditions being unfavourable for their development. The climate is generally speaking dry and the drainage good.

Animal attacks are general all over, jackals and rats being perhaps the most serious, others being monkeys and wild boars.

42. The fact that deterioration rapidly sets in after cutting is thoroughly

Deterioration of the juice after cutting.

well understood and the custom is to take the canes direct to the mill. In fact the

cutting forms part of the *gur*-making operations and goes on at the same time.

43. Canes are usually cut at the ground as low as possible, and this is always done at one operation, the tops being removed after reaping: There is

Cutting.

practically only one type of cane grown in the Province, and I know of no local variations of these rules.

44. The yield per acre in canes is not usually calculated by the cultivator, but the Lyallpur Station experimental weightings give some idea of the yield per

Yield per acre in canes.

acre in canes and also of the percentage of *gur* to cane.

45. The cultivator invariably manufactures or partly manufactures his own produce. Canes, except the *paunda* varieties, are never sold as such.

Manufacture.

The two chief products are *gur* and *mal rab*, the latter being generally sold to the sugar manufacturers. The process in the manufacture of *gur* and *mal rab* being practically the same, a description of *gur*-making will be sufficient to indicate the character of the manufacture of both products in the Province.

46. It may be said at the outset that the *gur*-making methods vary very little throughout the Province, any difference being generally due to the skill and industry of the individual *gur*-maker.

47. The two kinds of cane-pressing mills in use are the *belna* and iron roller mill. Both are too well known to need any description. The iron roller mill has come largely into use and is generally recognised by the cultivator to be quite a success. Some districts still hang on to the *belna* mill. These tracts are mostly in the districts irrigated by Persian wheels where the cultivator has been in the habit of using the trash of the cane for rope making. It is acknowledged by the users of the iron mill that it expresses 10 per cent. more juice and costs about one-half the labour of the *belna*. In the face of this it is difficult to see how the argument for the "*belna*" can be maintained, but it is probably only a matter of time until the use of the iron roller mills becomes universal. The mills as a rule either belong jointly to several cultivators or are hired by them for the season.

48. The canes are cut and stripped by men who receive as payment for their labour the tops and a few whole canes.

The expressed juice flows into either a large jar or is collected by several small jars. These jars are made of earthenware, but I have heard of cases where old *kerosine-oil tins* have been used.

49. When sufficient juice has been expressed it is poured into the boiling-pan, being strained either over the fire or before it is put on the fire.

The most common practice is to have only one boiling pan, but in some places batteries of two are used, one, the cooler one, being raised a little higher than the other.

While the juice is being boiled the scum is removed by ladles and either thrown away, given to sweepers or fed to bullocks. Where *mal rab* is the product aimed at, the juice is generally cleared by using a preparation of the bark of the *suklai* tree. Sometimes also the root of the *bhindi* plant is used for this purpose and in rare cases liming is carried out. Milk also is sometimes added after about two hours' boiling. When crystals appear, if *rab* is wanted, the boiling mass is emptied into clear earthen vessels called *matlis*, while if *gur* is desired boiling is continued until all the water has disappeared and the mass is of a thick curdlike consistency.

50. The proper moment for ceasing boiling in both cases is merely judged by the *gur*-maker himself: no tests are employed except to see roughly the state of the mass by taking out a small quantity with the fingers. The boiling *gur* is emptied into a shallow circular earthen pan called *gand*. The mass is stirred for a few minutes by a *khurpa* and then allowed to cool.

51. After cooling, the *gur* is collected into the centre of the *gand*, beaten between the hands, and made into round balls, in which shape it is sold in the market.

The jaggery as a rule has to be sold at once, but the purchaser is usually on the spot.

52. The whole process goes on simultaneously through day and night. As one boiling is finished, a new lot of juice is ready. The juice thus stands no longer than the time of boiling (2—2½ hours). Collecting pans where used are not heated.

53. As a rule the leaves and trash are sufficient for fuel, but occasionally where the *belna* mill is used and some of the trash is used for rope-making, extra

fuel in the shape of wood, cowdung, or cotton stalks has to be used. It may be said in any case that no residue gets back to the field for manure.

54. Liming is comparatively rare. I am not in a position to say whether it is done completely or not.

Liming.

I am not aware of any process used for preserving jaggery.

55. Table IV gives the average monthly retail prices of *gur* in the Punjab for the years 1901—1905. The average works out at about R4-8-0 per maund of 82 lbs. The cheapest time is of course during and after the *gur*-making season. The price usually is at its maximum in September and October just before cutting time.

56. The cultivator as a rule sells his *gur* when it is ready for the market and so does not benefit by the rise in price which takes place later on. As a rule he considers R3-8-0 to R4 a good price for good *gur* at marketing time.

57. In the principal cane tracts the supply of *gur* is greater than the demand and the surplus *gur* goes to those parts where cane-growing is less important. In the Punjab a ready market is always obtainable within the Province.

58. *Profit and Loss Account of Sugarcane cultivation in the Province.*— I have the greatest suspicion of such calculations which are after all only estimates. It is no doubt quite possible to give a statement of the cost of cultivation in particular instances and even to give an average cost of production in different localities. But the cost of production, calculated on the basis of hired labour, may easily vary to the extent of R10 per acre which in many cases is equal to the net profit.

A record of the actual nett revenue from the crop of one piece of land for a number of years would really be of use, but unfortunately we have no such record.

I append the actual cost of production at the Lyallpur Agricultural Station with the ordinary *desi* cultivation calculated on a hired labour basis—

I. Cultivation—	R a. p.	R a. p.
Ploughings	8 0 0	
24 carts manure (300 maunds)	12 0 0	
Seed (bought)	12 0 0	
Sowing	2 0 0	
Weeding with <i>khurpa</i>	6 0 0	
Hoing with <i>hahi</i>	2 0 0	
Irrigation expenses	2 0 0	
Water rate, etc.	10 0 0	
	54 0 0	54 0 0
II. Manufacture of <i>gur</i> —		
*Trashing	30 0 0	
Pressing	25 0 0	
<i>Gur</i> -making	7 8 0	
	62 8 0	62 8 0
		116 8 0
		per acre.

Revenue.

30 maunds <i>gur</i> at R3-8-0 per maund	105
*Value of tops, etc (given to trashers)	30

135

leaving a profit of R18-8-0 per acre.

*This is the usual practice.

The price of seed given above is, I think, excessive. The writer has a number of such calculations made at Jullundur, Phillour, Hoshiarpur, Karnal and Rohtak, but considers that they are not reliable enough to publish. The cost of *gur*-making, however, in each case is about the same, *viz.*, R1 per maund of *gur*.

Probably the Lyallpur figures represent about a fair average throughout the Province.

Other saccharine product.

59. The other saccharine products from sugarcane are—

- (1) *Shakar*, which is simply *gur* finely ground.
- (2) *Khand*, the drained raw sugar obtained from *mal rab*. The process is as follows. The *rab* is emptied into large *kachha* vats lined with matting holding from 100 to 400 maunds. At the bottom of the vat is placed a mat constructed of reeds resting on bricks 8 or 9 inches high or on wooden supports. Over the reed matting a piece of coarse cloth (*pal*) is spread. The bottom of the vat is drained into reservoirs to hold the molasses. The molasses called *Shira* are frequently collected in earthen jars. The *rab* having been poured into the vat or *khanchi* is left for 3 weeks or a month. After the molasses have drained away the mass which remains is covered with a water weed called "*jala*" to the depth of a few inches. This is changed every day for about a fortnight. The mass gradually becomes clear and takes on a lightish colour at the top. This is removed and the remainder covered up again. The stuff removed is put in the sun and worked with the feet. It is now *khand*.
- (3) *Misri* is prepared from *khand* by boiling it with water and a little milk. The scum is removed and the liquid poured into earthen or metal vessels where the *misri* crystallizes. The quantity of water added seems to vary considerably from one-fourth to an equal quantity of the *khand*.
- (4) *Bura*, a superior form of *misri*, is obtained from *khand* by boiling it as for *misri*. The syrup is removed from the fire and stirred with two wooden instruments called *mosads*. The substance is sifted and powdered.
- (5) *Taviki misri* is the usual *misri* obtained by pouring the purified *khand* into an iron tray.
- (6) *Kusa misri* is obtained by pouring the purified *khand* into small earthen bowls where it is permitted to stay for a week. Some *shira* is extracted and the mass is now *kusa misri*.

60. Little has been hitherto done in the way of introducing improved machinery for sugar-making into the Province. At present only one factory

exists. It is situated in the Gurdaspur District. After a chequered career, during which it was found to be impossible to make the concern pay as a sugar factory pure and simple, it has combined the business of a soda-water factory and has been lately paying 10 per cent. on capital. The factory deals with *rab* which is obtained from the cultivator.

61. *Introduction of new varieties.*—This has been attempted but in a spasmodic fashion owing to the want of an organised Agricultural Department. This difficulty, however, will soon be overcome especially as the new agricultural station at Jullunder is in the heart of the cane-growing districts.

62. This point can only be settled by actual trials on experimental stations. It is too early to say whether improved cultivation may be an economic success or not.

63. The canal irrigation system of the Punjab has been and is still being enormously developed. The question of increased well-irrigation by oil-engines and other motor powers is under consideration by the Agricultural Department. A very large increased area of land will thus have a regular water-supply and it is possible that a considerable proportion may eventually become cane-yielding.

64. Probably we may look for more improvement in the manufacture of *gur* and *rab* than in any other direction. The existing methods are crude and very

Improved methods in manufacture.

probably wasteful. It is possible that instructions in better methods might be of great assistance to cultivators. This might possibly be undertaken at the new Jullundur station.

65. With regard to the introduction of small plants for sugar-making the writer has really too little acquaintance with the customs and practices of the country to express a definite opinion. There is little doubt, however, but that small concerns would have a better chance than large ones. Possibly there might be a chance through village co-operation in the matter. The small native sugar refineries are in the hands of the *banias* at present, who doubtless make a handsome profit. It has been stated that the decline of "rab-making" in some districts is due to that fact.

66. It is difficult to say whether it would be better for one factory to produce the sugar from the raw material or to buy the product of the cultivator for that purpose.

67. The fact that the *rab*-making process is profitable and leaves the cultivator a good price for his labour would seem to be averse to the former proposal. The question of transport would also be unfavourable.

68. The question of Government aid cannot at present be discussed. The whole question requires first of all to be gone thoroughly into, and that has not been done. Experimental work will be undertaken at the Jullundur station when it is established, but until then little work of any value can be accomplished.

S. MILLIGAN,

Deputy Director of Agriculture, Punjab.

TABLE I.

Average monthly rainfall at Head-quarters of each District in the Punjab.

District.	Number.	District.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total average rainfall in a year.
DELHI.	1	Hissar	0.66	0.42	0.50	0.22	0.66	1.87	4.63	4.25	2.08	0.27	2.07	0.43	13.01
	2	Rohtak	0.82	0.56	0.54	0.24	0.73	2.68	5.91	5.66	3.21	0.34	0.03	0.51	21.22
	3	Gurgaon	0.88	0.41	0.49	0.16	0.68	2.75	8.39	7.10	4.32	0.34	0.04	0.34	25.92
	4	Delhi	1.02	0.61	0.87	0.35	0.71	3.18	8.38	7.44	4.42	0.39	0.10	0.43	27.70
	5	Karnal	1.23	1.16	0.73	0.41	0.97	4.11	9.40	6.90	4.80	0.37	0.12	0.50	30.55
	6	Ambala	1.53	1.58	0.86	0.55	0.86	4.09	11.01	8.74	4.50	0.44	0.24	0.67	35.07
	7	Simla	3.21	3.07	2.48	2.32	3.71	7.84	13.42	17.87	6.17	1.19	0.41	1.35	67.97
JULLUNDUR.	8	Kangra (Dharmatale)	4.89	4.88	3.87	1.95	2.58	11.04	40.81	39.19	12.44	1.32	0.25	0.57	125.69
	9	Hoshiarpur	2.42	1.83	0.92	0.47	0.74	3.91	9.94	9.55	4.79	0.29	0.10	1.24	36.00
	10	Jalandur	1.52	1.25	1.03	0.59	0.73	2.81	7.75	7.20	3.44	0.38	0.09	0.71	27.64
	11	Ludhiana	1.44	1.11	1.14	0.65	0.85	2.66	8.81	6.59	3.70	0.81	0.08	0.73	28.25
	12	Ferozapore	1.11	0.88	0.68	0.51	0.57	2.28	6.32	4.86	2.41	0.51	0.05	0.47	20.61
LAHORE.	13	Montgomery	0.53	0.60	0.42	0.21	0.39	1.12	2.86	2.72	0.94	0.13	0.05	0.27	9.64
	14	Lahore	0.87	1.13	0.82	0.51	0.60	1.86	6.65	4.88	2.10	5.43	0.11	0.47	20.70
	15	Amritsar	1.76	1.14	0.86	0.41	0.63	2.57	7.03	7.33	1.69	0.26	0.05	0.50	24.29
	16	Gurdaspur	2.18	1.87	1.41	0.57	0.97	4.16	9.90	8.71	3.63	0.49	0.14	1.09	34.94
	17	Sialkot	1.94	1.85	1.53	1.27	1.05	2.38	10.30	9.74	2.99	0.49	0.26	0.77	35.22
18	Gujranwala	1.44	1.41	1.17	0.70	0.77	1.86	7.35	6.11	2.14	0.41	0.20	0.62	24.18	
RAWALPINDI.	19	Gujrat	1.90	1.52	1.76	1.02	0.74	2.38	7.86	6.94	2.41	0.42	0.05	0.27	27.84
	20	Shahpur	0.82	0.95	0.95	0.63	0.63	1.13	3.76	3.07	1.50	0.15	0.22	0.33	14.28
	21	Jhelum	1.96	1.38	1.56	1.00	0.87	2.00	7.59	6.39	2.34	0.45	0.24	0.50	26.38
	22	Rawalpindi	2.50	2.10	2.09	2.05	1.42	1.79	8.24	7.71	3.18	0.53	0.04	1.11	33.86
	23	Attock	2.17	1.95	1.67	1.11	0.63	0.52	3.57	3.36	2.02	0.16	0.36	0.53	18.69
MULTAN.	24	Mianwah	0.77	0.73	0.79	0.77	0.62	0.81	2.95	2.62	0.91	0.05	0.28	0.20	11.55
	25	Lyalpur	0.41	0.72	0.71	0.08	0.42	0.84	3.39	1.43	1.68	0.12	0.17	0.12	8.09
	26	Jhang	0.51	0.45	0.71	0.36	0.43	1.03	3.32	2.18	0.84	0.14	0.06	0.34	10.33
	27	Multan	0.39	0.66	0.42	0.37	0.59	0.43	2.19	1.66	1.00	0.07	0.06	0.27	7.11
	28	Muzaffargarh	0.38	0.35	0.35	0.33	0.34	0.36	1.36	1.42	0.52	0.08	0.08	0.27	5.78
	29	Dera Ghazi Khan	0.41	0.45	0.56	0.32	0.45	0.47	1.63	1.23	0.45	0.05	0.11	0.26	6.39

TABLE II.

Showing the area of the sugarcane crop of the Punjab for the last five years, i.e., from 1901—05.
(HARVESTED AREA.)

Division.	Number.	District.	AREA UNDER SUGARCANE IN—					Average, * 1901—04.
			1901.	1902.	1903.	1904.	1905.	
DELHI.	1	Hissar	1,101	779	741	904	116	71
	2	Rohtak	21,739	18,117	19,994	24,434	5,408	21,171
	3	Gurgaon	9,477	5,487	7,880	7,587	485	7,548
	4	Delhi	17,271	17,512	16,350	17,575	7,959	16,927
	5	Karnal	19,541	20,766	19,322	19,553	11,843	19,795
	6	Ambala	8,828	10,377	12,350	15,870	10,001	11,855
	7	Simla	...	...	...	...	...	...
JULIAN- BUR.	8	Kangra	5,687	4,982	4,769	4,829	2,306	5,061
	9	Hoshiarpur	21,074	22,114	24,149	24,021	17,507	22,839
	10	Jullundur	30,040	31,682	31,181	27,797	10,440	30,169
	11	Ludhiana	12,498	11,896	11,465	9,692	6,391	11,139
	12	Ferozepore	2,966	2,109	2,109	1,507	1,039	2,071
	13	Montgomery	1,006	582	435	411	866	608
	14	Lahore	6,832	5,655	6,176	6,504	2,799	6,679
RAWAL- PINDI.	15	Amritsar	20,146	16,645	17,638	16,546	4,104	17,498
	16	Gurdaspur	49,917	48,231	52,612	51,590	28,260	50,587
	17	Sialkot	36,690	30,546	32,135	34,919	28,491	34,570
	18	Gujranwala	30,971	22,174	19,762	20,492	9,569	23,349
	19	Gujrat	7,833	7,461	6,406	6,694	5,501	6,998
	20	Shahpur	1,448	1,074	1,509	2,641	1,523	1,665
	21	Jhelum	304	312	265	238	236	281
MULTAN.	22	Rawalpindi	104	158	126	116	185	181
	23	Attock	7,624	1,792	1,650	1,557	1,763	1,680
	24	Mianwali	43	49	70	108	118	66
	25	Lyalpur	37,553	28,683	33,358	30,672	6,842	32,566
	26	Jhang	5,483	2,134	1,711	459	248	2,672
	27	Multan	1,079	1,370	1,015	1,141	832	1,157
	28	Muzaffargarh	4,663	6,560	5,732	5,392	4,575	5,594
29	Dera Ghazi Khan	54	51	78	88	65	77	
TOTAL			356,947	320,258	330,787	333,231	155,405	335,301

* The year 1906 being exceptional is omitted from averages.

TABLE III.
Percentage of Sugarcane to cultivated area.

Name of District.	Percentage.	Remarks.
Hissar	00	District poor, rainfall 15 inches.
Rohtak	3 8	
Gurgaon	9 8	Insecure.
Delhi	3 5	
Ambala	2 5	
Kangra	7 3	Hill district.
Hoshiarpur	2 8	
Jullundur	3 9	
Ludhiana	1 5	
Ferozepore	0	Dry, rainfall 14 inches.
Montgomery	1 3	Very dry, rainfall 8 5 inches.
Lahore	6	
Amritsar	2 0	
Gurdaspur	5 6	
Sialkot	3 7	
Gujranwala	2 4	
Gujrat	9	
Shahpur	2	
Jhelum	90	Rawalpindi Division colder with shorter season
Rawalpindi	00	
Attock	2	
Mianwali	00	Poor district very dry
Lyalpur	2 6	Slight rainfall, irrigation good.
Jhang	2	
Multan	1 7	Dry.
Muzaffargarh	1 2	Do.
Dera Ghazi Khan	00	Do.
Average for the Province		1 7

TABLE IV.

Showing the average monthly wholesale prices of sugar (raw) at Lahore for the years 1901-1905.

Months.	1901.	1902.	1903.	1904.	1905.
	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.
January . . .	4 9 2	4 1 8	4 1 8	3 15 4	4 9 2
February . . .	4 3 6	4 3 6	4 0 10	3 12 3	4 18 9
March . . .	4 3 6	4 4 4	3 13 8	3 12 3	5 0 8
April . . .	4 6 9	4 8 2	3 15 4	3 14 1	5 0 8
May . . .	4 11 5	4 9 2	4 0 8	4 1 8	5 5 4
June . . .	5 2 0	4 4 4	4 0 10	4 3 4	5 12 3
July . . .	5 2 7	4 4 4	3 9 4	4 6 9	5 11 5
August . . .	5 2 7	4 5 3	4 3 4	5 6 10	6 2 6
September . . .	5 5 5	4 4 4	4 5 2	5 6 10	6 8 6
October . . .	5 2 7	4 5 3	4 11 5	5 11 7	6 2 7
November . . .	5 6 11	4 3 4	4 8 3	5 2 11	6 7 1
December . . .	4 9 2	4 1 8	4 3 4	4 8 2	6 0 8]

TABLE V.

Export of gur from the Punjab from 1896-1906.

Year.	By rail.	By land.	Total.	Remarks.
	1,000 maunds.	1,000 maunds.	1,000 maunds	
	R	R	R	
1896-97 . . .	450	120	570	Expressed in thousands of maunds. 1 maund=82 lbs. nearly.
1897-98 . . .	810	90	900	
1898-99 . . .	570	120	690	
1899-1900 . . .	420	130	550	
1900-01 . . .	600	140	790	
1901-02 . . .	350	500	850	
1902-03 . . .	230	130	410	
1903-04 . . .	370	110	480	
1904-05 . . .	570	110	680	
1905-06 . . .	210	110	320	
Ten years' average . . .	463	156	619	

TABLE VI.

Imports of gur and sugars into the Punjab for 1896-1906.

Year.	Sugar refined.	Sugar unrefined.	Gur, etc.	Total.	Remarks.
	R	R	R	R	
1896-97 . . .	770	* 1,130	...	1,900	Expressed in thousands of maunds. 1 maund=82 lbs. nearly.
1897-98 . . .	960	* 1,360	...	2,320	
1898-99 . . .	800	* 1,590	...	2,390	
1899-1900 . . .	680	720	1,160	2,560	
1900-01 . . .	1,030	370	680	2,080	
1901-02 . . .	1,360	640	1,280	3,280	
1902-03 . . .	900	770	1,380	3,050	
1903-04 . . .	1,350	810	1,080	3,220	
1904-05 . . .	1,220	810	1,080	3,110	
1905-06 . . .	2,160	840	2,450	5,450	
Average for 10 years . . .	1,123	904	909	2,936	* No distinction made up to 1899-1900 between gur and unrefined sugar.

TABLE VII.

Estimated consumption of sugar products in the Punjab for the years 1896-1906.

	1896-97	1897-98	1898-99	1899-1900	1900-01	1901-02	1902-03	1903-04	1904-05	1905-06	Rev
Estimated home production.	8,890	7,860	8,910	8,290	7,610	8,590	7,460	7,720	7,770	8,140	
Imports	1,900	2,820	2,890	2,560	2,090	3,280	3,050	3,220	3,110	5,450	
Total	10,790	9,880	11,800	10,850	9,690	11,810	10,510	10,940	10,880	8,590	
Deduct—Exports	570	900	690	550	740	850	410	480	680	320	
Total home consumption	10,220	8,980	10,610	10,300	8,950	10,960	10,100	10,460	10,200	8,270	
Deduct—Refined sugars	770	960	800	680	1,030	1,360	900	1,850	1,220	2,160	
Consumption of <i>G^W</i> and unrefined sugar.	9,450	8,020	9,810	9,620	7,920	9,600	9,200	8,110	8,980	6,110	

Each item in thousands of maunds

TABLE VIII.

Analysis of oil cakes—Punjab.

	H. O.	Ash	Sand.	Oil.	Woody fibre.	Albud N.	Non albud N.	Total N.	Phos. acid.
Rape (sarson) cake	6.81	6.78	1.69	10.28	9.85	4.35	.81	4.66	2.68
Rockel (Tara Mira) cake	5.84	7.17	1.14	9.35	7.84	5.00	.87	5.87	...
Sesamum (Til) cake	6.95	14.19	2.80	8.08	3.67	5.97	.83	6.29	...
Torn cake	7.40	8.64	2.20	11.34	8.32	4.46	.29	4.75	...
Castor cake . . . . .	...	...	...	...	...	...	...	3.93	1.33

TABLE IX.

(Extract from Lyallpur Farm Report 1903-04)—To show weight in lbs. of canes per acre and percentages

Area sown in acres.	Manure applied.	Method of cultivation.	Description of method.	CUTTINGS PER ACRE IN ROWS.			PERCENTAGES.			Green tops per acre.	Remarks.
				Canes.	Jules.	Gar.	Jules to Canes.	Gar to Jules.	Gar to Canes.		
1/4th	Farmyard manure 100 lbs. N. per acre before sowing + oil-cake 50 lbs. N. per acre as a top dressing.	Behar System	Trenches about 14" deep are made 2 1/2' apart. Cuttings are planted on both sides of the trench.	20,048	12,028	3,248	60.00	27.00	16.20	8,780	
1/4th		Mauritius System (modified).	Two cuttings are planted in each pit dug 3" deep and 2' apart between ridges made according to the Poona System.	35,052	19,280	3,400	55.00	17.80	9.70	15,724	
1/4th		Poona System	Ridges are made 2' apart in beds of 10' x 10', and cuttings are planted between the ridges.	33,736	16,296	2,800	49.30	17.32	8.80	14,520	
1/4th		Ditto		22,540	13,372	2,412	59.32	18.00	10.70	8,652	The or were true in the field weeks be the harve
1/4th		Country system	The cuttings are placed in the furrow behind the native plough, and the field is levelled.	39,776	23,520	5,008	59.3	21.3	12.6	18,040	

Note.—Ploughing .. 2 Waterings .. 20
Weeding .. 5 Waterings (in the variety experiment) .. 19

TABLE IX—(Contd.)

Extract from Lyallpur Farm Report 1904-05—To show weights in lbs. of canes per acre and percentages.

Area sown.	Name of Variety.	Manure applied	OUTPUT PER ACRE IN LBS.			PERCENTAGE OF.			Green tops per acre.	Dry leaves per acre.	REMARKS.
			Canes.	Juice.	Ger.	Juice to canes.	Ger to juice.	Ger to canes			
1½ acre each.	Katha Variety.	Castor cake 150 lbs. N per acre before sowing.	14,500	7,372	1,840	5.084	9.24	18.17	9,538	...	
		Rape cake 150 lbs. N. per acre before sowing.	17,100	10,100	1,820	59.06	18.02	10.64	829	2,232	
		Farm yard manure 150 lbs. N. per acre before sowing.	4,772	3,890	604	77.11	16.41	12.65	2,354	792	
		Farm yard manure 100 lbs. N per acre before sowing and nitre 50 lbs. N per acre as top dressing.	19,896	10,028	1,760	50.40	17.55	8.84	9,508	1,898	Ploughings 1
		Farm yard manure 100 lbs. N. per acre before sowing and rape cake 50 lbs N. per acre as top dressing.	5,548	3,892	660	70.15	16.96	11.89	1,648	908	Weedings 3
		Farm yard manure 100 lbs. N. per acre before sowing and castor cake 50 lbs. N. as top dressing.	11,900	5,484	964	46.09	17.58	8.10	4,784	1,740	Waterings 13
		Unmanured	6,452	3,516	524	54.49	14.90	8.13	2,556	1,173	

Results of the Experiment with methods of cultivating sugarcane.

Area sown.	Manure applied.	Method of cultivation.	Description of method.	Year.	OUTPUT PER ACRE.			PERCENTAGE.			Green tops per acre.
					Canes.	Juice.	Ger.	Juice to canes.	Ger to juice.	Ger to canes.	
1½ acre each.	Farm yard manure 100 lbs N. per acre before sowing + Oilcake 50 lbs. N. per acre as a top dressing.	Behar system	Trenches about 14 inches deep are made 2½ feet apart. Cuttings are planted on both sides of the trench.	1903-04	20,048	12,028	3,248	60.00	7.00	16.20	8,780
				1904-05	16,964	8,276	1,344	48.84	6.24	7.92	13,508
		Mauritius system (modified).	Two cuttings are planted in each pit dug 3 inches deep and 2 feet apart between ridges made according to the Poona system.	1903-04	25,052	12,280	3,400	55.00	17.80	9.70	15,724
				1904-05	7,820	3,480	576	47.54	16.55	7.27	6,196
		Poona system	Ridges are made 2 feet apart in beds of 10' x 10' and cuttings are planted between the ridges.	1903-04	26,736	16,296	2,800	48.30	17.38	8.30	14,520
				1904-05	12,460	7,024	1,164	56.37	16.67	9.84	1,964
		Ditto.	As above, but the canes are trashed 3 weeks before harvesting.	1903-04	22,540	13,272	2,412	59.99	18.00	10.70	8,858
				1904-05	8,640	4,268	636	49.36	16.12	7.96	4,436
		Country system	The cuttings are placed in the furrow behind the native plough and the field is levelled.	1903-04	29,776	23,520	5,008	59.30	21.30	12.30	8,040
				1904-05	11,900	5,484	964	46.09	17.58	8.10	4,784

Ploughings 9; Weedings 4; Waterings 20-31.

BURMA.

This note follows, as far as possible, the lines indicated in Mr. Barber's "Scheme for Provincial enquiry into the Sugarcane Industry," and the sections follow the paragraph numbers of Mr. Barber's paper.

1. It may at the outset be said that if India has certain advantages over other sugar-producing countries, such as its cheap and abundant labour, *etc.*, the scarcity and consequent dearness of labour in Burma put it at a great disadvantage in sugarcane as in all other products in which it must compete with India, and for which it has not a specific market of its own. A low rate of cooly hire in Lower Burma is 8 annas a day or Rs15 per mensem, and subject to correction, I imagine that this is very much higher than the labour rate in other sugar-growing parts of India. The rates for labour to manufacture the sugar would be proportionately in excess, so that, as a commercial venture, sugar is not likely to take much hold in Burma.

2. *Climate.*—The principal sugarcane-growing districts of Burma are—

Amherst, Thaton and Toungoo in Lower Burma and Yamethin and Kyaukse (rather for quality than quantity) in Upper Burma.

The following statement shows the maximum and minimum thermometer readings at the recording stations in these districts for the year 1905 :—

Statement showing the Minimum and Maximum Thermometer's readings at the recording stations of Amherst, Thaton, Toungoo and Yamethin by months for the year 1905.

	January.	February	March.	April	May.	June.	July.	August	September	October	November.	December.
AMHERST (MOULMEIN).												
Dry minimum thermometer	64.42	63.1	73.6	76.7	76.9	74.64	74.20	74.07	74.20	75.30	70.10	62.60
Dry maximum do.	87.84	91.7	92.8	94.7	92.7	82.72	83.40	81.90	83.80	86.60	87.10	90.10
THATON.												
Dry minimum thermometer	54.23	61.21	68.32	69.27	72.81	73.53	72.55	73.18	73.57	74.16	70.67	67.90
Dry maximum do.	83.61	87.64	91.39	93.77	91.00	82.10	79.08	80.42	80.97	85.26	86.87	86.97
TOUNGOO.												
Dry minimum thermometer	55.97	59.61	69.96	73.73	77.43	75.46	75.34	74.87	75.80	75.50	69.53	60.35
Dry maximum do.	83.96	89.39	95.06	91.00	93.00	89.42	87.13	87.08	87.40	89.60	86.20	82.50
YAMETHIN.												
Dry minimum thermometer	55.06	59.07	72.09	74.04	76.93	75.86	75.00	74.23	74.43	74.37	67.71	59.01
Dry maximum do.	82.90	87.36	93.77	93.84	93.21	90.71	87.63	87.73	87.77	83.31	83.67	80.31

Rainfall.—The following statement shows the recorded rainfall by periods for each of the districts specified for the year 1905 :—

Districts.	From 1st January to 31st March	From 1st April to 30th June.	From 1st July to 30th September	From 1st October to 31st December.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.
Amherst (Moulmein)	0	62.39	104.49	11.31	178.19
Thaton	0	84.17	140.49	7.25	231.91
Toungoo	0.60	24.55	54.33	9.77	89.30
Yamethin	1.07	8.05	18.86	7.74	35.72
Kyaukse	2.53	4.93	13.60	7.56	28.62

3. *The age of sugarcane cultivation in Burma.*—It is difficult to trace the past history of sugarcane cultivation in Burma. The principal sugarcane tract of Burma has always been the Bilin township of the Thaton District, and writing of it in 1882 Mr. J. E. Bridges, I.C.S. (retired), says: "In Burmese times there were small patches of black cane grown round Bilin and sugar was manufactured in small quantities. Shortly after the English took the country the 'Madras cane' was introduced from Moulmein, and it is now the cane almost exclusively grown in this tract." This is the only reference of any value that I can trace.

4. *The extent and character of cultivation.*—The following statement shows by districts the total area under sugarcane in 1906:—

District.	Area.	District	Area.
	Acres.		Acres
Akyab	261	Amherst	688
Kyaukpya	608	Tavoy	62
Sandoway	705	Mergui	81
Hanthawaddy	181	Thayetmyo	24
Pegu	182	Pakokku	30
Tharrawaddy	557	Magwe	1
Prome	807	Mandalay	2
Maubin	127	Bhamo	8
Pyapon	104	Myitkyina	10
Basson	185	Katha	2
Henzada	157	Lower Chindwin	2
Myaungmya	447	Upper Chindwin	5
Toungoo	1,368	Kyaukse	381
Salween	149	Meiktila	253
Thaton	4,291	Yamethin	1,587
		TOTAL	12,710

The total Provincial area for the past five years has been—

Years.	Acres.
1901-02	15,235
1902-03	16,277
1903-04	18,108
1904-05	11,803
1905-06	12,710
TOTAL	68,683

It will be noted from the above statements that the cultivation is scattered in small areas over many districts and that only in three is there an area of over 1,000 acres. The total, never great, shows evidence of shrinkage; but this is so small and the total area affected so insignificant that no particular reason can be assigned. It may be noted that Mr. Bridges found 3,753 acres under sugarcane in Thaton in 1882, so that there has been some increase there.

General character of the cultivation.—In newly cultivated tracts in Lower Burma it is a common practice to take a small crop of sugarcane off newly cleared land preparatory to laying out the land in continuous paddy. This is generally on a patch of about an acre or so near the river bank, and, in fact, in most districts of Lower Burma this is about the extent of the cultivation. In the Bilin township of Thaton District, however, Mr. Bridges found cane cultivation pretty constant on one piece of land with fallowing every second or third year; in some cases the fallow area being planted out in paddy with sufficient spaces between the paddy to allow of cane tops being laid down in September. In this same tract in 1897 it was found by the Settlement Officer that as a rule only half a holding is worked annually, the other half being fallowed for about ten months, i.e., between the cutting of the crop and the preparation of the land for the new one. In Yamethin, Upper Burma, sugarcane rotates with early sessamum every alternate year, the period of fallow being three to four months in the year, i.e., between the reaping and sowing of the respective crops.

In Toungoo sugarcane is either grown in the ordinary method of Lower Burma without irrigation or manuring or on high poor land of sandy loam which is well manured and irrigated from a surface tank or well. As a rule this land is deteriorated paddy land, but after a sugarcane crop has been taken off, the treatment which the land has received to produce this crop leaves sufficient fertilising material in the soil to give a good crop of paddy and it reverts to its original crop for two or three years.

In Kyaukse sugarcane, with the other crops of the district, receives the benefit of the elaborate system of irrigation which the district enjoys. Sugarcane generally follows Goa beans, is always irrigated, and is only planted over in three years on the same soil. In Moulmein and in a few other districts we find both methods—the casual shifting cultivation and the permanents.

Relatively the permanent method of cultivation found in Thaton is considered the most important. The small areas recorded against other districts are simply small patches on the borders of creeks planted with coarse sugarcane which is only used as a sweetmeat and not manufactured. The bulk of the sugarcane of Burma is so used.

Origin of the soil.—Mr. Bridges thus describes the soil in Bilin :—

"The soil of the valleys of the Bilin and Thebyu rivers is almost entirely deep grey loam, mixed here and there with light clay. The land is covered by the floods for a few days at intervals during the rains to a depth of two or three feet and a thick layer of alluvial soil deposited on it." The Settlement Officer in 1897 says that: A sandy silt is preferred for cane cultivation. Given this soil over a good clay, the outturns are as a rule good. The rivers overflow their banks two or three times every season, thus giving the necessary amount of water to the plants and at the same time making fresh deposits. Cane is also grown on higher land when they depend on rain. In Toungoo sandy loam is the favourite soil. In general the favourite soil is either deltaic or alluvial formation revived from time to time by silt deposits. I am sorry that the short time at my disposal has prevented me from making the collection of soils suggested.

5. *Varieties of cane grown.*—I note on this with diffidence as I have no botanical adviser. Mr. Bridges noted the following :—

(1) Black cane (in Burmese times).

(2) Madras cane introduced shortly after we took the country, of yellowish colour and so flexible that it does not require any supports. It grows to a height of 10 to 12 feet. Percentage of sugar in juice by saccharometer ranges from 20 to 27·14. Percentage of coarse sugar in juice ranges from 12·52 to 17 per cent.

(3) The "*Kaing Kyan*," so called from its resemblance to *Kaing* or elephant grass. Whitish in colour, and grows to same height as Madras cane, but is much thinner. Also flexible and does not require supports. Juice contained 21·43 per cent of sugar by saccharometer and 13·42 per cent of coarse brown sugar according to actual experiment.

(4) The "*Anyagyan*" or Upper Burma cane, reddish in colour with short thick joints: 20 per cent. of sugar by saccharometer: 12·52 per cent. of coarse brown sugar.

(5) The "*Kyaukgoung-gyam*"—Large cane of greenish colour with short thick joints: 14·28 per cent. of sugar by saccharometer: 8·94 per cent. of coarse brown sugar. It grows best in alluvial clay when it gave 22·85 of sugar by the saccharometer and 14·31 of coarse brown sugar.

Both these canes are very brittle and require supports. They are eaten as a sweetmeat and cannot be utilized for making sugar as they break at the joints while passing through the mill. These are probably the most popular canes and the most largely cultivated in Burma.

(6) The "*Kyannet*" or black cane is a thin cane of a dark purple colour. It has green leaves and yields but little juice: 24·25 per cent. of sugar by saccharometer; 15·19 per cent. of coarse brown sugar.

There is another variety of black cane with purple leaves which is used by the Burmans as a cure for insanity.

Mr. Bridges' enquiry is probably the most exhaustive that has been made into the varieties of canes.

The "Madras cane," introduced about 1860, is the most general in places where systematic cultivation is gone in for; otherwise Nos. 4 and 5 above.

6. *Recorded introduction of new varieties.*—There are no recorded experiments with exotic canes in Burma. As noted above, the "Madras" cane is generally distributed over the country. It is reported, however, that "Mauritius" cane grows luxuriantly and abundantly in Mr. Milne's grant at Zeyawadi, Toungoo. An experiment with Chinese cane in Kyaukse failed.

7. *"Sports" and seedling canes.*—No new canes are known to have been so produced in Burma.

8. *Other sources of sugar and spirits.*—No sugar is manufactured in Burma on any scale from any other source. The juice of the toddy palm is the favourite liquor of the drinking section of the community.

PART II.

* CULTIVATION.

9. *Planting and reaping seasons.*—*In Lower Burma.*—Plant in September; also when 'ratooning' is in vogue from November to the beginning of January. Reap about November.

In Upper Burma.—Sown broadcast or planted in December and January and reaped in November to January.

10. *Rotations and mixed cropping.*—In Lower Burma the cultivation in the main sugarcane-growing tracts is generally permanent. Occasionally peas or other vegetables are taken as a catch crop in the cold weather. Generally only half a plantation is worked each year and a crop of paddy is frequently taken off the part not devoted to sugarcane.

Paddy and sugarcane thus practically rotate. In Upper Burma sugarcane rotates with early *sessamum* every alternate year, the period of fallow being three to four months in the year, *i.e.*, between the reaping and sowing of the respective crops.

11. *Ratoons.*—Mr. Bridges notes that when ratoons are sufficiently thick no new plants are put down after the cane has been cut, but as a rule cane tops are planted in the intervals between the ratoons.

Fifteen years later the Settlement Officer saw only few instances of ratooning in the same tract and was told that the owner was letting his plants ratoon either because he was unable to procure more cane to plant or in order to obtain seed to plant the following year. The Settlement Officer notes that in Amherst they ratoon on an average for three years, occasionally for five years. Ratooning seems to be rare in Upper Burma.

12. *Preparation of the land for planting.*—The land is first cleared of all weeds and then ploughed up. The plough used is an iron one, and to make the furrows a wooden piece, in shape something like a bat, is fastened on to the blade. About a month or so after the cane is planted the ground is carefully weeded and the soil loosened. This may be done only once or it may be done three times during the year. It depends on the quality of the soil, the amount of weeds which spring up and the interest of the cultivator. Usually the weeds are removed and the ground loosened twice. In Upper Burma, for this crop, as for all other crops, the methods of cultivation are somewhat more thorough. The land is well ploughed and harrowed, trenches 6 feet apart and 1½ feet wide are then made by means of a plough and in the trenches holes, 12 inches deep, are dug with spaces of 6 inches between them. After the showers of April and May when the plants are about 4 feet high the trenches are filled up and three weeks after the ground between the rows is well hoed and loosened. In July and August small drains are made from end to end of the field to prevent flooding, and the earth thus obtained is used for banking and supporting the plants. Until the end of the rains weeding and repairing the banks are carried on. Only farmyard manure, and that sparingly, is used.

13. *Planting.*—After the land is furrowed the cane is cut into pieces about 1½ feet long, each piece having three or four eyes and is laid along the furrows with about 12 inches interval between each piece. This is done in September or October, sometimes a little later. A little earth is spread over

each piece. If cane tops are used instead of cane pieces, after weeding, holes are dug, each about 1 foot in depth and 1 foot across. Cane tops soaked in water to induce germination are then planted, generally three in a hole. The holes are then filled up, water poured on and the soil well pressed down.

14. *The source from which the seed is obtained.*—The Burman evinces a preference for cane pieces as against cane tops, his theory being that the out-turn of jaggery from a field planted with pieces is much larger than from one planted with tops. In flooded land when planting is late, tops are used for filling up intervals.

15. *The part of the cane used for planting.*—The general practice in Burma seems to be to cut up the whole cane into sets and plant them, only the lower rooting joints being rejected.

16. *The actual preparation of the sets for planting.*—There are generally three joints to each piece of cane used for planting. Canes which have flowered are never used for seed as they are considered worthless for planting purposes. Occasionally cane tops are soaked a few days in water to induce germination, after which they are planted out. Nothing is done to resist fungoid attacks.

17. *The number of sets per acre.*—In Yamethin, where very careful enquiries were made by the Settlement Officer, the number of sets per acre is given at 11,150. The average for Lower Burma would seem to be just about 12,500 in the best land and 9,500 in second class land. There seems to be generally a certain amount of method in the planting.

18. *The mode of planting.*—The cane is ordinarily planted in trenches with intervals of a foot to a foot and a half between each cane and the cane is subsequently banked up. There is an interval of about 6 feet between trenches. These trenches are gradually banked up till they become ridges.

19. *Supplying vacancies.*—The Burman does not worry himself about failures and seldom, if ever, fills up vacancies. I am not in a position to make any remarks on the keeping of canes.

20. *Seed beds and nurseries.*—I have not come across these in Burma.

21. *Stool-planting.*—No instances of this have come under my notice.

22. *Irrigation and drainage.*—In Lower Burma irregular irrigation from wells or streams is sometimes resorted to. In Kyaukse the land chosen is first well irrigated before planting. It is again irrigated 2½ months after planting if the land is at all dry; and again a month and three months later. If the field is at all water-logged a drain, 4 feet deep, is dug round it.

23. *Cultivation.*—Before planting the land is cleared of grass and weeds. About 10 days after the cane has been planted the earth is loosened in the intervals between the holes and the cane pieces further covered up with mould. In the beginning of January the earth is again loosened and the plants further covered up. About the month of May the land is again cleared of weeds and grass and the plants are then left until the month of August or September, when they are stripped of the leaves that have become old and withered. Clearing of weeds is done once or three times a year with the "Mamooty" or Burmese *dah*.

24. *Manuring.*—Is little used in Burma; the only manure available is badly treated farmyard manure which is occasionally used for sugarcane before planting. The trash is sometimes burned, but not universally. It is more generally used for fuel for the mills.

25. *Treatment of the canes during growth.*—This is described in paragraph 23.

26. *Treatment of the fields preparatory to reaping the canes.*—In Burma the fields receive no special treatment.

27 to 32. *Disease Phenomena.*—The disease which is most commonly known is red smut, while white-ants and the moth-borer are very common. In the total absence of scientific advice I am not in a position to note on the specific diseases referred to in these paragraphs.

33. *Reaping.*—The canes bloom about the month of November: they are then severed with a *dah* from the stool close to the ground. The tops and branches are cut off, the former being used for seed and the latter for cattle-food: the cane is then cut in two pieces of about 4 feet each and carried in bundles to the mill.

34. *Deterioration after cutting.*—The mill and furnace are always erected in the holding and close to the cultivators' hut: only sufficient cane to feed the mill for one day is cut: there is therefore no time for deterioration after cutting.

35. *Mode of cutting the canes.*—As close to the ground as possible; the tops extending to where the hard cane is met.

36. *Yield per acre in canes.*—Average number of canes in Mr. Bridges' enquiries 10,809—average weight 37,378 lbs. In Yamethin the average number of canes was 18,492; but the weight was not taken. In the area operated on by Mr. Bridges, the Settlement Officer in 1897 got the following results:—

Average number of canes per acre:—

Class I land	.	.	.	.	.	12,577
„ II land	.	.	.	.	.	9,503

Average weight of canes per acre (after tops cut off):—

Class I land	.	.	.	.	.	30,704 lbs.
„ II land	.	.	.	.	.	18,314 „

In Toungoo in Class I land the average number of canes was found to be 12,800 per acre and the weight 59,108 lbs.

PART III.

MANUFACTURE.

37. *Manufacture of jaggery or gur.*—The old form of mill described as follows by Mr. Bridges is still in very general use. “The mill consists of two heavy upright cylinders, about 1 foot in length and 2 feet in diameter. The cogs are circular and are cut in two rollers superposed to the crushing cylinders. A shaft about 12 feet long is fixed to one of the upper cylinders and is turned by a buffalo yoked to it. A few improved machines are now used: they consist of three upright pyngado cylinders and the middle cylinder to which the shaft is attached turns the other two by means of short straight wooden cogs.”

Generally the older pattern mills still find favour; but in places they have been ousted by the newer pattern. Mills with only two cylinders but with the short straight cogs are also now in use. As all canes are pressed twice and sometimes thrice there is some saving of labour in having a three-cylinder machine, for as the cane is passed through from one side it is passed back again from the other. With only two cylinders one man has to be constantly gathering up the partly crushed cane and carrying it round again to the other side.

As the juice is expressed it flows into a bamboo frame beneath the mill and from thence through bamboo piping into an iron pan in the furnace room.

“The juice is carried in chatties from the receiving pan to the iron boiling pans which are placed there in a row over a furnace dug in the ground. The fire is kindled at one end of the furnace and boils all the pans in succession on its way to the chimney. The liquor is at first placed in the pan furthest from the fire, and as it evaporates it is passed on by means of ladles to the next pan, and from this to the pan immediately over the fire. It gets thicker as it passes along, and the impurities are removed by means of a wooden skimmer. In each pan is placed a bamboo frame-work to prevent the boiling juice from escaping over the sides of the pan. After the juice in the third pan has become sufficiently thick it is taken off the fire and passed into an iron pan, where it is allowed to cool for a few minutes. It is poured on a bamboo mat spread evenly with a piece of bone and then divided with a piece of pointed bamboo into small squares. After it has become hard it is broken into cakes and packed away into bamboo baskets covered with leaves. Each basket contains about 175 lbs. of jaggery.”

Mr. Bridges introduced Thomson and Mylne's mills into Bilin. They were considered a great improvement on the wooden ones, but the cultivators objected to the small size of the cylinders: they would have hollow cylinders with a diameter of 1½ feet and a length of one foot, thus increasing the speed of the mill without any additional strain on the cattle. They would also have the shaft 10 instead of 7 or 8 feet long. As compared with the Burmese machine

in general use the Thomson and Myles mill was 12 per cent. slower, but yielded 20·28 per cent. more juice and jaggery: as compared with the improved Burmese it was 25 per cent. slower, but yielded 7·40 per cent. more juice and jaggery.

Fuel.—The cultivators and their hired labourers bring in enough fuel from the jungle. The cane trash, after being dried for a day or two, is also used as fuel, not by itself but with wood.

Sugar-refining.—Several attempts have been made at sugar-refining, but the net profit on the work was so small that these attempts were not repeated.

Prices.—The prices fluctuate so much that it is hard to say what an average local price for jaggery is. In Bilin the average opening price is nearly always R35 per 100 viss, but it goes down very quickly, as low perhaps as R16. A good deal of course depends upon the quality of the jaggery. The hard yellow cakes will keep longer and are worth about 10 per cent. more than the darker and softer cakes. The wholesale price in Rangoon is R35 per 100 viss in September and R30 in March, but the prices often fall much lower. The demand does not seem to be great, and is certainly not continuous, and a considerable amount of the jaggery, it is understood, comes from Madras.

38. *Profit and loss on sugarcane cultivation.*—The area under sugarcane cultivation in Burma is so small and scattered that it has in most cases not received special attention from Settlement Officers, but has been included amongst minor miscellaneous cultivation. Enquiries into profit and loss have however been made in Bilin, Amherst and Yamethin with the following results. Cultivators in Bilin always calculate by the *ta*—theoretically '29 of an acre, but owing to local variations taken by the Settlement Officer at '35 of an acre. The following is the cost of cultivation per *ta* :—

Clearing, ploughing, cutting up cane and planting	R	2	0
First loosening and weeding		1	8
Second loosening and weeding		1	4
Seed cane		6	0
Tools (annual cost)		1	4
		<hr/>	
Total		12	0

This equals R34 per acre. Deducting half the cost of loosening and three-fourths the cost of clearing and ploughing for home work we get R26 per acre as the cost of cultivation.

An average outturn of jaggery may be taken at 700 viss per acre. The monthly wages for cost of manufacture (one boiling gives 6·5 viss of jaggery or about 1,370 viss per month) are—

Two cutters at R11		22	
Two buffaloes at R4		8	
One herdsman		7	
One cook		20	
		<hr/>	
Total		57	

Rupees 29 per acre, the average outturn being only 700 viss per acre.

Implements.—(Annual) :—

One mill costs R40, lasts 5 years	R	8	
Four cauldrons cost R5 each, last 4 years		5	
Baskets, oil, etc.		9	
Plough and furrows repairs		10	
		<hr/>	
Total		32	

The average holding is 4·52 acres: cost of implements per acre R14. Cost of living is R75 per acre. The average price to meet the numerous fluctuations is taken at R22 per 100 viss. Leaving the cost of living out of the amount we get 7 (00) × 22—(R26 + 29 + 14, = R154—R69 = 85 per acre, or deducting cost of living R75 per acre = Rs. 10 profit per acre.

In Amherst with a price of R30 per 100 viss, and excluding cost of living, the Settlement Officer got a net profit of R6 6.51 per acre. As the ordinary sugarcane cultivator has usually other land, it is difficult to equate the proportion of his cost of living which should be put down to sugarcane separately. With a proportionate reduction the profit would probably be about the same as in Bilin—R10 per acre, clear, after deducting cost of living.

In the Yamethin report the cost of cultivation varies from R75 to R97 per acre. On a valuation of canes at R1-8-0 per 100 with an average yield per acre of 10,000 we get R150—R75=Rs. 75 or R150—R97=R53 as profit per acre (without cost of living).

39. *Character and richness of the juice.*—In the absence of the chemical analysis (and I understand none has ever been made of Burma cane) I can only write in an amateurish manner on this paragraph.

The Settlement Officer in Bilin found the percentage of juice in the cane to be on an average 57.79 in first class land and 55.61 in second class, and the percentage of jaggery in the juice to be 16.81 and 16.18, respectively. These are the only statistics on the subject I can trace except the early investigation of Mr. Bridges. He found from 24.25 to 24.71 per cent of sugar to juice and from 14.45 to 15.76 per cent. of jaggery in the juice.

40. *Sugar-making.*—So far as I know this is not attempted in Burma; and the present small acreage under this crop hardly suggests that the Burma production will ever affect the commerce of the world. I hope to be able to bring samples from the Rangoon bazaar as suggested at the end of this paragraph.

The Chief Collector of Customs reports that the imports and exports of sugar are as follows for 1905:—

Statement showing the imports of sugar, refined, into the Province of Burma during the Calendar year 1905.

Country of shipment.	Country of origin.	Quantity.	Value	REMARKS.
		Cwts.	R	
FOREIGN TRADE.				
<i>Sugar, refined.</i>				
United Kingdom	Austria, Belgium, France, Germany, Holland, Peru, Java, Straits, Réunion, Demerara, Trinidad, Guatemala, British Guiana, and West Indies.	7,819	88,716	
Austria-Hungary	Austria	5,957	59,836	
Belgium	Belgium	597	7,512	
Germany	Germany	20,277	219,914	
Holland	Holland	492	4,432	
Egypt	West Indies	2	25	
Aden	Germany	5	31	
Ceylon	Germany	4	45	
Hongkong	Java and China	58,222	6,73,502	
Java	Java	204,328	2,118,466	
Siam	Straits	...	7	
Straits Settlements	Straits, Java and China	27,243	304,426	
Total		3,25,456	3,471,912	
<i>Sugar, unrefined (excluding molasses).</i>				
Java	Java	1,970	18,715	Raw sugar. Brown and unrefined sugar.
Straits Settlements	Straits	358	3,221	
Total		2,328	21,936	

Statement showing the exports of sugar, refined and unrefined, into the Province of Burma during the Calendar year 1905.

Country of shipment.	Country of origin	Quantity.	Value.	REMARKS.
COASTING TRADE.				
<i>Sugar, refined.</i>				
		Cwts.	Rs	
Bengal	{ Indian	11,470	1,80,235	
	{ Foreign	985	14,606	
Bombay	Indian	40	795	
Madras	Indian	28,073	3,19,591	
Total		38,548	5,15,277	
<i>Sugar, unrefined (including molasses)</i>				
Bengal	{ Indian	11,809	68,136	
	{ Foreign	1,567	8,386	
Bombay	Indian	75	1,322	
Madras	Indian	3,882	37,771	
Total		17,333	1,10,615	
Grand Total		3,38,885	4,119,740	

Statement showing the exports of sugar, refined and unrefined, from the Province of Burma during the Calendar year 1905.

Country of destination.	Country of origin.	Quantity.	Value.	REMARKS.
FOREIGN TRADE.				
<i>Sugar, refined.</i>				
Straits Settlements	Foreign	Cwts.	Rs 5	Re-export.
<i>Sugar, unrefined (including molasses).</i>				
Siam	Indian	457	1,820	Jaggery 455 cwts. Rs1,796.
Hongkong	Indian	1	10	
Madagascar	Indian	40	200	
Total		498	2,030	
COASTING TRADE				
<i>Sugar, refined.</i>				
Bengal	{ Indian	9	85	
	{ Foreign	562	6,886	
Bombay	Foreign	632	8,854	
Madras	{ Indian	1	15	
	{ Foreign	9	90	
Total		1,213	15,930	
<i>Sugar, unrefined (including molasses.)</i>				
Bengal	Indian	398	2,604	
Madras	Indian	30	232	Jaggery 19 cwts. Rs165.
Total		338	2,836	
Grand Total		2,049	20,801	

PART IV.

IMPLEMENTS.

41. The cultivation of sugarcane is on such a small, and apparently, a declining scale that the Department of Agriculture would hardly be justified in devoting much attention to it till some of the more popular and extensive crops have been exploited. The crop will however find a place on both the experimental farms; the indigenous variety will be carefully studied and exotics tried. We shall be glad to assist other provinces by trying under the peculiar conditions of Burma any experiments they may want attempted, *e.g.*, acclimatization experiments and the effect on Indian canes of transporting them to Burma.

MAYMYO:
The 8th December 1906.

J. MACKENNA,
Director of Agriculture, Burma.

CENTRAL PROVINCES.

The chief districts in which sugarcane is grown in the Central Provinces can be divided into three classes according to the method of irrigation which is practised. In the districts of Betul and Chhindwara water is entirely supplied by wells. Further south in Chanda and Bhandara tank irrigation is the general practice, while in Balaghat and Bilaspur water is raised from low-lying *nalas* and tanks supplemented if necessary by wells. With this exception the methods of cultivation are fairly general all over the provinces. The cane-growing districts of Betul and Chhindwara lie on the Satpura plateau at an elevation of about 2,000 feet. Here in comparison with other parts of the provinces the climate is fairly cool and during the cold season the thermometer sometimes fall below freezing point, doing damage to sugarcane and other crops. The majority of the gardens in Balaghat have an elevation of about 1,000 feet and the climate is similar to that of Nagpur, but damper in the monsoon. Bhandara District is slightly cooler than Nagpur, the maximum temperature not usually rising above 112° while Chanda has recorded 119°, the highest shade temperature in the Central Provinces:—

Month.	NAGPUR, ELEVATION 1025 FEET.		RAIPUR, ELEVATION 170 FEET.		CHANDA, ELEVATION 684 FEET.	
	Mean maximum	Mean minimum	Mean maximum	Mean minimum	Mean maximum	Mean minimum
January	83.5	54.9	78.5	54.4	87.1	53.7
February	84.2	54.8	79.1	54.0	86.1	52.9
March	95.5	66.4	91.9	67.1	87.1	60.5
April	101.0	71.1	97.2	71.9	100.6	72.4
May	110.8	82.3	106.5	81.9	109.4	83.2
June	106.5	81.9	105.2	83.5	106.4	82.4
July	86.6	75.3	86.3	73.8	90.9	76.6
August	88.0	75.3	88.0	75.8	89.1	76.2
September	86.8	73.1	86.7	74.6	87.1	73.6
October	81.5	66.4	89.1	69.3	70.5	66.0
November	87.8	60.0	85.3	60.6	87.1	67.7
December	82.8	62.4	79.5	53.3	82.6	49.3

Average rainfall during the last 38 years

Month.	Nagpur	Betul.	Chhindwara.	Balaghat.	Bilaspur	Raipur	Bhandara.	Chanda.
January	40	54	76	81	45	43	55	27
February	40	51	42	52	52	42	44	35
March	83	52	40	45	65	61	61	68
April	88	19	36	34	65	51	75	53
May	49	0	51	61	115	433	55	62
June	899	780	860	1144	853	1027	947	783
July	1311	1346	1090	1828	1416	1407	1536	1623
August	1004	1175	759	1592	1199	1329	1415	1295
September	845	724	905	989	111	691	951	998
October	206	213	181	173	193	194	140	184
November	45	49	52	43	52	32	52	43
December	31	43	38	20	24	18	28	25
	4541	4515	4180	6076	4909	5378	5399	5230

Area under cultivation.—Taken as a whole the area under sugarcane in the Central Provinces is decreasing. This decrease is most apparent in what were formerly the chief cane districts—Bhandara, Betul and Chhindwara. Its causes will be discussed later.

Table showing the decrease in area under sugarcane in the Central Provinces.

	Betul.	Chhindwara.	Balaghat.	Bilaspur.	Raipur.	Bhandara.	Chanda.	PROVINCIAL AREA.		
								Irrigated.	Non-irrigated.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
At 80 years' Settlement—										
1884 to 1899	7,000	6,175	4,078	5,144	2,415	10,959	4,074			95,698
1894-95	6,712	5,548	1,788	4,327	1,255	4,882	3,483	18,049	15,086	89,115
1899-1900	4,655	2,936	1,120	2,851	825	3,329	2,319	28,448	1,757	26,205
1904-05	2,789	1,529	1,548	2,799	795	2,168	1,028	19,601	1,789	21,389
1905-06	2,315	1,554	1,687	3,380	1,584	2,264	1,068	15,809	2,481	17,740

Character of the cultivation.—In the sugarcane districts almost every village has a few gardens which are generally small in area, about two acres being the average size. The position of the garden is changed from year to year, cane being grown once in the course of a three or four years' rotation. It thus most frequently happens that a new garden lies alongside the old one and is sown very conveniently as the crop on the preceding garden is harvested. The other crops in the rotation vary with the nature of the soil and water supply. On the lighter lands, such as the *sehar* of Balaghat, the rotation consists of rice, mung (*Phaseolus mungo*) or urad (*Phaseolus radiatus*) and sugarcane. On the black soil of Chhindwara and Betul the rotation is with wheat, gram, linseed, peas or mixtures of these crops. Gram has generally the reputation of being the best preparation for sugar. Various other rotations are occasionally practised. In Bilaspur sugar and urad are grown alternately; in parts of Chanda the land is left fallow for three or four years between the crops while in Chhindwara some ryots take sugarcane after cotton. This latter practice, however, is not at all a common one. Ground-nut (*Arachis hypogaea*), and sann hemp (*Crotalaria juncea*) are also sometimes grown as the preceding crop while upon the unirrigated areas of Bilaspur the rotation follows rice upon black cotton soils and til (*Sesamum Indicum*), urad, cotton or one of the smaller millets upon inferior land.

Soils.—Where the water-supply is good, much sugar is grown upon fairly sandy soils such as the *sehar* of Balaghat or *wards* of Chanda. Of the black soils, *kali-morand* and *muttabarra* are all used, the majority of gardens being situated upon *morand*. *Kali* appears to be the least expensive land for sugarcane cultivation, the natural water-supply being good and less manure is required. Where, however, conditions are favourable *sehar* land produces good quality gur. The value of any land for sugarcane depends mainly upon its water-holding capacity.

Varieties of cane grown.—The varieties of sugarcane grown in these Provinces are few in number. The most important is *pachranga*, a purple and yellow striped cane found in practically every district. It produces a fair quantity of juice and a good, although dark-coloured, gur. It is also fairly hard and so less liable to attack from jackals. This cane frequently gives a white sport known as *gadhara*, but the latter from the observation of the cultivators never throws back to *pachranga*. The origin of *pachranga* is quite unknown. It is frequently mixed in the gardens with a few stools of *kala*, a dark red cane having no particular value in the northern parts of the Provinces. To the south it is grown to a larger extent. A variety of importance in the north of the Provinces is a thick yellow cane known as *engrezi*, *poundhi* (Betul) or *bhounthi* (Balaghat). It appears to have been an *otahete* cane introduced about fifty years ago by Colonel Sleeman, then Commissioner of the Division. It is a cane yielding a large quantity of juice and a good quality, yellow gur. Its one disadvantage is that having such a soft rind it is much attacked by jackals and its introduction into some districts seems impossible unless all the cultivators adopt it simultaneously. Otherwise the jackals would select out the

poundhi gardens and destroy them completely. An attempt was made in 1904 to introduce this cane from Betul into Balaghat. It was only partially successful as owing to the time taken in transit many canes perished on the way. There is a fourth variety which is only grown in the Bilaspur and Balaghat Districts and which has proved upon analysis to be one of the richest canes in India. It is a greenish white cane smaller than *poundhi* and known as *malyagar*. There appears to be no record of this cane having been introduced into other districts, but as it grows only in the best parts of Bilaspur and Balaghat it is quite possible that it is less hardy than other varieties.

In addition there are a few varieties of hard canes which are frequently grown around the outsides of the gardens in order to protect the better varieties from jackals. Their juice is mostly used for drinking purposes, while the canes are given by the cultivator to his labourers and others.

Sugar is not prepared in these Provinces from any plant but the sugarcane. An attempt was made at the Nagpur Farm by Mr. (now Sir Bampfylde) Fuller to prepare it from *Sorghum*, but the product was unsatisfactory. The whole of the native spirit consumed in the Provinces is prepared from Mahua (*Bassia latifolia*).

General cultivation.—Throughout the greater part of the Provinces the cane is sown at the end of December or January and reaped at any time from the end of December to the beginning of March. It thus occupies the ground for at least 12 months, while in the Betul District the period extends to as much as 14 or 15 months. In some parts of the Balaghat District where an inferior variety of hard cane is largely grown, the crop is planted in March or April and reaped in November. In addition to the time the crop is actually on the ground another period of from two to seven months must be added during which the land is undergoing preliminary cultivation. When the poorer classes of cane are grown the rotation is frequently with one of the smaller millets or early paddy; a mixture of kodon (*Paspalum scrobiculatum*) and kutki (*Panicum polypodium*) is sometimes used for this purpose.

Mixed cropping is but little practised, chillies (*Capsicum frutescens*) and castor (*Eicemus communis*) with occasionally a little ambari (*Hibiscus cannabinus*) being the only crops grown with the cane. It is, however, a frequent practice to grow castor, tur (*Cajanus indicus*) or bhendi (*Hibiscus esculentus*) around the boundaries of the garden.

Ratoons.—The practice of ratooning is quite unknown in many Districts nor has it even been heard of. It is sometimes carried out for one year in the Bilaspur District on land where hard canes are grown without irrigation. In parts of Balaghat there is a superstition that if a cultivator continues to grow his crop from ratoons it will result in the gradual extermination of his family. At Dongaria, in the east of the Chhindwara District, *mung* or *sarari*, a thin hard variety, is sometimes grown from the stools of the previous crop after burning off the old leaves and watering, but the return is generally below that obtained from fresh seed. In the Betul District both the *poundhi* and *pachranga* varieties have been tried from ratoons, but without success, the former in particular giving an unsatisfactory crop. This was, however, most probably due to the fact that no manuring was given the second year, but simply the usual amount of watering and interculture.

Preparation of the land.—This is commenced as soon as the previous crop has been removed, which gives, with a rabi crop occupying this position in the rotation, a period of seven or eight months before sowing. Following paddy the time for preparation of the land is much curtailed, but this is counteracted to some extent by the fact that such rotation is only practised on the lighter soils. Ploughing is done with a wooden country plough which consists of steeply inclined narrow share with an iron point but no mould-board. This is worked by two bullocks in two directions across the field and the soil broken into blocks without being inverted. About 10 to 12 ploughings are usually given or even more, with the result that a tilth to the depth of from 9 to 12 inches is obtained. If time permits one or two *bukharings* are also given and occasionally the land levelled by means of a heavy log of wood. The lumps of soil are then broken down by hand and except in paddy fields, water is given previous to planting.

In some districts a portion of the manure is usually applied at this time consisting generally of well decayed cattle manure. Village refuse is also given if available. The practice of folding sheep or goats is unknown in the north of the Provinces, but sheep are folded in the Chanda District.

Source of seed.—All seed used is obtained locally, frequently from the adjoining garden or from a garden which has a local reputation for seed supply. The common practice is to uproot the whole cane, divide it into pieces containing three or four eyes each and use the latter as sets. Where *khari* land, i.e., land receiving the village drainage, is planted with sugarcane, the crop is invariably sold for seed purposes. The reason for this is that cane from *khari* land never produces good *gur* and the canes being well grown, the practice of using them for seed is undoubtedly a good one. In districts where the harvest is early, canes for seed are left standing for a few weeks until required, while in others the seed cane is cut and planted before the main bulk of the crop is reaped. Occasionally the canes are topped as they stand and the tops carted away for seed. The rest of the cane is pulled for *gur* making when required.

Selection and preparation of seed.—There seems to be no preference amongst the ryots for any special part of the cane as seed, the whole being cut up and used indiscriminately. No observation seems to have been made or opinion formed as to which part of the cane gives the best outturn.

As a rule three eyes are contained in each set, but when the sets are sold the length of each is of more importance than the actual number of joints. No preparation is given to the sets and, if necessary, they are left covered up with leaves for four or five days before planting. After that time they begin to lose vitality. In the few areas where inferior canes are grown without irrigation, the canes are soaked in water for eight or ten days before planting in order to hasten germination.

Planting.—This operation is always carried out in saturated soil except upon unirrigated land. In this case the canes are not cut but planted whole, an implement resembling a large country plough, called a *bawan*, being used. The *bawan* has a large hole passing downwards through the sole and through this the canes are passed and pressed into position as the implement is moved along. In general practice the land is divided by a plough with a double mould-board into furrows about two feet apart. At right angles to these furrows main water channels are formed, and as one coolie directs the water two or three others plant the sets. As each set is dropped into position it is pressed down by the foot to a depth of about five inches. As a rule the ends of the sets touch and even, in thick planting, overlap, the rate of planting being modified by the distance between the sets in the row rather than by the distance between the rows, which is fairly constant through all the cane-growing areas.

No other system of seeding is in vogue and should the germination be bad, nothing appears to be done to supply the vacancies.

Irrigation.—Within about a week of planting irrigation begins and continues regularly until the rains. Where the soil is light, water is applied as frequently as every fourth day. On black soils the period between waterings may be ten or even fifteen days, the time depending upon the depth and quality of the soil. Where water can be obtained from tanks the cost of irrigation is reasonable, but during recent years the expense of lifting it from wells has increased. This is alleged to be mainly due to the three following causes:—
(1) Dearthness of bullocks since the famine years, (2) scarcity of water owing to a succession of dry years, (3) dearthness of leather *motes* due to the export of hides from the villages.

Should there be a *nala* near the garden a hole is dug in its bank and the water lifted by manual labour. The lift consists of a kerosine tin at one end of a pole and a lump of clay at the other, the pole being balanced at its centre. A man standing over the well pulls the empty tin down and when full the weight of the clay raises it again, the water being then discharged into a channel. In dry seasons the hole must be deepened, the rate of watering then becoming very slow. Where the source of supply is not more than four or five feet below the level of a garden an arrangement known as a swing bucket is used. With this two men sit over the water and by means of a shallow basket

held by ropes swing up small quantities into a distributing channel. From a depth of four feet about one-tenth of an acre can be irrigated in three days. After the rains have ceased, water is again applied at intervals of about three weeks, the applications becoming less frequent as the crop ripens.

Surface cultivation.—During the hot weather of April and May the land is worked with a *kudāl*, a tool resembling a shorthanded pick. This if carried on continuously is one of the most costly operations, so that although weeding receives attention from almost all cultivators, thorough surface cultivation is only practised by the more wealthy. Nothing is done to the gardens after the rains until harvest except such application of water as is necessary. Mulching in any form is unknown, grass being in most districts very scarce. On an average about four or five weedings and one picking are given.

Manuring.—Only one form of manuring is generally practised, the chief exceptions being where the land receives village drainage or is folded by sheep. The bulk of the manure consists of sweepings and rubbish, mixed with a small quantity of cattle-dung. There is no general rule as to the time of its application. If the cultivator has a fair amount of manure for disposal then part is applied in the preliminary cultivation of the land and part subsequently as a top dressing. If only one application can be made it is generally done after seeding, during the hot weather. The ryots prefer the manure as well rotted as possible, otherwise it harbours white-ants. Artificial manures are absolutely unknown and seem likely to remain so while communication with large towns is so difficult and the majority of the cultivators lacking in capital. The supply of oilcake, although sometimes used as manure, is too small to be of much importance, many of the oil seeds grown in the Provinces yielding edible cakes suitable for cattle food. Much of the cane residue, after drying in the sun, is burnt under the evaporating pans, but as the prevailing form of furnace gives poor combustion with this fuel, the residue is frequently returned to the land where in course of time it decomposes. Green manuring is practised in the Betul and Chhindwara Districts only and even there to no great extent. Sann, Jagni (*Guzotia obifera*) and occasionally urad are the crops used for this purpose, but the bulk of the cultivators have no knowledge of the practice at all. Ten to twenty-five cart-loads of manure are usually given per acre costing from Rs. 3 to Rs. 12. Where sheep are fed upon the land the cost may rise to Rs. 40 per acre for manuring.

Treatment of canes during growth.—It is the general practice in these Provinces to wrap the canes together in bundles of about six or seven and bind them with the lower leaves or with the leaves of inferior varieties growing on the outskirts of the garden. This operation is done twice during the months of July and August. Staking with bamboos is carried out in a few districts, but is not a general practice. The most important of these subsidiary operations is fencing as a protection against jackal and wild pig. This has become a great expense during recent years owing to increase in the price of wood. The fence generally consists of thickly matted thorny bushes sometimes supported between two rows of bamboos. It is frequently from four to five feet high and needs constant repair as the jackals force their way through wherever possible. Another plan in the Bilaspur District is to build a mud wall about five feet high around the garden, but this is quite a local practice. There is a great demand for gun licenses in many villages in order that a gun may be procured to scare away the animals at night when nearly all the damage is done. This, however, will not lessen their numbers appreciably and the continual firing can have only a temporary effect. A watchman is sometimes kept to guard the gardens, but the majority of the areas are too small to justify such an expenditure.

Treatment before reaping the canes.—In the best districts it is customary before harvesting the crop, and where a break in the irrigation has been made, to give two or three final waterings. Frequently, however, irrigation is continued regularly until harvest time and no reason seems to prevail for these practices.

Diseases and pests.—More canes are lost in the Central Provinces through wild animals, chiefly jackals, than through all other causes combined. Second to these pests is the troublesome parasitic weed *Agia (Striga lutea)*. This is

most virulent during the rains and in the cold season dies off. Upon the lighter soils it is less noxious than upon the stiffer black soils, the *sehar* land of Balaghat being practically free while much loss occurs upon the *kali* and *morand* soils of Betul. Where gardens are badly infested the cultivators frequently rest them from sugarcane for some years and use *urad* and *jagni* as a green manure. Change of crop is also given, but even after ten years it is said to be difficult to effect a complete eradication. It is more than probable that the cultivators do not collect the weed and burn it at the most effective times. Attempts are made to get rid of the weed during the growing season, but it appears that when once a firm hold has been obtained it is frequently left to come to maturity and the part of the garden affected, more or less abandoned. The only other pests doing damage to any extent are white-ants and the moth borer. The former are mostly prevalent on the lighter soils and do not seriously interfere with the crop on *kali* or *morand* land. Moth-borer is fairly general and does considerable damage during the hot weather. Various methods are resorted to by the cultivators for ridding their gardens of these pests. A mixture of camphor and asafetida tied in a bag is suspended in the water channel as a remedy for the borer. A piece of bear skin is used in the same way as a check against white ants. Incantations and offerings are made by the Gonds to disease-checking gods, this being also considered a remedy against damage by jackals. Salt dissolved in the irrigation water is used as a preventative for white-ants. Its utility, however, is questionable and it is perhaps worthy of notice that on *khari* land where the cane is supposed to be inferior through excess of salt in the soil, the damage caused by white-ants is not diminished. Apart from the cane actually devoured by jackals much loss is sustained by rot setting up where bruises have been caused by these animals.

Although as a rule the flowering of the cane causes no trouble to the cultivator, yet there are occasions when it is regarded as a grave misfortune. Such is the case in particular with the *Pachranga* variety which flowers only at very long intervals, but which phenomenon in some districts is regarded as a very ill-omen leading to the destruction of the cultivator's family. To prevent such a catastrophe the owner leaves his garden uncut when the crop becomes the public property of the village. Other minor forms of disease not widely prevalent in these Provinces are those which result in stunted growth. One of these called in the vernacular "*murri*" attacks the plant in March, causing the leaves to twist around the main shoot, while another form known as "*ohista*" acts in a similar way in July and covers the plant with a white netlike growth. Frost also does a certain amount of damage occasionally in the Betul and Ohhindwara Districts. Amongst the cultivators white-ants are known as "*dimah*" and the moth-borer as "*ronthi*" or "*murer*." Smut (Vern. *kanki*) is but seldom seen.

Time and method of reaping.—The harvest for *gur* making commences as a rule about the end of December and continues until March. Where the ryots require money urgently the canes are frequently cut for eating purposes as early as November. Cane harvest takes precedence before all other work on the land and when once it has started and the weather is favourable it is carried on without a break until all is completed.

Should cloudy weather, however slight, intervene, harvesting and *gur* making are immediately suspended. As the earliest *gur* fetches the best price, harvest frequently takes place before the canes are really ready, although the advantage thus gained is, in the opinion of some cultivators, counterbalanced by the lower yield of juice. Canes which ripen very quickly are looked upon with disfavour by the ryots who prefer to see the tops remaining green for a considerable period.

The milling and *gur* making plant is almost invariably situated quite close to the gardens so that no delay is caused in bringing canes to the mill. The gardens also being small, the cutting can easily be regulated to keep pace with the *gur* making, deterioration of the cut cane being thus prevented.

The canes are usually pulled up singly with a portion of the root attached and are then stripped and the root trimmed off by means of a small sickle, the work being generally done by women and children. The tops are also removed at the same time unless they have been taken previously for seed purposes.

Yield of canes per acre.—The following figures have been taken from a number of measurements made in various years and will give an idea as to the cropping power of an average sugarcane garden :—

Year.	Village.	District.	Soil.	Variety of cane.	Weight of cane per acre in lbs.	Weight of juice per acre in lbs.	Weight gur per acre in lbs.	Mill used.
1902-03	Koshi	Bhandara		Pachra n g a and Kala.	19,410	10,680	1,750	Poona.
	"	"	"	"	22,620	11,200	1,685	Local.
	Futli	"	"	Dhaur (white).	42,170	24,700	5,080	Poona.
1904-05	Lanji	Balaghat	Sibar	Dhauri	19,850	10,400	2,840	Poona.
	"	"	"	"	19,100	9,200	2,040	Local.
	"	"	Mutburra	"	17,140	9,600	1,960	Poona.
	"	"	"	"	17,180	8,000	1,740	Local.
	Auria	Betul	Morund II.	Engrezi or Poundt.	15,450	8,000	1,550	Poona.
	"	"	"	"	26,350	14,000	2,150	Local.
	Jowalkhara	"	Morund I and II, Kachhar II.	Engrezi, Pachranga, Saradi.	30,800	16,000	3,150	Poona.
	"	"	"	"	38,000	18,000	3,400	Local.
	Nuka	Balaghat	Mutburra	Kath a 1 o r Mangi.	7,580	3,200	590	Poona.
	"	"	"	"	7,460	3,000	575	Local.
1905-06	Lanji	"	Sehar	Dhauri	29,200	17,300	3,300	Poona.
	"	"	"	"	24,100	11,980	2,620	Poona.
	Harda Tola.	"	Kachhar	"	33,940	21,070	3,330	Poona.

Manufacture of gur.—Only one method is in vogue throughout the provinces and this is of the simplest description. With the exception of the Betul District wooden mills are in most general use. They are made locally of babul (*acacia arabica*) and consist of two wooden rollers each with three skew teeth carved out upon the upper end. One roller is rotated by a bullock gear, the teeth conveying the motion to the other. Pressure is obtained by wedges which force the ends of the rollers inwards. A wooden mill can be driven by one pair of bullocks and will take from five to seven canes at once, but they need to be put through the mill three times before extraction is complete. Endeavours have been and are still being made to introduce iron mills into many districts, but these have not up to the present been adopted with much readiness. About twenty years ago the light iron Behar mill was demonstrated in the Betul District through the action of Mr. Macdougall, then Deputy Commissioner, and these met with so much favour that wooden mills in that district are unknown. It is only reasonable to suppose that had they been introduced into other districts at the same time their adoption would have been more general. At present the return from sugarcane cultivation is so uncertain that cultivators are unwilling to make a large outlay for a new implement although the cost of iron mills has greatly decreased. Twenty years ago the cost was Rs. 170; satisfactory mills can now be obtained for Rs. 40 to Rs. 80.

The mill is invariably sunk into the earth and the juice passes from it through a channel into a conical collecting jar sunk still deeper. To thoroughly cleanse the collecting jar is therefore a matter of some difficulty. The juice is strained as it leaves the mill through a piece of tin plate provided with holes, but this only removes the large pieces of foreign matter. When the evaporating pan is ready, the juice is baled into it, being strained as it passes through a wicker basket. This again is far from satisfactory and as the basket is well shaken when all the juice has been strained, very little real benefit results. The last of the juice passing through the basket is quite black in colour. The collecting pan is of such a size that it just holds enough for one evaporation. It is generally quite close to the furnace and only protected from impurities falling in by a bamboo mat. The pans, which are used singly, are about 7 feet in diameter and 12 inches deep. Formerly earthen pans were used and then iron ones, the ore being obtained from local mines such as those at Kinhi in Balaghat. At present the pans are either obtained ready made from Bombay or Calcutta or sheet iron is obtained and made up by the local smith. Occasionally such a man makes a reputation for his pans and then not only sells them over a large district, but may become an agent for iron mills as well. Efforts have been made to introduce the shallow form of pan from Poona, but without much success. One well-to-do cultivator, a malguzar, with a large area of cane, had been awarded one of these pans as a prize, but had not taken the trouble to fetch it quite a short distance by road.

The furnace is generally a hole in the earth bricked up to support the pan and with no other outlet, but the one where fuel is fed. A small outlet for the products of combustion is sometimes made at the back of the furnace, but no attempt is shown to prevent it becoming choked up. With such an arrangement combustion is very incomplete and the efficiency of the furnace very low. The fuel consists partially of leaves and residue of the canes, the latter having been previously dried in the sun. With the prevailing form of furnace the cane residue makes poor fuel and needs to be supplemented with wood. For this purpose the fencing of the gardens is used and larger material brought from the jungle. The provision of fuel, however, is one of the chief troubles of the cultivator.

As the scum rises to the surface it is strained off through wicker baskets the juice returning to the pan while the scum is not utilized any further. Neither liming nor any clearing process is practised although before the commencement of *gur* making the inside of the pan is rubbed with a mixture of butter, linseed and turmeric. The *gur* maker determines the point at which the evaporation is finished by the appearance of the bubbles of steam as they rise to the surface. The actual movement when the heating should cease is found by dipping the finger into water and then into the boiling syrup. If the latter congeals between the fingers and is of the desired consistency the pan is at once removed from the fire. After standing for about ten minutes it is poured into a flat rectangular box let into the earth to a depth of about 8 inches. When crystallised, the *gur* is scraped together into a cloth of drain; the resulting semi-spherical lump of dark yellow or brown material being known as a *bhela* and weighs about 140 lbs. Much of the *gur* made in the various districts is consumed locally and the remainder is exported chiefly to the Berars or the Hoshangabad valley. Here the superior quality of the Betul *gur* in particular still finds a market for it even against that produced at a cheaper rate in other Provinces. Locally the *gur* is sold retail at about 5 or 6 seers per rupee, the price being a little higher, 4 to 5 seers per rupee, for best quality *gur* from the *Poundi* cane. It is also sold wholesale to merchants coming from outside districts at from 45 to 60 rupees per *khandi* (280 seers).

It is a point well worthy of notice that at every fair sized village imported crystalline sugar of good quality can be obtained at about 4 seers per rupee, a price but little higher than the locally manufactured and often inferior *gur*. The latter retains its market owing to its greater sweetening power.

Cost of the Cultivation.—The cost of cultivation of one acre of cane over the whole of the Central Provinces is on the average about Rs. 150. It becomes less when the cane is grown on larger areas, but comparatively few gardens are more than 2 or 3 acres in extent. Given below are detailed costs of cultivation obtained from village *patwaris* and cultivators. In some years

the crop yields a profitable return, but much depends upon fluctuating influences over which the ryots have no control.

The cost of cultivation of an acre of sugarcane in the Betul District (Jowalkhera village).

	Pachranga.			Engreal.		
	Rs.	a.	p.	Rs.	a.	p.
Cost of 24,000 sets	20	0	0	40	0	0
Charges for a mote and a nara for year	5	0	0	5	0	0
Wages of 2 men for 5 and 6 months respectively	40	0	0	50	0	0
Half cost of keeping a pair of bullocks	20	0	0	20	0	0
Sowing charges	2	0	0	2	0	0
Cost of 20 cart-loads of fencing materials	7	0	0	7	0	0
Charges for weeding 3 times	3	0	0	3	0	0
Charges for earthing once	2	0	0	2	0	0
Tying of leaves 3 times	6	0	0	6	0	0
Oil for mote and nara	2	0	0	2	0	0
Wages of 15 (men and women) for 4 days at Rs. 2-5-0 a day	9	4	0	9	4	0
Cost of fuel	12	0	0	12	0	0
Hire for mill (Rs. 1-8-0) and pan (Rs. 0-8-0) for 4 days	8	0	0	8	0	0
Rent on land	1	8	0	1	8	0
Cost of manure (cattle-dung and rubbish)	3	0	0	3	0	0
Hire for bullocks for juice expression for 4 days	8	0	0	8	0	0
Additional cost of watching for 3 months . . . . .	...			6	0	0
TOTAL	148	12	0	184	12	0

Outturn per acre in a normal year—

Pachranga—5 *khandis* (1,400 *seers*) *gur* at Rs. 40 per *khandi*=Rs. 200.

Poundi or *Engrezi*—6½ *khandis* (1,750 *seers*) at Rs. 45 per *khandi*=Rs. 281-4-0.

Character of the juice.—The following table shows the composition and variation in the analysis of the juice obtained from cane grown in different districts during successive years. As the composition of the cane depends largely upon the nature of growth and time of cutting, these figures can only be taken as giving a general idea as to the value of the juice produced in these Provinces.

Composition of the juice and gur obtained from canes grown in the Central Provinces.

[Analyses made under the direction of Dr. J. W. Leather.]

Season.	Village.	District.	Variety.	PER CWT BY WEIGHT.		PER CWT BY VOLUME.		Gur	
				Cane sugar.	Glucose.	Cane sugar.	Glucose.	Cane sugar.	Galucose.
1903-04	Guriya	Chhindwara.	Pachranga and Gadhar .	11 15	820	11 87	878		
	"	"	"	12 80	967	12 51	1 04		
	Nagalwari	"	"	8 18	1 62	8 87	1 72		
	Chiklee	Betul	Pachrang .	12 27	785	12 22	785		
	"	"	"	12 78	851	12 77	816		
1904-05	Betul	"	"	10 99	748	11 47	11 74	1 57	
	"	"	"	12 84	971	12 71	1 04		
	Auna	"	Engrezi	12 46	1 72	12 26	1 32	66 90	12 09
	"	"	"	14 09	1 77	15 07	1 89	66 10	14 94
	Jawalkhera.	"	Pachranga	12 26	1 15	14 11	1 22	73 97	9 68
	"	"	Engreal	8 89	2 09	9 22	2 20	67 92	15 60
	Dunawa	"	Pachranga	14 57	748	15 53	797	72 78	10 78
	"	"	"	11 07	1 41	11 69	1 48	70 52	12 22
	Umri	Raichhat	Kathai	15 08	853	16 19	916	69 72	11 47
	Sawngi	"	"	14 71	946	15 25	1 02	63 25	12 52
Pangson	"	"	12 42	1 10	14 21	1 17	73 05	10 54	
1905-06	Langi	"	Dhanrur Ma-lyagur.	20 62	1 80	22 40	1 27	79 42	8 55
	"	"	"	17 52	2 77	18 69	2 29	81 34	6 75
	"	"	"	12 80	87	12 80	82		
	"	"	"	11 28	2 16	12 25	2 29		

Expenditure incurred in former years to grow 30,000 sets, i.e., 1½ acres.	Present expenditure incurred to grow 30,000 sets, i.e., 1½ acres.
<i>R a. p.</i>	<i>R a. p.</i>
	<i>Charges for forest</i>
	10 carts fencing at 4 annas per cart 2 8 0
	30 carts fuel at 2 annas per cart 3 12 0
Forest charges 1 0 0	5 carts bamboos at 8 annas per cart of 100 2 8 0
	1 cart wood for plough 1 0 0
TOTAL 22 6 0	Total 58 8 0

(2) In recent years rainfall has been rather uncertain, and with the water levels in the wells low, the cost of irrigation has increased.

(3) Scarcity of cattle has affected the cost of tillage and irrigation while the exportation of hides has increased the annual outlay upon well gear. The cattle used by the ordinary ryot are frequently also of a very inferior type.

(4) Labour has in many districts become very scarce and the rate of pay has risen. A male labourer now received 3 annas a day and a female 2 annas, against 1½ and 1 anna respectively in former years. Many coolies have also gone to work in mines, while others owing to the boom in cotton have taken up land for themselves and grow that crop.

(b) *Substitution of other crops.*—The two crops which to a large extent have replaced sugar are cotton and wheat, these being, in the opinion of the ryots, less expensive to cultivate, and yield a more certain return. It is not unusual to see in some districts disused wells adjoining cotton fields and showing where sugar was formerly the most important crop grown. Certain tracts of land in recent years have also risen in importance as centres of wheat export, only sufficient cane to supply *gur* for home consumption being now grown.

IMPROVEMENTS.

(1) *Water-supply.*—With the extension of irrigation works and the cheapening of water-supply an impetus should be given to the sugarcane industry in some parts of the Provinces, although in many others cultivators must still depend upon their wells. Demands for mechanical power to replace bullock gear are occasionally met with, but owing to difficulty of transit and distance from skilled labour in case of a break-down, such an installation as even a simple wind motor would involve great expense.

(2) *Introduction of new varieties.*—Owing to the liability of the best varieties to be attacked by wild animals, introduction of improved canes must be accompanied by better protection from damage. The cane to be valuable must be hard and yield a large amount of juice of good quality. The best canes grown at present, from the point of view of *gur* making, are too soft. Indiscriminate introduction of new varieties must be carefully guarded against.

(3) *Manuring and cultivation.*—In practically all the sugarcane districts of the Provinces the introduction of artificial manures to any extent is at present out of question. Something might be done to advance the proper use of cattle dung, although this is difficult where fuel is scarce. The greatest promise seems to lie in green manuring and the selection of suitable rotations. One of the greatest sources of expense to the ryot is in the renewal of the fence around his garden each year and much would be saved if the cane could be grown in successive crops on the same land. Selection of varieties suitable for ratooning would assist in this and also mixed cropping to a certain extent. Something also might be done in the way of surface cultivation to conserve the water-supply in the soil and thereby lessen the amount of irrigation required, while considering the high cost of sets in proportion to that of the whole season's cultivation, it is not unlikely that a lower seed rate would yield a more profitable return.

(4) *Gur-making*.—Improvements in furnace construction are very necessary, particularly in the form of a grate upon which to burn a thin layer of fuel, and also an outlet chimney to give more draught through the furnace. Minor improvements in straining and clarifying the juice might also receive attention. The Poona form of furnace has been demonstrated in many districts, but has only been adopted in a very few instances. With *gur* commanding so high a price it is not easy to foresee the monetary return likely to be obtained by the manufacture of refined sugar. The molasses would certainly form a valuable addition to the present available cattle foods. Owing to the wide distribution of the sugarcane areas and the scarcity of irrigation, even small factories would be unworkable under present conditions.

APPENDIX.

Description of the varieties of sug cane grown in the Central Provinces according to the method of Mr. J. W. Morrison and Dr. J. W. Leather—Agricultural Ledger No. 8 of 1898—

Variety	Pounda or Engrezi.
Where grown	Betul, Chhindwara and Chanda.
General appearance	Fairly thick, tall and soft, yellow or greenish yellow in colour. Frequently bent at top. Black smudges common. Does not ratoon well.
Type	C.
Bloom	At nodes only.
Nodes—	
Ring N ₁	Dark yellow but not very distinct.
Band N ₂	Yellow dots in a green ring, root dots slightly marked.
Band N ₃	Grey coloured.
Height	7 feet to 8 feet without tops
Girth	4 inches to 5 inches. Diameter increases towards the centre of cane.
Internodes	3½ inches to 5 inches.
Aerial roots	On six or seven lower nodes only.
Buds	Very small, flat, oval, pointed, grooved, colour varies.

Variety	Pachranga.
Where grown	Fairly general throughout the provinces.
General appearance	A medium-sized fairly hard cane, irregularly streaked in purple, yellow and green. The cane is straight in growth and does not ratoon well.
Type	B and E, slightly zigzag.
Bloom	A little on the top internodes.
Nodes—	
Ring N ₁	Indistinct, colour varies, generally light yellow. Extends around one half of the cane.
Band N ₂	Root dots distinct.
Band N ₃	Light grey in colour.
Height	6 feet to 7 feet without tops.
Girth	3 inches to 3½ inches. Diameter of centre part of cane slightly the greatest.
Internodes	2½ inches to 5½ inches.
Aerial roots	On four or five lower nodes.
Buds	Khaki coloured, flat, oval, grooved, pointed.

Variety	Kala satla.
Where grown	In same districts as Pachranga and mixed with that variety.
General appearance	A dark purple cane, fairly long and straight. The rind is marked longitudinally by thin white irregular lines.
Type	B and E, slightly zigzag.
Bloom	On top internodes only.
Nodes—	
Ring N ₁	Very distinct, light yellow.
Band N ₂	Root dots smooth but distinct, on yellow ground.
Band N ₃	Blue-grey in colour.
Height	7 feet without tops.
Girth	3 inches. Fairly uniform throughout length of cane.
Internodes	4½ inches to 5½ inches.
Buds	Light brown in colour, oval, sharply pointed, grooved fairly prominent.
Aerial roots	At bottom node only.

Variety	Gadhara.
Where grown	In same districts as Pachranga.
General appearance	A medium sized cane, yellow or green in colour. The nodes at the top and bottom are set fairly close together.
Type	B and E, slightly zigzag.
Bloom	At nodes only.
Nodes—	
Ring N ₁	Very distinct, dark orange in colour.
Band N ₂	Greenish white with distinct root dots.
Band N ₃	Grey ring, well defined.
Height	6 feet to 7 feet without tops.
Girth	3 inches to 3½ inches. Slightly thicker in middle part of cane.
Internodes	2½ inches to 5 inches.
Aerial roots	Up to the 10th node from the bottom.
Buds	Small, oval, brown in colour and grooved.

Variety	Bhondhya, Saradi, Katha.
Where grown	Balaghat, Bilaspur and Chanda.
General appearance	A dull brown coloured cane of nearly uniform thickness throughout its length. The rind is marked by longitudinal thin black lines. Inside surface of leaves frequently pink at the base. A very hard cane.
Type	A generally, but occasionally B.
Bloom	Covers most of the internode.
Nodes—	
Ring N ₁	Wide and distinct, light yellow in colour.
Band N ₂	Root dots on a white ground, not distinct.
Band N ₃	Grey ring, not well defined.
Height	7 feet to 8 feet without tops.
Girth	2 inches to 2½ inches. Diameter fairly uniform.
Internodes	5½ inches. Very regular in length.
Aerial roots	On 3 or 4 lower nodes only.
Buds	Fairly large, pointed, oval, prominent, yellow in colour and not grooved.

Variety	Saradi.
Where grown	Chindwara and Betul.
General appearance	Dull purple, mixed with a little green in colour. A thin cane and very hard.
Type	B.
Bloom	Covers most of the internode.
Nodes—	
Ring N ₁	A dark purple, swollen ring.
Band N ₂	Irregular in shape with very prominent root dots on a pale yellow ring.
Band N ₃	Light grey in colour, not well defined.
Height	5½ feet to 6 feet without tops.
Girth	1½ inches to 2½ inches. Diameter greatest at the bottom.
Internodes	2½ inches to 4½ inches.
Aerial roots	On lower 2 or 3 nodes only.
Buds	Khaki-coloured scales with slight grooves, very small.

Variety	Malyagar or Dhour.
Where grown	Bilaspur and Balaghat.
General appearance	A medium-sized greenish-yellow cane with characteristic black smudges which extend downwards from the nodes rather more than half the length of the joint, rind soft.
Type	B.
Bloom	General, at and below nodes.

Nodes—	
King N ₁	Distinct, pale yellow in colour.
Band N ₂	Fairly wide, light yellow in colour, root dots numerous and distinct.
Band N ₃	Distinct grey band of bloom.
Height	6 feet to 8 feet without tops.
Girth	3 inches to 4 inches. Fairly uniform throughout length.
Internodes	3 inches to 3½ inches.
Axial roots	Very few and found on bottom nodes only.
Buds	Very prominent, oval, pointed and brown in colour deep grooves.

EASTERN BENGAL AND ASSAM.

Preliminary.—The Agricultural Department was unable to spare an officer of its own for the enquiry into the sugarcane industry of the province. It had accordingly to be entrusted to District Officers, who collected information through the medium of their subordinate executive staff. The subject was an unfamiliar one to most of the investigating officers: much of the information received was therefore vague and unintelligible.

This Note has been prepared on the basis of the district reports, supplemented by such information as was available in the office of the Agricultural Department. The points raised in Mr. Barber's scheme of enquiry are dealt with *ad seriatim*.

PART I.

INTRODUCTION.

2. *Climate.*—The climate of Eastern Bengal and Assam is fully described in the subjoined note written by Mr. G. T. Walker, F.R.S., Meteorological Officer to the Government of India:—

Temperature.—The mean annual temperature of Eastern Bengal and Assam is appreciably lower than that of other parts of India in the same subtropical latitude. This is mainly due to the cooling influence of the exceptionally heavy rainfall of the province in April, May and the first half of June, during which period the weather over the larger part of the rest of northern India is dry, and warmer than at any other time of the year. The strong contrast of temperature between the east and the west of northern India usually lasts until August, by which time monsoon rainfall should have fallen freely in the north-west, and its moderating affect on temperature is no longer confined to north-east India.

Monsoon rainfall ceases in Eastern Bengal and Assam at about the end of September, and from November until February there ensues a general similarity between the temperature of the province and that of the belt of country lying to the west of it in the same latitude.

Over the greater part of India the upper and lower limits of temperature occur in May and January respectively, and it is in May that the strong cooling influence of spring rainfall is most apparent in this province. Not only, then, does the rainfall of those months reduce the mean annual temperature, but it does so most conspicuously at the time when the warmest weather of the year would otherwise occur, and it thus very greatly diminishes the annual range of temperature, while deferring the actual maximum until July everywhere except in the coast districts.

The yearly range varies from 17° or 18° in the districts below the northern tropic to 23° in the extreme north-east corner of Assam, and when this is compared with the range of 30°, which occurs in the east of the United Provinces and Rajputana, it will be seen that the climate is unusually equable in this respect.

In the coolest months of the year, January, weather is warmer on the coast than in the interior, temperature varying from 60° at Dibrugarh in Assam to 67° at Chittagong; in July a nearly uniform temperature, differing little from 82°, is recorded over the whole province.

The following table exhibits the monthly average of mean daily temperature at twelve selected stations in the province:—

Station.	Monthly average of mean daily temperature.												Year.
	January	February	March	April	May	June	July	August	September	October	November	December	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chittagong	66.6	70.7	77.2	81.3	85.0	81.8	81.2	80.3	81.6	80.0	74.4	68.1	77.2
Shohar	65.1	68.2	74.6	78.9	80.0	83.6	83.7	82.2	82.1	80.5	74.2	67.4	75.9
Barisal	66.0	70.7	79.2	83.2	84.7	85.5	85.0	82.8	82.4	81.1	73.9	66.9	75.2
Narayanganj	66.6	70.4	79.1	83.8	83.5	82.7	83.6	83.2	82.7	81.6	74.8	67.7	75.3
Mymensingh	63.2	67.0	75.7	81.5	81.2	82.1	82.7	82.5	82.3	79.7	72.3	65.4	74.4
Bogra	64.0	67.4	77.1	84.1	83.3	83.5	82.8	82.4	82.0	80.0	72.2	65.5	77.2
Sibsagar	69.8	68.2	69.6	74.5	78.2	82.9	84.0	83.5	82.2	77.8	69.0	61.1	73.9
Dhubri	68.6	67.0	75.0	79.7	79.3	81.1	82.1	82.2	81.1	73.7	71.7	64.7	73.6
Jalpaiguri	61.4	64.7	72.2	78.9	80.2	81.0	82.5	82.4	81.8	77.8	71.0	64.1	74.9
Dinajpur	62.8	66.3	75.2	82.7	82.0	82.5	84.0	82.7	82.8	79.7	71.7	64.2	76.6
Tespur	61.5	64.4	71.5	74.6	79.2	82.5	82.6	82.7	82.2	73.1	70.2	62.9	74.5
Dibrugarh	59.7	62.2	68.4	71.5	77.5	80.7	81.9	81.2	81.0	77.0	69.0	61.4	72.6

Humidity.—The high humidity of the whole province has become proverbial, and the results of observations bear out this popular belief, showing that, despite the great seasonal changes which occur elsewhere in this latitude as in other parts of India, the weather in the valley of Assam and delta of Bengal preserves its humid character with but small variation throughout the year. There are indeed few parts of the Indian area in which the air is so persistently damp as in Assam and the swampy regions of the Sunderbans at the mouths of the Ganges, without intermission from January to December; the upper half of the Brahmaputra Valley has a mean daily humidity exceeding 80 per cent., and over the remainder of the province humidity closely approaches that figure during the greater part of the year, while in February, March, April and November does it fall in mean value below 70 per cent.

The following table of mean relative humidity at 8 A.M., at twelve stations in the province for each month shows, how exceedingly damp the year is at all times of the year, and how near is the approach to saturation over the whole of the province:—

Station.	Average relative humidity at 8 A.M.												Year.
	January	February	March	April	May	June	July	August	September	October	November	December	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chittagong	87.3	84.3	82.7	80.2	82.4	82.2	82.0	82.7	82.4	82.3	82.9	82.5	82.5
Shohar	81.0	82.0	82.1	82.7	82.2	82.3	82.2	82.9	82.7	82.2	82.0	82.0	82.0
Barisal	86.5	84.3	84.3	82.2	82.4	82.3	82.0	82.1	82.7	82.4	82.3	82.5	82
Narayanganj	87.2	82.6	82.7	82.1	84.3	82.4	82.1	82.2	82.2	82.0	82.2	82.2	82.7
Mymensingh	81.4	84.9	81.1	82.0	82.2	82.5	82.5	82.3	81.3	82.2	82.7	81.2	82.3
Bogra	82.2	79.4	79.9	76.5	82.1	82.5	82.3	82.3	82.3	82.5	82.2	82.2	82.3
Sibsagar	86.0	82.5	82.2	80.1	81.5	81.7	82.3	84.4	84.3	82.4	82.2	82.2	84.9
Dhubri	81.1	82.7	74.5	78.3	82.3	82.5	82.3	82.6	81.8	82.5	82.3	82.3	82.1
Jalpaiguri	80.9	82.5	75.0	75.3	82.5	82.2	81.2	81.7	82.7	82.1	84.2	82.5	82.2
Dinajpur	82.9	79.3	82.2	71.7	80.1	82.2	82.0	82.1	82.7	82.7	82.3	82.3	82.1
Tespur	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
Dibrugarh	84.0	81.0	82.0	82.0	82.0	82.0	82.0	84.0	82.0	82.0	82.0	82.0	82.0

It cannot be said, however, that the absolute amount of water vapour present in the air is so marked a feature as is the humidity measured on the relative scale, that is, as a percentage of the possible or saturation amount. The quantity of vapour which the atmosphere is capable of containing depends solely on its temperature and increases rapidly with a rising thermometer; there are accordingly many parts of India and Burma where, in consequence of prevalent high temperature, absolute humidity is considerably above that of Assam, although the approach to saturation is not nearly so close. Such are the districts of Lower Burma and those lying along the Madras and Konkan coasts where, from November to April, high temperatures and proximity to the sea give an absolute humidity greater even than that in the valley of the Brahmaputra.

Absolute humidity is near its minimum in the early days of the year and is subject to but slow increase during February; for the next four months however it rises rapidly more especially in the interior districts of Eastern Bengal and up to the extreme north-east corner of Assam. From May to September humidity remains steady, and thereafter very rapidly declines to a minimum near the end of December.

Cloud.—Skies are seldom entirely clear over the province at any time of the year, and although during the cold weather months, when clear weather prevails over nearly the whole of northern India, the proportion of cloud-covered sky is at a minimum, it is still in excess of 10 per cent. on the coast and of 60 per cent. at Subsagar.

The cloudiest months are July and August when the proportion, which is fairly uniform over the whole province, lies between 72 per cent. and 93 per cent. The clearest months are November, December and January, but even then during the mornings thick fogs commonly cover the low grounds of Assam and the neighbouring tracts of Eastern Bengal, and remain undissipated till late in the day; these give place in the early spring, as the weather becomes warmer, to thick low-lying clouds, which gather daily over the valleys and afford the heavy rain which is a marked feature of the province at this time of the year.

Rainfall.—The rainfall of the province occurs in two periods of the year, the first extending from March to May and the second throughout the summer monsoon season.

The conditions which determine the earlier rainfall are largely those of geographical position and of the land surface, at any rate so far as concerns the two valleys of Assam, lying to the north and south of the uplands of the Garo and Khasi Hills. In the spring months there is no such continuity of steady rainfall as occurs during the monsoon, but the weather is characterised by storms which burst after the heat of the day, and generally come from a westerly or north-westerly direction.

The valley of the Brahmaputra is covered by swamp and forest land and largely protected by hills from the approach of drying winds; there is accordingly ample cause for its heavy spring rainfall in the excessive local evaporation. In the more open valley of the Surma and Barrak similar conditions also hold, with the added feature that the damp southerly winds from the head of the Bay of Bengal pass freely over its low-lying stretches and penetrate to the hills which form its northern boundary.

In Eastern Bengal the air during these months is on the whole less nearly saturated than in Assam, and rainfall, although it occurs there also, is less frequent and lighter than in the more easterly districts of the province.

Between these spring rain-storms and the succeeding rains of the monsoon season, a break of dry weather and westerly winds frequently intervenes.

During the months of the monsoon, rainfall is due as in other parts of north-east India, to the influx of southerly sea winds from the head of the Bay, and its distribution is necessarily much influenced by the contour of the country. The monsoon winds flow across the delta of Bengal in a direction nearly at right angles to the coast lines; where, their even flow being checked by the surface of the land, eddies and commotions result which induce heavy rainfall in the more immediate neighbourhood of the coast. These winds are hemmed in on the east by the Tippera hills and opposed on the north by the

Garó-Khasi range and the Himalayas. As a consequence they are deflected to the west and north-west, and while rising over the lower slopes of the hills undergo dynamic cooling which causes condensation of their water vapour and heavy rainfall.

For these two reasons the rainfall of the delta of Bengal decreases from the coast line on the south for some distance into the interior, and from the Valley of the Surma on the east to the broad plains of Bengal on the west. Thus the monsoon rainfall is found to decrease from 111·4" at Sylhet to 62·3" at Barisal, and to 50·3" at Calcutta; while from Barisal to Dacca the gradation is from 62·3" to 52·3". Still further to the north the influence of the hills begins to display itself in producing a rapid increase of precipitation, so that the decreasing rainfall from Barisal to Dacca is succeeded from Dacca to Mymensingh, 70 miles nearer to the Garó Hills, by an increase of 18". Rampur Boalia, which is at about the same distance as Dacca, but to the south-west of the Garó Hills, has a fall of 47·9" in the five months from June to October; while Bogra 60 miles nearer, has a fall of 57·9" and Rangpur, which is about the same distance as Bogra from the Garó Hills, but 70 miles nearer to the Himalayas, has as much as 68·0" in the same period. In all these cases the greatest differences are shown in the earlier months of the monsoon, and the effect disappears in October, when proximity to the coast becomes the most influential factor in determining the distribution of rainfall. The same characters are shown also in the case of the more eastern stations of Noakhali, Comilla, Sylhet and Cherrapoonjee, where rainfall decreases from 92·9" at the first station to 67·3" at the second, and thereafter increasing, on the further approach towards the hills, to 111·4" at Sylhet, culminates at Cherrapoonjee on the summit of the southern scarp of the Garó Range in the enormous fall of nearly 360".

The following table gives the rainfall data for the spring, monsoon and winter months:—

Normal District rainfall.

Division.	District.	Spring— March to May.	Monsoon— June to October.	Winter— November to February	Total of year.
		Inches.	Inches.	Inches.	Inches.
Rajshahi	Jalpaiguri	21 81	115 28	1 82	188 91
	Cooch Behar	21 63	96 96	1 10	119 69
	Rangpur	14 44	63 20	1 16	78 80
	Dinajpur	8 97	59 86	1 13	69 96
	Malda	6 23	49 02	1 63	56 88
	Rajshahi	8 66	46 88	1 63	57 17
	Pubna	12 12	47 26	2 08	61 46
	Bogra	11 33	52 93	2 00	66 31
Dacca	Mymensingh	17 48	67 13	2 02	86 63
	Dacca	16 81	51 49	2 33	71 13
	Faridpur	14 52	48 31	2 75	65 53
Chittagong	Bakerganj	13 49	68 75	2 88	85 12
	Tippera	18 09	55 00	2 50	75 59
	Noakhali	17 78	91 82	3 39	112 99
	Chittagong	17 43	91 47	2 91	111 81
Surma Valley and Hill Districts	Sylhet	39 97	94 45	3 46	137 88
	Cachar	38 42	86 64	4 54	129 60
	Goalpara	27 06	86 93	1 62	115 61
	Kamrup	21 68	63 39	1 86	76 93
	Darrang	21 86	58 87	2 71	83 44
	Nowgong	16 32	52 33	2 13	70 78
Assam Valley	Sibsagar	23 46	56 54	3 99	83 99
	Lakhimpur	30 33	77 71	5 53	113 62
	Manipur*	17 22	47 08	5 21	69 51

* Rainfall for one station only.

It will be seen that in the Assam Valley the rainfall is greatest at the two extremities, and smallest in the middle region represented by Tezpur, Gauhati and Nowgong: this peculiarity is possibly due to the fact that to the south of this region lies the most lofty part of the Shillong plateau, on the southern

face of which the monsoon currents are largely drained of their abundant water vapour before passing on their course over the central tableland to the valley beyond. To the west of the central plateau the valley is open to the winds of the Bengal delta, while to the east the average height of the hill range falls greatly admitting the south-west monsoon by the gorge of the Jatinga Valley, over the low uplands of north Cachar and down the long valley of the Dhansiri, into the great plain of Sibsagar and Lakhimpur.

Notwithstanding the unusually heavy spring rainfall of the province of Eastern Bengal and Assam by far the greater part of the annual amount occurs between June and September, and has its maximum in June or July. Taking the period of the six months' heaviest rainfall, May to October, the rainfall of May at stations in Assam and the more north-eastern parts of Eastern Bengal varies from $\frac{1}{3}$ to $\frac{1}{10}$ of the total for the whole six months, and averages for all stations about $\frac{1}{7}$; whereas in the Gangetic delta it averages $\frac{1}{11}$, and decreases westwards until at some of the more westerly stations of the delta the proportion is only about $\frac{1}{15}$.

Storms.—The storms of Eastern Bengal and Assam are of three types, differing in both character and place of origin:—

- (a) The cold weather storms which occur during the months of December, January, February and occasionally in March;
- (b) The cyclonic storms which pass from the Bay of Bengal during the south-west monsoon period and
- (c) The nor'westers and tornadoes, which are confined to the hot weather months.

The storms of the cold weather are similar in most respects to the depressions of Western Europe. They are caused by areas of low pressure moving from west to east, exhibit a slight circulation of wind, and give rise to unsettled weather, with more or less precipitation. Many of these storms can be traced from an origin as far west as Persia, across the Punjab and the United Provinces to their final stages in Assam, where their presence is indicated by only a slight lowering of the barometer, cloudy weather and some rain.

The cyclonic storms which form in the Bay of Bengal move along paths which vary in direction from month to month, and cross the Coast of India at different points. As a rule these storms pass from the sea to the land to the west of the mouth of the Ganges, but from September to the end of December an occasional storm may move into the south of Eastern Bengal: none, however, has been known to penetrate up the Assam Valley beyond the Garo Hills. The most severe storms of this type occur in October and November, and it is in the former of these months that the province is most frequently affected by them.

The hot weather storms are perhaps of the greatest interest, for, while they are of smaller extent, they occur frequently, attain great intensity and are often very destructive. They appear to owe their origin to the interaction between the damp sea winds and the dry winds from the interior supplemented by the action of the hills in giving rise to vigorous forced ascents of air. Their usual form is that of severe thunderstorms accompanied by hail; but sometimes they develop into tornadoes, the most intense form of small revolving whirls. These are rarely more than a few hundred yards in diameter and their paths of destructive violence are seldom longer than 10 miles; but along these paths they advance rapidly and with little warning overturn and destroy houses and trees, and cause general destruction of life and property. The rainfall associated with hot weather storms is of importance in north-east India, and more especially in Assam, where it is a valuable factor in the growth of tea.

The great humidity of the atmosphere, the absence of hot parching winds and the abundant showers which are received in the three months preceding the advent of the monsoon give Eastern Bengal and Assam a decided advantage over most other parts of India in regard to the cultivation of sugarcane and many other crops. The need of irrigation which adds greatly to the cost of cultivation in other parts of India is seldom felt in Eastern Bengal and Assam. Herein the climate of the province approaches that of the cane growing countries in the tropics more closely than any other Indian province. Owing to the great rainfall during the monsoon and the constant humidity of the air, the

soil remains moist long after the cessation of the monsoon, enabling the sugarcane crop to continue in active growth for a longer period than in the drier parts of Northern India.

3. *The age of sugarcane cultivation in India.*—The Hindu scriptures abound in allusions to sugarcane. Many of these are quoted or alluded to in Dr. Watt's Economic Dictionary. The oldest reference is *perpapa* in the *Ramayana*, in which Rama is said to have worshipped the goddess Durga with an offering of sugarcane juice. The Sanskrit Dictionaries give numerous synonyms for sugarcane which it is hardly necessary to quote here. The District Engineer of Rangpur quotes a passage from the *Statak Smriti* in which the sugar-mill (*ikshu jantra*) is mentioned. He also quotes a verse from *Rajanirghanta* (of which the age is uncertain) in which mention is made of four varieties of sugarcane—(1) *Paundraka*, (2) *Banshekahu*, (3) *Syamekshu* and (4) *Baktekshu* which literally mean: (1) the sugarcane of Paundra, which signified in ancient times the country watered by the Karatoa river in Northern Bengal, included in the present districts of Rangpur, Dinajpur and Bogra; (2) the bamboo cane which is perhaps the same as the tall, thin, hard *khari* or *khagri* cane of the present time; (3) the yellow cane; and (4) the red cane, the last two being obviously the prototypes of the yellow or white and the red or purple canes of our times. In fact, were we to classify the canes grown at present merely from their outward appearance, we should have to adopt a similar classification to that of *Rajanirghanta*. It is possible that the name *Paundaraka* has descended to us in the shape of such words as *Paunda*, *Pura*, *Puri*, etc., all of which appertain to the thicker and softer varieties of cane suitable for chewing.

The extent and character of cultivation.—Sugarcane is cultivated more or less in every plains district of the province. There is very little of this crop in any of the hill districts. The only hill districts where an appreciable quantity of sugarcane is grown are the Chittagong Hill Tracts, Manipur and the Khasi Hills, but the area occupied by it is so small as to be almost negligible. The following statement shows the acreage under sugarcane in the year 1905-1906 in the several districts of the province:—

Division.	District.	Acreage.	Total.
Rajshahi	Jalpaiguri	4,700	
	Dinajpur	25,000	
	Malda	2,800	
	Rajshahi	18,100	
	Rangpur	16,000	
	Bogra	20,000	
	Pabna	3,200	
	Total	89,800	89,800
Dacca	Dacca	19,700	
	Faridpur	25,000	
	Bakarganj	18,500	
	Mymensingh	7,000	
	Total	70,200	70,200
Chittagong	Chittagong	9,000	
	Tippera	5,700	
	Nac'hali	600	
	Chittagong Hill Tracts	800	
	Total	15,600	15,600
Surma Valley	Sylhet	22,000	
	Cachar	5,900*	
	Total	27,900	27,900
Assam Valley	Goalpara	1,200	
	Kamrup	4,800*	
	Darrang	2,200*	
	Nowgong	22,000*	
	Sibsagar	6,000*	
	Lakhimpur	5,000*	
	Total	20,900	20,900
GRAND TOTAL FOR THE PROVINCE			224,400

The total area cropped with sugarcane in 1905-1906 thus appears to be about 2½ lakhs or little short of a quarter million of acres. Out of this area about 90,000 acres, or 40 per cent., was in the Rajshahi Division, 70,000 acres, or 30 per cent., in the Dacca Division, and the remaining 30 per cent. was shared by the remaining three divisions. It should be noted, however, that the acreages given above are, with the exception of those marked with asterisks, very rough estimates, which may be far from the truth. The acreages given against Cachar and the Assam Valley districts, with the exception of Goalpara, are based on survey and can be accepted as fully correct. Except for these few districts, it is not possible, from a consideration of the annual agricultural statistics, to say for certain what proportion of the total cultivated area is occupied by the sugarcane crop in each district, or whether the area has been increasing or decreasing in recent years. In the six districts for which accurate statistics based on a field-to-field survey are available, the actual areas under sugarcane in 1895-96 and 1905-1906 and the percentage which the area in the latter year bore on the total cultivated area are exhibited below:—

District.	Acreage, 1895-96.	Acreage, 1905-1906.	Increase+ or decrease— in 10 years per cent.	Percentage of area on total cultivated area.
Cachar . . .	1,071	5,878	+440.8	1.9
Kamrup . . .	3,810	4,315	+ 13.2	0.9
Darrang . . .	1,951	2,177	+ 11.5	0.8
Nowgong . . .	1,928	2,238	+ 16.0	1.1
Sibsagar . . .	6,879	5,974	- 13.1	1.2
Lakhimpur . . .	1,859	4,990	+168.4	1.9

The cultivation has rapidly increased in Cachar, where, as well as in the neighbouring district of Sylhet, time-expired tea-garden coolies have settled in large numbers and begun to cultivate sugarcane on hilly jungle-covered land which at one time was considered useless except for growing thatching grass. In the Lakhimpur district also, the area under sugarcane has undergone considerable expansion in recent years. The sugarcane industry in this district, as well as in the adjoining parts of Sibsaagar and Darrang, is now mainly in the hands of Nepalese immigrants. These people are nomadic in their habits and scarcely remain in a place for more than five or six years. Their custom is to settle down in the midst of a forest, usually on the banks of a river, make a clearing in the forest, grow sugarcane on it for as long as a single crop with its ratoons will last, and then shift to a new forest site. They are able to produce jaggery so cheap that the native Assamese cultivators are unable to compete with them; hence in those parts of Assam where the Nepalese have taken to growing sugarcane, the natives of the country have practically abandoned its cultivation. To this fact may be attributed the slight decrease of area under sugarcane in the Sibsaagar district, where of all districts in Assam the crop was at one time cultivated to the largest extent.

Though trustworthy statistics of area are not available for any of the Eastern Bengal districts or for Sylhet and Goalpara, it would appear from the district reports that in the open well-cultivated parts of the country, the cultivation of sugarcane is giving way to jute, which in recent years has assumed an unexpected importance owing to the extraordinarily high prices now being paid for the fibre and which is far easier to grow and gives a quicker return than sugarcane. On the other hand, the cultivation of sugarcane has been rapidly increasing in the more backward tracts where jute does not thrive well, e.g., the hilly tracts in the south of the Surma Valley bordering on the Tippera Hills, and at the foot of the Sitakund Range in Chittagong, and the high jungly tract of country in Rangpur known as the *khior* or the *barind*. There is no doubt that, barring jute in the more favoured parts of the country, there is no crop which pays the cultivator who can afford the labour to grow it so well as sugarcane, and the profitableness of the crop has rather increased than otherwise in consequence of the growing demand for jaggery, which has resulted from the opening up of communication in the interior of the country and the increasing prosperity of the rural population. The gradual introduction of iron-mills, which has enabled the cultivators to obtain larger yields of jaggery than was possible with the old fashioned wooden mills, is

another of those causes which have tended to make sugarcane cultivation more profitable than before.

Some of the district reports have assigned other more or less local causes for the increase or decrease of sugarcane cultivation. Thus, in Chittagong, it is said that the example of some planters, who have been growing sugarcane on hill slopes which were at one time considered worthless for any agricultural purpose, has led many people to do the same. In Goalpara, the subsidence of the ground level caused by the great earthquake of June 1897, is reported to have rendered the country excessively liable to flood and consequently less suitable for sugarcane thus causing a contraction of the area cultivated with that crop. A rise in the price of mustard cake, which is commonly used for manuring sugarcane in certain parts of Sylhet, is reported to have led to a curtailment of the sugarcane area in those localities. The inflow of saline water is, among other causes, held responsible for the comparative neglect in which sugarcane has fallen in the southern parts of the Backarganj district.

The cultivation of sugarcane is of comparatively recent introduction in the Chittagong Hill Tracts, and possibly also in the Manipur State. In the Chittagong Hill Tracts, it was introduced from the adjacent district of Chittagong some fifty years ago. The cultivation of sugarcane in Manipur on a systematic scale is said to date from the time of Raja Sir Chandra Kirti Sing (1850-86), though the plant was not wholly unknown in the State before his time. The cultivation of sugarcane for *jaggery* is an industry of recent growth in the Noakhali district. A large area of sugarcane is found in the south-eastern parts of the Faridpur district, where it was unknown till 30 or 40 years ago. The crop is grown there on river *chars* or *dearas* which are annually submerged.

The bulk of the sugarcane crop in the province is grown in small patches of one or two bighas (one bigha = $\frac{1}{4}$ of an acre). The area of a sugarcane field is determined by the amount of labour at the command of the cultivator. There is a saying that a man who does not possess seven sons and twelve grandsons should not engage in sugarcane cultivation. Except in certain localities, it is rare for any one to grow sugarcane mainly or wholly with hired labour. The Nepalese sugarcane growers in Upper Assam, besides working with their own hands, employ a good deal of hired labour. A number of families squat down in one place, and sugarcane being practically the only crop which they grow and the only source of their income, the area cultivated by each is comparatively large. No information is, however, available as to the average area of sugarcane cultivated by each family. Two European planters, Mr. Cattell and Mr. Brownlow, and a Bengali planter, named Babu Nabin Chandra Sikdar, have large sugarcane farms in Chittagong, and an Assamese gentleman, Srijut Debeswar Gossain, cultivates about one hundred acres of sugarcane on his farm at Barpathar, in the Sibsagar district. These farms are managed on commercial lines, and are believed to be profitable concerns. The land is cultivated wholly with the help of paid labour.

The principal kinds of soil on which sugarcane is grown in Eastern Bengal and Assam are either of deltaic or recent alluvial formation. The soil is either loam or clayey loam. Sugarcane is rarely grown on sandy soil.

Sugarcane is also grown to a considerable extent on a class of soil which passes under the name of old alluvium. It is believed to owe its origin to the disintegration of laterite rocks. It covers a large tract of country in the centre of the Rajshahi Division (known as the *Khar* or *Barind*) and also occurs in many parts of the Assam Valley, notably in the Golaghat subdivision, which is an important centre of sugarcane cultivation. The same soil occurs in the tract of country in the Dacca district known as the Madhupur jungle. The soil is usually a red or yellow clay, having evidently a great deal of iron in its composition. The old alluvium tracts occupy a comparatively elevated level and are immune from floods. The soil is more difficult to cultivate than new alluvium (*pai*), and does not retain moisture so well as the latter. In such soil the planting of sugarcane has to be deferred till April or May (and often till June), or if the crop be planted earlier, it has to be nursed by frequent waterings through the early stage of its growth.

The only examples of sedentary soil in Eastern Bengal and Assam on which sugarcane is grown are met with in the low hills or *teelas* in Sylhet

and Cachar and the sloping plains at the foot of the Sitakund Range in Chittagong. The soil is derived from sandstone rocks and is usually of a light open texture.

Very few analyses exist of the soils of Eastern Bengal and Assam. A number of tea soils has been analysed by Dr. H. Mann and others, but these scarcely throw any light on the character of the soils on which sugarcane is habitually grown.

Generally speaking, the bulk of the area in which sugarcane is grown consists of land on which the ordinary crops of the country are grown. Such land is too poor to bear a sugarcane crop without being manured. In the Dacca Division and the southern parts of the Rajshahi Division a great deal of sugarcane is grown on land which is annually submerged, and, being enriched with silt, stands in no need of manuring. So also in the case of land newly reclaimed from forest, the soil is naturally rich in vegetable mould and is capable of bearing sugarcane without the help of any manure.

From what has been stated above, the various descriptions of land in which sugarcane is cultivated in the province will appear to fall into the following classes, on each of which the character of the cultivation is of a distinctive type:—

I. *Alluvial land beyond the reach of floods.*—It is the most important class of land on which sugarcane is grown in the open thickly-populated parts of the province. The soil is usually of a loamy character, and being seldom allowed to remain fallow, it is too poor, as a rule, to bear sugarcane without manure. The crop is, therefore, invariably manured and cultivated with greater care and attention than elsewhere. The varieties of sugarcane usually cultivated in this class of land are the medium soft yellow or white cane preferred for the manufacture of jaggery and also used for chewing.

II. *Alluvial land which is annually submerged and enriched with silt.*—This class of land is mostly found in the deltaic districts of the Dacca and Rajshahi Divisions. The land is never manured. The only varieties of cane that can be grown on such land are the thin hardy kinds of cane which can bear submersion. The crop receives comparatively little attention, and such operations as trashing and wrapping are practically unknown. The jaggery made is of inferior quality and in many places where the inundation is heavy and lasts long, the crop droops prematurely as the result of prolonged water-logging and has to be harvested as early as October.

III. *Old alluvium (khar or barind) in the Rajshahi Division.*—The prevailing soil is a red or yellow clay which is more difficult to work than new alluvial soil and is liable to suffer from drought. Here, too, the thin hardy varieties of cane are grown by preference. They can stand drought better than the softer and more valuable canes, and receive less attention.

IV. *Land newly reclaimed from jungle.*—This class of land is found mostly in Upper Assam and in hilly tracts in the south of the Surma Valley and at the foot of the Sitakund Range in Chittagong. A nomadic system of cultivation is pursued. The land after being cropped with sugarcane is abandoned. The soil being rich in humus is never manured. In Upper Assam, the soil on such land is of alluvial origin and usually very rich. Successive crops of ratoon, often as many as five, are taken off the land before it is abandoned. The cultivation is of a primitive nature, though it is believed to be very profitable. The usual kind of cane grown on this class of land in Upper Assam is a thick soft white cane which elsewhere is grown only for chewing purposes. In the Surma Valley and Chittagong, the soil in newly reclaimed forest land is of sedentary origin, and is not, as a rule, rich enough to bear sugarcane longer than two or three years. The land lies high and dry, and the soil being of a light texture, the crop is liable to suffer from a prolonged absence of rain. There is, besides much risk of loss from wild pigs and jackals. For these reasons, the thin hardy varieties of cane, which are comparatively immune from drought and wild animals, are grown by preference in such land.

5. *Varieties of cane grown.*—It is not possible, from the meagre descriptions furnished in the district reports, to prepare anything better than a rough preliminary classification of the varieties of cane grown in the province. Appended to this note will be found a list of the varieties mentioned in the district reports with such description of each as has been furnished.

Roughly, the canes of Eastern Bengal and Assam may be divided (1) according to use, into (a) chewing, and (b) jaggery canes; (2) according to colour, into (a) white, grey, yellow or green canes and (b) black, purple or red canes; (3) according to character of rind, into (a) soft and (b) hard cane; and according to thickness of stem into (a) thick and (b) thin canes. Following this empirical classification, the varieties of cane found in this province may be grouped as follows:—

I.—CHEWING CANES—TALL, THICK, AND SOFT.

A. Black or purple.—It is known as Bombay or black Bombay cane in most district in Bengal, *Saheban* in Northern Bengal, and *Kalapura* or *Teli* in the Assam Valley. This variety was at one time largely cultivated, but it has proved extremely susceptible to disease (the red smut); nowadays it is grown in tiny patches near the rayat's homesteads and used only for chewing. It is a tall, thick, soft cane and is distinguished by the internodes being thicker in the middle than at the nodes. It is not, however, so rich in saccharine matter as some of the medium soft yellow kinds ordinarily grown for jaggery or the hard purple cane known as *Kajla*.

B. Yellow.—It resembles IA closely, except in regard to the colour of the rind which is of a yellowish green colour. It is variously known as *Pura*, *Bagapura*, *Bombay*, *Bom* or *Bompura* in different parts of the Assam Valley. This cane is grown largely by market gardeners in the vicinity of Dacca, and is known there as the White Bombay. It is the favourite cane of the Nepalese squatters in Upper Assam. It is subject to disease, but not to the same extent as the purple variety (IA). The *Vendumukhi* cane of Rangpur perhaps belongs to this class.

II.—JAGGERY CANES OF MEDIUM SIZE—FAIRLY SOFT.

Yellow, white or green.—Includes the largest number of sub-varieties which cannot be distinguished from one another without a close study of their appearance and character in the field. In this class will come the *Mag. Mugi* and *Bogi* canes of Assam, the *Dhalsundar* of Dacca and the *Dhal* or *Dhali* cane of the Surma Valley. These canes are the most important among the varieties grown for jaggery. They are also largely used for chewing. The *Sharang* cane of Dacca and the *Shamsha* cane of Sylhet and Cachar belong apparently to this class.

III.—REED CANES—THIN, TALL, HARD-RINDED.

A. Yellow, white or green.—These canes rank as the hardest of all. They are comparatively immune from injury by drought, inundation and wild animals, and are, therefore, grown exclusively in all situations where danger from these causes is feared. They also suffer less from insects and fungus disease. The commonest names for canes of this class are *Khari*, *Kheri*, *Khagra*, *Khagri*, *Ikuri Malaha*, *Magari*, *Majara*, etc., all of which are derived from the names of common reeds. These canes are poor in sugar-content, but as they grow freely and raton much better than any other, they seem to be coming into popular favour and to be supplanting the better kinds of cane in certain parts.

B. Black or purple.—Known variously as *Kajla*, *Kajli*, *Kali*, *Rangi Teliya*, etc., meaning either purple or black or of the colour of mustard oil. This variety ranks among the hardier canes, and next in this respect to III A.

IV.—WILD CANE.

In *chur* lands in Eastern Bengal, a kind of reed known as *latá* or *kháld* is met with, which is used extensively as fodder. The canes are sometimes given to children for chewing. This reed is cultivated as a fodder in the *churs* of the Meghna and the Dhaleswari river in the Dacca district. The Collector of Faridpur has reported a variety of reed cane, which also is called *lata* and has furnished the following description of the cane:—

It is a yellow cane with a shade of purple, hard and not much thicker than a man's finger. In several places it is confused with the *khagri*, which is a distinct variety of recent introduction. It is too hard both for white ants and jackals and is generally grown on land that will grow no other cane, namely,

lands on which 4' to 6' of water stands during the rains. The *gur* is of bad quality and of blackish colour, and sometimes this cane is used as fodder.

But the Collector does not include it among the wild canes.

It is not quite understood what is meant by Giant canes. The Black Bombay cane (IA) attains an enormous size in good soil and under good cultivation, and may then be known as a Giant cane.

In regard to quality, the medium yellow varieties (*Mac*, *Dhalsundar*, *etc.*) are said to yield the best jaggery, and are grown in preference to all others wherever the surroundings are favourable to the cultivation of sugarcane. The *Kajla* cane is said to be the richest in sugar-content. The *Khari* or *Khagri* canes (III A) are the poorest in point of the yield of juice and sugar, but are preferred in many places for reasons already mentioned.

6. *Recorded introduction of new varieties.*—The Bombay varieties of cane are admittedly of foreign origin. The Black Bombay cane is believed to have been brought to India by Captain Sleeman from Mauritius. This cane is known as *Shahaban* (*lit.* brought by *sahaba*) in Northern Bengal and was introduced in Rangpur by some European planters in 1840 (see Mr. Glazier's Statistical Account of Rangpur, 1873). It was introduced into Assam either at the time of Captain Welsh's expedition (1793-94) or by European sugarcane growers in Kamrup in the middle of the last century. Some of the district reports mention it as having been introduced some 50 years ago.

The *Sharang* cane of Dacca is believed to be identical with the *Samsara* cane of Bengal which is said to have been imported from Otaheite about the beginning of the last century. The Sylhet name of *Shamsa* might be only a variant of the word *Samsara*. These few constitute the only instances on record of exotic canes introduced in Eastern Bengal and Assam.

7. *"Sports" and seedling canes.*—Very few people in the province seem to know anything about "Sports" and seedling canes. Sylhet is the only district from which the phenomenon of "Sports" in sugarcane has been reported. The white *Khagra* cane there is said occasionally to give rise to the red or *Rangi* cane.

An instance of a new variety which has come into existence as the result of degeneration is the *Assamese Pura* (also called *Keteki Pura*) cane of Assam which is believed to have sprung from an exotic variety (yellow *Pura*) of which mention has already been made.

Seedling canes are wholly unknown. Except in Upper Assam, it is unusual to see any "arrows" in a cane-field, and there it is only the tall reed canes that are found to flower. It is not known whether any one in Eastern Bengal and Assam has ever attempted to raise sugarcane from seed, nor is it known whether the seeds produced locally are fertile or not.

8. *Other sources of sugar and spirit.*—The only other source from which sugar is produced in Eastern Bengal and Assam is the date-palm which is largely grown in the western parts of the Faridpur district bordering on Central Bengal. Date sugar is also produced to a small extent in many other districts of Eastern Bengal, but the total quantity of date jaggery produced in the Province is after all small, and except in a few of the south-western districts, it does not affect the sugar market in any way. Date jaggery is preferred to cane jaggery on account of its nice flavour, but it does not keep well and turns sour during the rains.

Spirit is produced in Eastern Bengal and Assam from jaggery, *mahua* flowers which are imported from Behar and the United Provinces, and rice.

PART II.

CULTIVATION.

9. *Planting and reaping seasons.*—The season of planting sugarcane in Eastern Bengal and Assam extends from January to May. In most alluvial soil, the planting takes place as a rule in the first three months of the year. Where the soil is liable to dry up during the hot weather, the planting is deferred till the spring showers in April and May have sufficiently moistened the soil, and in unfavourable years, the planting may be continued up to the first fortnight of June. In case of late planting like this, the invariable custom is to plant the sets in seed-beds, and transplant them later in the field. This

appears to be the common custom in most parts of the Assam Valley and in parts of the Dacca and Surma Valley Divisions. The market gardeners of Dacca commence to plant their canes as early as November, but these are used only for chewing.

The reaping season for jaggery canes is governed largely by the exigencies of general agriculture. It does not commence usually before the close of the winter rice harvest about the middle of January. The reaping commences with the ratoon cane which attains maturity in a shorter time than plant cane, and where there is much of it, the crushing may commence as early as the middle of November, that is, as soon as the weather has become fair and settled. In the inundated tracts of the Gangetic delta where reed canes are grown, the harvest commences as early as September. The long water-logging to which the crop is subjected, causes it to droop prematurely, and the cultivators commence to gather it soon after the flood has subsided and left the ground high and dry.

The bulk of the cane crop is reaped between the middle of January and the end of March, but in localities where sugarcane is largely cultivated, reaping may continue to as late a period as the end of April. A Bengali saying,

Maghe una Falgune duna,

Chaitte mule mul, Baisakhe nirmul,

embodies the wisdom of the raiyat in regard to the reaping season. Freely translated, it means that sugarcane reaped in *Magh* (15th January to 15th February) give slightly less (jaggery than the normal yield); if reaped in *Falgun* (15th February to 15th March), the yield is double; in *Chait* (15th March to 15th April), it just pays; but if reaped in *Baisakh* (15th April to 15th May), it ends in total loss. From this proverb, the best time for reaping cane in Bengal would appear to be the month from the middle of February to the middle of March. The weather at this time is moderately cool, and the cane after having reached its maximum growth about the beginning of December, has had time to complete those metabolic changes which result in the formation of sugar.

The cultivators know from external appearances, such as the drooping and withering of the leaves, the change in colour and glaze of the rind, etc., when the cane is ripe and fit for reaping; but they seldom look for any signs, and commence reaping as soon as the proper season has arrived and they are free to turn their attention to this work.

The period which elapses between planting and reaping may be said to vary from seven to twelve months. It depends chiefly upon the time of planting which, as stated before, extends from January to the end of May, varying according to the conditions of weather and soil, and upon the time when the cultivator is able to crush his cane. It would seem that the time of planting has little relation to the ripening of sugarcane. The crop, whatever be the time of planting continues in active growth all through the rainy season and during the first six weeks or two months of the dry weather which follows, and it is not until the growth of the plant has been arrested by the increasing dryness of the soil in January onwards that the ripening process comes into full play.

Very little is known in regard to the time which different varieties of cane take to ripen. In Dinajpur, the *Potashi*, *Sahaban* and *kheri* canes are reported to be ready for crushing as early as October and November, while the *Moogi* and *Basna* varieties which appear to be those mostly cultivated do not attain maturity till March and April.

10. *Rotations and mixed cropping.*—Fixed rotations for sugarcane appear to be very seldom observed in any part of the province. In old cultivated land, sugarcane is preceded and followed by such ordinary dry crops as early rice, pulses, jute and mustard, and in the case of edible canes by vegetable crops.

Mr. A. C. Sen, in his Report on the agriculture of the Dacca district, mentions an instance in which a regular system of rotation is followed. It relates to the cultivation of sugarcane by the market gardeners of Dacca, with whom cane cultivation is a speciality. They grow sugarcane for three years running (including two years for ratoon) on the same land. After this the

field is ploughed and sown with early rice or *mashkalai* (*Phaseolus Boxburghii*). It is followed again by sugarcane, which is again kept up for three years, and so on.

The practice of allowing land to remain waste for a number of years is a common one in many parts of the province. It may be said to be the general rule in the poorer classes of soil, such as the red clay soil of the old alluvium tracts in North Bengal and Assam and the *teela* soil of the Surma Valley. The land is broken up and cropped with sugarcane for one or two years, and is then left waste for several years before it is taken up again for sugarcane. In Assam, a crop of *phaseolus* pulse is taken after sugarcane before the land is abandoned to waste.

Mixed cropping in case of sugarcane is not a common practice in Eastern Bengal. In Northern Bengal, *rahar* (pigeon pea) is occasionally sown in rows among the sugarcane. The Nepalese cultivators in Lakhimpur (Upper Assam) grow a little maize mixed with cane in the first year, the planting of cane as well as maize being done more or less broadcast. The market gardeners of Dacca cultivate melons along with sugarcane. The melon is sown in December and harvested in March and April, and occupies the interspaces between the rows of young sugarcane, with which it does not in any way interfere. In the Chittagong Hill Tracts, maize and *bhindi* (ladies' finger) are grown among sugarcane. These crops are off the ground before the cane grows high enough to overshadow them.

A common practice in many parts is to grow *rahar* on the edges of sugarcane fields. It serves as a wind-break, and also as a fence against cattle. Near Dacca, the stems of *rahar* plants thickly sown on the edges of the fields are tied together with horizontal pieces of split bamboo and made to serve as a fence against jackals and cattle. In Northern Bengal and Kamrup, it is common to see jute sown as a border round cane fields. Another plant called *bilakhani*, is occasionally sown on the embankments with which it is the practice in Assam to enclose sugarcane fields. It serves the same purpose as *rahar* and yields a large quantity of fuel for the boiling of jaggery.

11. *Ratoons*.—The practice of ratooning cane is general in the province. It is believed to be more profitable. In most places, the crop deteriorates so quickly that not more than one ratoon crop can be taken with profit. In exceptionally favoured soil, *e.g.*, the virgin forest soil of Upper Assam and Sylhet and the rich alluvial soil in the Chittagong Hill Tracts, as many as three to five ratoon crops are taken. The hard-rinded varieties of cane ratoon better than the softer kinds. One or two of the district reports speak of ratoon cane being more subject to red-smut than plant canes, but on this point very little information has been received. In inundated land the practice of ratooning is hardly possible and is rarely found.

12. *Preparation of the land for planting*.—The actual mode of preparing the land differs in three different kinds of land :—

- (1) In the case of old cultivated land, which bears crops every year, the preparation of land does not commence till the commencement of the cold weather. Very often an early cold-weather crop, such as mustard, pulse or *til*, is taken off the land, and the cultivation for the sugarcane crop is not taken in hand till January. The land is ploughed up and harrowed with the ladder as many times as is found necessary to secure a good tilth. The number of ploughings varies naturally according to the character of the soil and the conditions of the weather, and has been variously estimated at from eight to twenty. The number of harrowings is about twice the number of ploughings given, the usual rule being to pass the ladder twice over the ground between two successive ploughings. The land is invariably manured with cattle dung except when it is enriched with silt. The manure is usually spread on the land either before the ploughings commence or in the intervals between the ploughings.
- (2) In case of land that has remained fallow, the custom is to dig it up with the spade during the rains or in the beginning of the cold weather, and leave it in this condition for some time. Then after the clods have weathered down to some extent, the land is

ploughed and harrowed repeatedly until the requisite tilth has been obtained. Such land also requires to be manured.

- (3) In case of virgin forest land, the first step towards preparation of the soil is to cut down the underwood and then after a time to fell down the overhanging trees. Fire is set to these heaps when sufficiently dry, and the ground is cleared as far as possible of partially burnt wood. These operations take place during the cold weather. The land is neither dug nor ploughed. All that is done is to dig out the pits in which the sets are to be planted. The pits are dug some time before the planting takes place in order to aerate the soil. No manure is used. The soil being rich in vegetable mould needs none beyond the ashes derived from the burning of the forest.

The use of the crowbar for cultivation is unknown in Eastern Bengal and Assam. The only implements used in the tillage of sugarcane land are the spade (*kodali*), the plough and the ladder (*mai*). In clayey soil, it often becomes necessary to use a wooden mallet for crushing the clods which cannot be reduced by the ladder.

Bare fallowing in the sense that the land after being broken up is left uncropped for a year is not known to be practised in any part of the province.

13. *Planting*.—The various points under this head will be considered in paragraphs 14 to 21.

14. *The source from which the seed is obtained*.—The cultivators purchase the seed only when they first start cultivating the crop and rarely afterwards. They preserve the "tops" of their own crop and use these for seed. The only instances in which cuttings are procured annually from a distance have been reported from Faridpur and Bakarganj. In the inundated parts of those districts, the cane crop is harvested as early as September and October, and the crop dies prematurely as the result of prolonged water-logging. Hence the necessity of obtaining cuttings from a locality where the crop is free from injury by floods. In the neighbourhood of Dacca City, the market gardeners occasionally purchase sprouted cane cuttings which are sold at Rs per thousand.

The "tops" are taken from plant as well as ratoon cane. The latter is preferred in some localities owing to the internodes being shorter. In Upper Assam, "tops" from ratoon canes are considered worthless and hence seldom used.

The practice of leaving a portion of the cane crop to stand over till it is required for use as seed cannot be said to be a general one in Eastern Bengal and Assam. It is possible only in those places where the sets are obtained by cutting of the whole cane into pieces. It is known in Manipur, in the Jabar-mal mauzas of Bakarganj which supply seed for the inundated tracts in that district and Faridpur, and in the country round Dacca. In Rangpur, entire fields of ratoon cane are sometimes bought up for seed purposes and these also may be regarded as "stand-overs."

15. *The part of the cane used for planting*.—The general practice, as already mentioned, is to use the upper part of the cane, that is to say, the "tops" for seed; but there are localities in which the whole cane is cut up into sets for seed. The latter practice has been reported from Rangpur, Bakarganj, Sylhet, Manipur and the country round Dacca, but it is after all only secondary to the use of "tops" which are always preferred.

In using sections of the whole cane for seed, the lower rooting joints are always excluded. Sets obtained from the whole canes often fail to germinate, hence it is never safe to use them except where the sets are first planted in a nursery and only such as produce shoots are transplanted in the field.

The use of the whole cane as seed is reported to be practised in some villages near Kutubpur in the Rangpur district. The practice does not seem to be known elsewhere.

16. *The actual preparation of the sets for planting*.—In most places the "tops" which contain six or more joints are cut up into sets, each containing two or three internodes. In Rangpur, the tops used are about a cubit long and are not cut up into smaller pieces as is done elsewhere; but sets obtained from the whole cane contain three or four internodes each. In the Assam Valley

the general practice is to keep three or four joints in each set, and often so many as six to eight. In Sylhet and Chittagong a set often contains a single "eye" the practice being to plant the sets in the first instance in a seed bed to ensure germination.

Pickling the sets in various solutions before planting is a practice which may be said to be practically unknown in this province. In Rangpur the sets are sometimes pickled with kerosine oil and water as a preventive against white-ants. The soaking of sets in water before planting is a common practice in many parts of the Province, the object aimed at being to accelerate the germination. It is also said to reduce the sweetness of the sets and thus to render them less attractive to white-ants.

17. *The number of sets per acre.*—The number of sets used per acre has been variously returned at from 3,000 to 4,000 in Lakhimpur to 30,000 in Rajshahi. It depends, of course, on the distance at which the sets are planted from each other. The larger figures (15,000 and upwards) are reported from districts or localities in which the harder and poorer varieties of cane are grown. These are planted close and receive less attention than usual.

18. *The mode of planting.*—The mode of planting varies in different localities, and depends on the character of the cultivation pursued. A few typical examples are quoted below.

In virgin forest land in Upper Assam.—As already mentioned, the forest is cut down and burnt, and the land is neither ploughed nor hoed, and no manure is used. Pits are dug in the ground and into these the cuttings are placed. Reaping and planting usually proceed about the same time, and the sets are planted out straight off without receiving any preliminary preparation. No fixed distance is observed in digging the pits, but they are made equidistant as far as the nature of the ground, encumbered as it is with stumps of trees and partially burnt wood, allows. The pits are made about one yard from each other, so that about 4,000 cuttings suffice to cover an acre. The depth of the pits is about 12 inches.

In old arable land in the Assam Valley.—The soil is prepared by repeated ploughings and harrowings, preceded, in the case of fallow land, by digging with the spade. The planting takes place in April and May. The day chosen for planting must be preceded by sufficient rain, and if drizzling rain lasts throughout the day, so much the better. The field is partitioned into strips of 8 to 12 feet in width separated by drains, which communicate with a ditch which surrounds the field. Trenches 2 to 3 feet apart are made with the spade; these run at right angles to the drains, and in these trenches the sets are planted, about 9 inches apart from each other. A little soil, often mixed with cowdung, is lightly scattered over the cuttings and they are left to themselves until they strike root.

In old alluvial land in Rangpur.—The land is prepared by ploughings and harrowings as elsewhere. Furrows are made with the plough 12 inches apart, and along these the sets are laid down 4 or 5 inches from each other. The furrows are fairly straight and equidistant and about 6 inches deep. After planting the sets, they are covered over with soil taken from the sides of the furrows so as to make the surface level.

In the flooded tracts of the Gangetic delta.—After the land has been prepared by ploughing and harrowing, shallow trenches, about 2 inches deep and 12 inches apart, are made with the spade, the "tops" are laid in the trenches at intervals varying from 12 to 18 inches and buried 2 inches deep after which the trenches are filled up with earth. The sets thus lie about four inches below the ground.

Near Dacca for chewing canes.—Ploughing and harrowing is commenced about the middle of September, and the land is got ready by the end of October. Parallel lines are drawn all over the field, 36 inches apart, and along these lines, at intervals of about 12 inches, pits 6 inches to 9 inches deep are dug with the spade, about 12 inches square on the surface and with slanting sides. The bottom of the pits is stirred with the *kodali*, and the earth below is mixed with a little soil from the top and some well-rotted cowdung. While the field is being prepared, the sets are "hatched" in a nursery, and the young plants become fit for transplantation when they are about a foot high. In each pit are placed two cuttings with the shoots on, and the pits are then

partially filled with soil, which is pressed round the plants. The plants are watered daily from a pot until they strike root.

In Manipur.—The field is laid out into beds, 8 feet wide, separated by furrows which serve as drainage channels. Three parallel rows of pits are dug on the ridges, the rows being 2 feet apart from each other and the pits about 8 inches from each other along the rows and 4 or 5 inches deep. Well-rotted cowdung and ashes are placed at the bottom of the pits. The planting takes place in April and May. The sets are previously planted in a seed bed, and throw out shoots, when they are taken out for planting in the pits. Four sets are planted together in each pit, of which one set is from the stem of the cane and three from the "tops." The sets are carefully covered with soil, and are watered immediately after planting and thereafter daily for some days. A mulch of grass is spread over the land to conserve moisture.

19. *Supplying vacancies.*—Careful cultivators preserve sets for filling up vacancies, but in most places vacancies, unless too many, are left unsupplied. Vacancies seldom occur when sprouted sets are used. In Rangpur, the cultivators occasionally fill up vacancies from sets thickly planted on purpose in the outskirts of the field. In Dinajpur, large vacancies, when they occur, are sown with jute.

When vacancies are filled up with fresh sets, it is done, as a rule, at the time of the first hoeing and weeding, which takes place within a fortnight to a month from the time of planting.

Cuttings are preserved in various ways. If they are to be planted within a fortnight or at the longest a month, after the cane has been reaped, they are kept in a cool, moist place protected from the sun. In some places the cuttings are planted thickly in a slanting position and covered with rice-straw, plantain leaves or loose earth, over which water is sprinkled from time to time. In other places they are tied together into bundles with the bottom ends on one side and embedded half-way up in soft mud.

If the cuttings are to be preserved longer than a month, they are planted in a seedbed or nursery in the manner described in the following paragraph:—

20. *Seed-bed and nursery.*—The practice of planting the sets in a nursery and making them sprout and throw out shoots before transferring them to the field is in vogue in most parts of the Province. In Northern Bengal alone it seems to be unknown. The *raison d'être* of the practice is to be found in the fact that irrigation is all but unknown in the Province, and except where the rainfall is assured or the soil is naturally moist, there is always some risk in planting the cane in the dry season. The planting of the crop has, therefore, to be deferred in many places until sufficient rain has been received in April and May and the risk of loss from drought has passed away. The nursery is made in a cool moist spot in the raiyat's homestead or near a well or tank. The ground is carefully prepared and liberally manured with cowdung and ashes. The soil is heavily watered and converted into puddle. The cuttings are laid horizontally and half buried in the mud, so as to leave only the upper surface visible, and so placed that the eyes or buds remain level with the ground. They are placed so thickly as to almost touch each other. The seed-bed is kept wet by watering from time to time.

Near Dacca, where young cane plants are raised for sale, great attention is paid to the cultivation of the seed-bed. After the cuttings are laid in the puddled seed-bed, powdered earth mixed up with ashes is spread over the bed, about 1½ inches thick, and over it is placed a mulch of rice-straw. After a day or two, when the seed-bed is found sufficiently dry, the straw is removed and the surface soil is gently stirred and pulverized, after which the straw is again put back over the seed-bed. Within a fortnight the cuttings begin to sprout, and within another fortnight or three weeks the shoots will have grown to a foot or eighteen inches high and become ready for removal to the field.

21. *Stool-planting.*—The practice of propagating cane from stools is known only in parts of the Sylhet and Nowgong districts, and even there it is rarely found.

22. *Irrigation and drainage.*—It is a most unusual thing to irrigate cane fields in Eastern Bengal and Assam. The crop is occasionally watered from pots for a few days after planting, and that is the only irrigation which it ever receives.

The market gardeners of Dacca, however, occasionally irrigate their cane fields from *kutchha* wells. The soil of the country near Dacca is a red ferruginous clay of lateritic origin which is apt to suffer from drought during the dry season. The same soil is found all over the Madhupur jungle in Dacca and in the *khair* or *barind* tract of country on the opposite bank of the Bramaputra in Northern Bengal. The softer and more valuable kinds of sugarcane cannot be grown on such soil without irrigation.

The raiyats are careful in the matter of drainage. In all situations which permit of the water being drained off the field, the land is enclosed with a ditch partitioned into compartments by parallel drains or furrows communicating with the outer ditch. In flooded tracts drainage is of course out of the question.

23. *Cultivation after planting*.—The after cultivation of the crop consists in weeding, hoeing and earthing up the roots of the cane. The number of hoeings and weedings considered necessary in different places and the implements used are mentioned below :—

Rangpur.—Two weedings with the hand-hoe (*pasun* or *khurpi*) and two ploughings between the rows with the country plough.

Rajshahi sadar.—One hoeing and weeding with the spade, followed a month later by one inter-ploughing between the rows.

Dinajpur.—In May, the weeds are uprooted by hand, and the interspaces between the rows are ploughed with the country plough. The same is done again in July.

Dacca chewing canes.—The cane is planted early in the cold weather. When the plants have taken root, the field is weeded and the soil near the roots loosened with the hand-hoe (*pashuni*). A few days after, the whole of the interspaces between the plants is hoed up with the spade, and the pits in which the cane was planted are partially filled. A second hoeing with the *pashuni* is given a fortnight later, and this time some well-rotted cowdung is placed round each clump and the pits filled up with earth. Another weeding and earthing follow, in the course of which the plants are earthed up. Throughout the rains, the field is kept clean and the soil loose by weeding and hoeing at intervals.

Faridpur.—After the plants have germinated and taken root, the field is weeded and the soil round the plants loosened with the sickle (*kochi*). Hoeing with the *kodali* follows, and when the plants are a cubit high, they are earthed up in V-shaped ridges. A second and occasionally a third weeding and hoeing are given.

Bakarganj.—Three or four times with the spade.

Chittagong.—Two hoeings with the spade. Additional weeding is not considered necessary except in the upland farms where the thatching grass comes up with the canes and has to be removed.

Tippera.—Two weeks after germination the first hoeing is given. It is repeated after every shower. Five to seven hoeings are considered necessary. When the stumps have grown about 3 feet, earth is thrown up round the roots so that the plants stand in ridges with furrows between the lines.

Chittagong Hill Tracts.—Three times during young growth.

Assam Valley.—In old cultivated land, the surface soil is hoed and the weeds removed with the *khanti* (spade) three or four times, and the cane is earthed up when three feet high.

Upper Assam.—In new forest land, three weedings and hoeings are considered sufficient. In the first year, this is done with the *dao*, and in ratoons the *kodali* is used. Only the surface is scratched to break up the hard soil. Mulching the field with grass after the cane has been planted and before it has had time to cover the ground is not in vogue.

24. *Manuring*.—It may be stated at the outset that inundated land which receives a deposit of silt every year is never manured: nor is land newly reclaimed from jungle. But all lands which lie above the reach of the floods and which have long been under cultivation are invariably manured for sugarcane. The principal and in most parts practically the only manure used is cowdung. It is supplemented, wherever possible, with ashes and household refuse. The general practice is to spread the cowdung over the field before the ploughings commence, or in the intervals between the ploughings.

Cattle-folding is practised in the vicinity of large pasturage grounds, but the practice is not at all common. In the Assam Valley, the field is manured with cowdung in the beginning when it is being prepared and repeated doses of powdered cowdung are given to the young crop at the time of hoeing. The same custom obtains among the cane-growers of Dacca, but they do not use powdered dung like the cultivators of Assam.

Cane-fields on the banks of the Dulai creek near Dacca City are manured with heavy dressings of earth taken from the creek. It is said to be an excellent manure. Tank earth is occasionally used for manuring sugarcane fields.

Rape or mustard cake is the only oil-cake which is ever used as manure in Eastern Bengal and Assam. Except in Sylhet and Mymensingh and among the cane-growers of Dacca, the use of oil-cake for sugarcane cannot be said to be at all general, though its use as such is known everywhere. Oil-cake is always used in the powdered state. It is applied in small doses to the roots of the growing cane, when the crop is being hoed or earthed up. There is no information as to the quantity of oil-cake which a cultivator would ordinarily use per acre. The price of oil-cake in Eastern Bengal and Assam may be said to vary ordinarily from Re. 1 to Rs. 1-8, but this year it has risen quite 50 per cent. above the normal price.

The cultivators of Eastern Bengal and Assam are very careless in the matter of conserving cowdung for manure. The usual practice is to throw down the manure on a heap outside the cowshed and leave it exposed to rain and sun. In most parts of the Assam Valley and the inundated parts of Eastern Bengal, very little use is made of cowdung, the greater part being absolutely wasted. The only crops ever manured are sugarcane and vegetables. A happy exception to this rule is found in the Jorhat and Golaghat sub-divisions of the Sib-sagar district, where the land has been impoverished by continuous cultivation, and the cultivators have begun to pay attention to the supply and conservation of cattle manure. The dung is kept in pits which are protected from rain by thatched roofs, and is powdered before being used for sugarcane. Cowdung is seldom used as fuel in the Assam Valley, even when it is not used as manure.

The trash or dried leaves of sugarcane is nowhere utilised as manure. It is invariably burnt either in the field after the crop is removed or in boiling the juice.

The use of green manure, either before or after planting sugarcane, is totally unknown in Eastern Bengal and Assam.

The only trustworthy experiment in the use of artificial manures on record is one made with superphosphate on the Bangpur Farm in 1905-1906. It was found that a dressing with 3 maunds of superphosphate—costing Rs. 10, increased the yield of jaggery by 9 maunds and 32 seers, which at the least valuation meant an increase of profit of Rs. 40. Certain manurial experiments with sugarcane are now being made in the Rajshahi Farm, but the results will not be known till a month or two hence.

25. *Treatment of the canes during growth.*—The operations to be dealt with under this head are trashing, wrapping the canes with leaves tying the canes to one another or to bamboo supports to prevent them from falling down and protection of the crop from jackals and other wild animals. Trashing is done in most places, but it is often neglected in case of the thin hard-rinded canes which are planted in close lines and taken little care of. Wrapping is a less common practice. It is never done with the thin hard canes, but the softer kinds are always wrapped wherever the crop is liable to much injury from wild animals. With these canes, it is found necessary to tie a number of clumps together to prevent them from falling. Bamboos are occasionally used for supporting the clumps, but the use of props is not at all common, except with chewing canes which grow to a great height and require artificial support.

Jackals are fought by various means, of which wrapping the canes is one. The field is fenced in many places with a closely woven bamboo paling sufficiently high to prevent the jackals from jumping over them. Thorny plants are used in places to strengthen the fence. It is usual to watch the cane-field at night. Jackals are scared away by beating tins. There are various other devices for creating noise to frighten away these animals. One

reported from Nowgong is a kind of improvised clatter or bell consisting of an inverted tin canister inside which hangs a heavy piece of wood. The tin is suspended by a rope from a bamboo post, and as it sways to and fro with the wind, the piece of wood hanging inside strikes against the sides and produces a clattering sound. Another in common use consists of a bamboo, the upper half of which is split into two half way down. It is fixed to the ground. One of the split ends is fastened to a rope. A man sitting inside his hut pulls the rope and then lets it go, causing the two halves of the bamboo to clap each other with force and make a violent noise.

Traps or baits are seldom used for killing jackals. It is the custom in many places to plant hard-rinded cane on the outside and the softer cane on the inside of the field to protect the latter from jackals.

26. *Treatment of the field preparatory to reaping the canes.*—The field receives no special treatment preparatory to reaping, and the irrigation of cane being unknown, nothing can be said as to the effect of watering the crop immediately before reaping.

27. *Disease phenomena.*—The most serious pests and diseases of sugarcane in Eastern Bengal and Assam are the jackal, the white ant, the red smut and the mothborer. In certain parts, wild pigs prove extremely destructive to sugarcane, and even the hardest varieties of cane cannot escape from their ravages. In Assam sugarcane is often damaged by wild elephants.

No serious attempt is made by the cultivators to cope with any of the diseases and pests except jackal (see paragraph 25).

28. *Diseases affecting the sets after planting.*—The only serious pest is the white ant. It attacks cane in all stages. In Rangpur, the sets are sometimes washed in a mixture of kerosene oil and water as a preventive against white ants, and the insects are picked off when they appear. In Sylhet, paddy husk is sometimes applied to the roots, and in places diluted cow urine is used as a remedy. Rape cake is believed in Assam to be efficacious for white ants, and is applied in small doses to infested plants. Land which annually goes under water is free from white ants. Jackals do not cause any appreciable injury to sets or to young cane, and it is not till the cane has attained some sweetness that they turn their attention to the crop.

The pine-apple disease is not known in Eastern Bengal and Assam. Red smut is known. In Faridpur, the cultivators are said to examine the sets for red smut, and those found to be affected by it are thrown away. None of the other district reports mentions this practice.

29. *Diseases affecting the whole plant.*—The *serch* disease of Java is happily still unknown in the Province. It is reported from the Nowgong district that a kind of parasitic fungus is occasionally found on the roots of sugarcane and checks the growth of the plant. The black smut locally known as *andhar sap*, has been reported only from the Kamrup district. The disease is said to "turn the plant into a black powdery-mass." From the description it seems the disease is not black smut (*Ustilago sacchari*), but may be what Dr. Butler has described as "sooty" mould in his bulletin on the fungus diseases of sugarcane. A thin hard variety of cane known as the *majara* or *malaha* in Assam is peculiarly subject to sooty mould, the cane being covered with a dense black powder which comes off on rubbing.

The moth-borer is a common sugarcane pest in Eastern Bengal and Assam. It has been reported from most districts of the province. The insect is known as *majakata* in Assam, and *manjera* in Bengal. Other local names are *mandar-hera* in Mymensingh and *mandarluri* in Noakhali. Most of these names imply an insect eating the inside of the cane. It is described as living near the apex of the plant and causing the crown to wither. The insect is found in the upper joints of the cane, and is possibly the white-borer (*Scirpophaga auriflua*) described in pages 130—133 of Mr. Lafroy's Indian Insect Pests. Some of the district reports speak of *manjera* as the red-smut, and attribute the disease to an insect. The fact that red smut is often associated with a borer has been mentioned by Dr. Butler in his report quoted above; it is no wonder, therefore, that the cultivators should speak of red-smut as caused by an insect. Affected plants are sometimes cut and thrown away, but the cultivators are usually too careless and indolent to adopt such a laborious process. Near Dacca, cane

growers strew turmeric powder over the plants as a preventive of the pest. It is believed in Sylhet that a liberal manuring with oil-cake has the effect of driving away the pest, and that it is caused by manuring the field with fresh cowdung.

30. *Diseases confined to the underground parts of cane plants.*—Besides white ants, the grubs of a beetle called *karapoka* or *kerapoka* are reported from several places as causing injury to the young shoots. An insect called *gata-bhur* is said to feed on the roots of growing plants, but no description of the insect has been received. None of the district reports mention any flowering parasitic plant growing from the roots of the sugarcane plant.

31. *Diseases affecting the stems.*—The red-smut is universal over the Province. It is mentioned in almost every district report. In some districts the disease is known as *manjera*, a name which is also applied to the moth-borer. In Dacca it is also called *dhasa*, which literally means rot. It is known as *upara* in Noakhali and *sinduria* in Kamrup. The cultivators are aware of no means for fighting the disease when it appears. The rejection of cuttings affected with red rot at the time of planting has been recommended as a preventive remedy. As already mentioned, the cultivators of Faridpur throw away diseased cuttings at the time of planting and although the remedy is one which readily suggests itself to all interested in the cultivation of sugarcane, it does not appear to be generally followed. In Sylhet, there is an idea that plantain trees planted among sugarcane prevent the disease from spreading. The soft Bombay canes are more susceptible to red-smut than any other, and it is for this reason they are seldom cultivated for the manufacture of jaggery. The thin hardy varieties of cane (*Khari*, *Khagri*, etc.) are the least affected by red-smut.

Stem-borer and various other insect pests have been mentioned in some of the district reports, but the descriptions of the insects are so meagre and vague that no useful purpose would be served by mentioning them in detail.

32. *Diseases affecting the leaves.*—No serious leaf disease has been reported. In Noakhali, an insect called *gun gunia* is said to eat up the leaves, but the insect has not been described, nor is the extent of injury known.

33. *Reaping—Time of cutting the canes.*—All that is known on this point has been stated in paragraph 9.

34. *Deterioration after cutting.*—The raiyats appear to be fully aware of the deterioration that results from delay in crushing the cane. Limited as their resources are, they try to crush the cane as soon after cutting as they can. The mill is set up close to the field, and as much cane is cut in a day as the mill is expected to crush during the next twelve or twenty-four hours. The normal practice is to reap the cane in the afternoon and crush it during the night or the following morning. In Lakhimpur, where sugarcane is cultivated on a large scale by Nepalese squatters, the cane is often allowed during the cold weather to lie for a week before it is crushed, and in Kamrup two or three days may often elapse before the cane can be crushed. Such delays evidently arise from want of means to crush the cane quickly, and not from any want of knowledge on the part of the cultivators.

35. *Mode of cutting the canes.*—Except when a ratoon crop is to be taken, the cane is cut as low down as possible. For ratoon, the cane is cut one to two inches above the ground. In cutting the cane, the old leaves are first removed, then the tops are cut off, and finally the cane. In some places the tops are removed after the canes have been reaped.

36. *Yield per acre in canes.*—None of the district reports affords reliable information on this point. But trustworthy data are available for Assam from the Annual Reports on crop cuttings which have been published since 1883-84. The average yield of cane in 1,610 experimental cuttings made during the nineteen years from 1883-84 to 1901-02, and covering a total area of 18639 acres, was 19'833 lbs. or a little under 9 tons per acre. A large number of cuttings were carried out in the Assam Valley in 1882-83 in connection with a special enquiry made by the Director of Agriculture. The average of 24 cuttings made by District Officers gave a yield of 27'083 lbs. of cane, or a little over 12 tons per acre. The maximum yield obtained in these experiments was 19 tons and the minimum 6 tons per acre.

PART III.

MANUFACTURE.

37. *Manufacture of jaggery or gur.*—Three descriptions of mill are in use for crushing sugarcane in Eastern Bengal and Assam, *viz.*, (1) the iron mill, (2) the wooden roller mill, and (3) the *ghani* or wooden mortar and pestle mill, the same as is used for crushing oil seeds. Steam crushing mills are used in several large sugarcane farms in Chittagong and Sibsagar. Iron mills have been introduced within the last twenty years. They appear to have completely supplanted the primitive wooden mill in all the districts of the Rajshahi Division and in Faridpur, Bakarganj, Noakhali, the greater part of Chittagong Division and Cachar. The Nepalese cane growers of Assam use iron mills, though among the Assamese cultivators, the use of the wooden roller mill is still all but universal. The earlier type of iron-mills has two vertical rollers but it is slowly giving way to three roller mills, which are more effective. Most of the iron mills used in the Rajshahi and Dacca Divisions are supplied by Messrs. Renwick & Co., of Kushtia. The firm maintain depôts of their own at different cane-growing centres, and let out the mills on hire to the cultivators. Iron mills are also imported from Calcutta by Bengali and Marwari traders for hiring out to their clients. It is seldom that a cane-grower purchases his own mill. Very often the mill is let out along with the boiling plant. The rate of hire varies from 8 annas to Re. 1 per diem, and the average expenditure on this account has been estimated in different districts at from R9 to R30 per acre. The charge would no doubt vary according to the description and price of the mill and the yield of cane per acre, and also according as it is let out with the boiling plant or not.

The following description of the wooden-roller mill is taken from a note by Mr. E. Stack, Director of Agriculture in Assam, written in 1883;—

“The crushing mill (called *kherkha* in Goalpara and *hal* in Upper Assam) is a rude but tolerably effective machine, and a quicker and less dangerous worker than the heavy beam-and-pestle arrangement of Upper India. It consists of two vertical rollers (*bhim*) placed in juxtaposition, with their lower ends resting in a flat trough (*bhorai*) scooped in a solid and heavy block of wood (*toljoti*) resting on the ground, while their upper ends pass through a rectangular space cut in a horizontal beam above *borjoti* supported by uprights (*hol khota*) let through the lower block into the ground. The rollers are held in their places by vertical clamps (*ghara*) which grip them at the upper and lower ends, and are driven home by wedges (*khal*). The portions of the rollers which project the upper beam (*borjoti*) are grooved so as to work into each other on the principle of an endless screw. The driving power is a horizontal beam (*katari*) applied to the head of the taller or “male” roller (*matabhim*), upon which the shorter or female roller (*maiki bhim*) revolves in the contrary direction. The male roller is usually, if not invariably, that on the right hand as one faces the mill, and the direction of progress is from left to right, that is to say, the men at work walk round with the left shoulder inwards. The whole machine is made entirely of wood, without a nail or a piece of iron in its composition, and its value varies according to the kind of wood used. A mill can be built of tamarind wood for eight rupees, but in *jam* wood (*Eugenia jambolana*) it will cost twelve, and if *nahar* (*Mesua ferrea*) is used, as much as fifteen rupees.

“All being ready for crushing, the first thing the cultivator does is to bind two of the finest cane-stalks along the beam of the mill, as an offering to Viswakarma, the god of artificers. The canes are then passed through the mill in batches (*ana* or *kana*) of six or eight at a time, the juice falling into the trough, and thence through a hole on to a sloping wooden tray, which transmit it by a lip of plantain leaf to the earthen vessel placed to receive it in a pit dug below. In some places the tray (*roadhara*) is circular in shape, with a raised wooden edge and a funnel-shaped escapement for the juice, but usually a simple slab of wood, slightly concave, is considered sufficient. The working of the mill is accompanied by a loud and strident noise, which is welcomed by the rajyats as a sign that the rollers are biting well, and is moreover a cheerful and useful accompaniment while the work is carried on by night, as is the practice towards the end of the season when the heat of the day would be

injurious alike to the men and to the cane juice. Each handful of canes is passed through the mill three or four times until they begin to yield mere foam, where they are thrown aside, and a fresh batch take their place. *Mugi* and *pura* can squirt out their juice plentifully on the first compression, and give less afterwards, while the harder and tougher *teliya* passes through almost dry, and only begins to yield juice to the second squeeze. At the third and fourth crushings the flattened canes are usually twisted into a rope, so as to prevent a bulkier body for compression. A boy sitting in front of the mill draws them out as they pass through the rollers, and hands them back to the man who sits behind and feeds the mill. Four or five men drive the machine, resting their hands on the beam, and pushing against it with the chest and shoulders. The force required to put the mill in motion was ascertained in one experiment made by Mr. R. T. Greer, Subdivisional Officer of Golaghat, to be 5 to 6 lbs. without cane, and 40 lbs. with *mugi* cane between the rollers, but 60 lbs. with *teliya*. The rate of progress in crushing is about 2 maunds (165 lbs.) per hour. A good deal of trash and impurity-earth from the imperfectly cleaned canes, fragments of the stalk, dust carried by the wind, etc., enter the earthen pot along with the juice; in fact after a couple of hours work, mud can be plentifully scraped off the plantain-leaf lip of the tray, but the raiyats seldom trouble themselves to clean it. When the pot is full it is changed for another. As the work proceeds, the wedges holding the clamps have usually to be driven home from time to time, to counteract the tendency of the rollers to work asunder."

The wooden-roller mill is extensively used all over the Assam Valley except by the Nepalese cultivators, and it is also used by the indigenous cane-growers of Sylhet. It is also in use in the more backward parts of the Dacca and Chittagong districts.

The *ghani*, also called *kalthu*, is used in Noakhali and parts of the Dacca district. It is worked by bullocks in the same way as in crushing oilseeds. The canes are cut into two or more pieces to prepare them for the mill.

No experiments are known to have been made in Eastern Bengal and Assam to show the comparative yields of juice expressed by the different mills. The three-roller iron-mill is more effective than the two-roller. The District Engineer of Bangpur reports that with the softer varieties of cane the expression obtained by the three-roller mill may amount from 65 to 75 per cent. of the weight of the cane, while the two-roller may not be able to express more than 58 per cent. A very large number of experiments made in the Assam Valley during the 19 years from 1883-1884 to 1901-1902 gave an average expression of 47.48 lbs. of juice per 100 lbs. of cane with the wooden-roller mill used in that valley, and in some experiments as much as 60 per cent. of juice was obtained. The great majority of these experiments appear to have been made with the medium soft yellow *mugi* or *mag* cane of Assam.

Earthen pots are generally used for catching the juice as it comes out of the mill. Kerosine tins are now used in many places for this purpose, and brass and wooden pots are also occasionally used.

The juice is never kept longer than is necessary to get a sufficient quantity to fill the boiling pan. This would often mean a delay of four to six hours. The Nepalese cane-growers in Lakhimpur often allow the juice to stand over from 10 to 12 hours in winter and from 4 to 5 hours in the hot weather.

The juice is always strained when it is poured into the boiling pan, and in places also when issuing from the mill.

Special collecting pans are used only in the Assam Valley. The pan is a boat-shaped vessel scooped out of a log of wood. It stands at the edge of the boiling-house, a few yards removed from the mill, and sometimes contain leaves of the wild fig tree, which are supposed to be useful in keeping the juice sweet. The juice is transferred to the boiling pan when some 12 to 15 gallons have been collected. The vessel is never heated. In Eastern Bengal and Surma Valley, no special vessel is used for collecting the juice as it accumulates, but in some places, each pot or tin as it gets filled with juice is poured into the boiling pan, and the juice is kept simmering till the pan is full, when the full heat is applied, and the juice begins to boil.

Nowadays, shallow circular iron pans are used in many parts of the province in preference to the earthen pans which were universally used at one

time and which are still in use in the more backward parts of the province. It may be generally said that wherever the iron sugar-mill is in use, the shallow circular iron pan is in use as well. The two go together, and in many places they are let out together to the raiyats. Deep hemispherical earthen pans usually arranged in batteries of two, three or four, are still used in different parts of the province. In a few places brass or iron vessels of similar shape have taken the place of earthen pans. In Faridpur, there is an objection against the use of the iron evaporating pan. It is said to make the *gur* blackish and give it an acrid taste. The boiling plant used in Rangpur consists of a large circular iron vessel about 6 feet in diameter on the top and 3½ feet at the base, and 18 inches deep. It is used in conjunction with an iron *korha* of semicylindrical shape, 18 inches in diameter and divided into three equal compartments. In place of the iron *korha*, a battery of three earthen pans may be used, along with the large circular pan already described. When a large quantity of juice is to be boiled, two iron *korhas* or two batteries of three earthen vessels each may be used. The juice is at first put in the main boiling pan and heated for about half an hour. It is then removed to the three compartments of the iron *korha* in equal proportions, leaving about 10 to 12 seers in the main pan. When the juice in this pan is sufficiently concentrated, the contents of the nearest compartment (No. 1) of the iron *korha* are transferred back to the main pan in small quantities at a time, the juice from the second compartment being transferred to compartment No. 1, and that of No. 3 to No. 2 at the same time. This process goes on until all the juice from the iron *korha* has found its way back to the main pan. Near Dacca, the boiling pan is a semicylindrical iron vessel of the same shape as the iron *korah* of Rangpur, but it is not divided into compartments like the latter, and is used singly.

In the open thickly-peopled parts of the province, where wood is scarce, megass and trash form practically the only fuel used in boiling the juice. During the first day or two, other fuel would be necessary to make a start. In the Assam Valley, the hilly tracts of Sylhet, Noakhali and the Chittagong Hill Tracts megass or trash is seldom used, fuel being abundant in those parts. The use of megass or trash as manure is mentioned in none of the district reports. In many places, the trash is burnt on the land; it is never ploughed in as manure.

The scum which rises in the beginning of the boiling operation is everywhere removed, and it is either thrown away or given to cattle. The scum which rises in the later stages of boiling is skimmed off in most places, and is used generally for mixing with tobacco. In the Assam Valley, the cultivators are less careful in the matter of removing the scum.

Generally, the raiyats of Eastern Bengal and Assam do not use any substance for defœcating the juice. When *gur* of specially good quality is to be made, the juice is cleared by the addition of a little milk at the time of boiling. The use of lime has been reported from several places (Faridpur, Dacca, Rajshahi, Chittagong Hill Tracts, Sylhet and Nowgong), but its use cannot be said to be at all general. The difficulty in using lime is to ascertain the exact quantity which should be used, as the slightest excess turns the *gur* black. Soda and *khar* (impure carbonate of potash obtained by burning plantain leaves) are used in a few places for clarifying cane juice. In Nowgong *khar* and lime are used only in case of damaged canes to neutralize the excessive acidity of the juice. In Sylhet, the juice of *simul* bark (*Bombax malabaricum*) is occasionally used as defœcant. The juice of the *bhindi* plant (*Hibiscus esculentus*) is used for the same purpose in the Chittagong Hill Tracts.

The usual form of jaggery made in Eastern Bengal and Assam is the semi-liquid *gur* known in Bengal as *dând* (or crystal-mixed) *gur* and in Upper India as *râb*. Solid *gur* (called *dhima gur* in Rangpur) is prepared in certain localities; the *jaggery* is moulded into blocks or cakes of various shapes and sizes by being poured into pits dug in the ground and lined with sacking cloth or leaves or into pots or bamboo baskets of various shapes, and is taken out after it has cooled down into a solid mass. In certain parts of Sylhet a kind of *jaggery* called *lali* is prepared; it is more of a syrup than *gur*, and is either used as such or sold to wholesale traders who reboil it into the usual form of *gur*.

For ordinary *gur*, the correct point in boiling is ascertained by various means. The chief among these is the size and appearance of the bubbles which are known at different stages by different names. For instance, in Assam three stages are marked by the size and shape of the bubbles. These are vulgarly known as *ophulia*, *babori phulia* and *temi mulia*, implying that the bubbles in the first stage are as large as the fruit of the O tree (*Dillenia indica*), that is, about 3 inches in diameter; in the second stage they are more frequent and shrink to the size of the *babori* flower (*Chrysanthemum coronarium*, a pot herb); while in the final stage, they present a hollow in the centre and are thus compared to the little box (*temi*) in which the Assamese peasant carries his stock of lime for chewing with betel-nut.

There are other methods for ascertaining the correct point in boiling. A little *jaggery* is taken up with a stick; if it falls in drops, the *gur* is still too thin; on the contrary if it falls in a continuous line and the line after descending some way is drawn back towards the stick, the boiling is complete. Experts can tell the correct point by feeling a drop of *gur* between the fingers. If a little of the boiling mass is thrown into cold water and turns solid, instead of getting dissolved in the water, it implies that the *gur* has been sufficiently boiled.

The general practice is to cool the *jaggery* to some extent before it is transferred to the pots in which it is to be kept. In the Assam Valley, the liquid mass is received in a wooden vessel (*gholani*) about six feet long, and of the shape of a canoe with one end cut square; it is stirred up with a Y-shaped instrument consisting of a triangle of bamboo fastened to the end of a stick (*hal bari* or *ghatani mar*). As the stirring continues, the liquid loses its dark brown colour, and assumes the hue and consistency of yellow mud. The process lasts half an hour. In those places where the shallow circular boiling pan is used, there is no special vessel for cooling the *jaggery* in. The pan is taken out of the fire, and the *jaggery* is stirred with a stick till the desired colour and consistency has been attained. Earthen and brass vessels are used in some parts for stirring and cooling the *jaggery*.

Semi-liquid and liquid *jaggery* are kept in earthen pots of various shapes and sizes. As a rule, no special care is taken to preserve *jaggery* beyond closing the mouths of the pots with earthen saucers and plastering them up with cowdung and mud. In Sylhet, solid *gur* is preserved by covering it with straw and plastering it over with cowdung and earth.

The usual price of *gur* in the different districts has been returned as follows. The figures denote the price per maund of 82½ lbs.

	Rs.
Rangpur	4 to 8
Rajshahi	4 „ 4-8
Dinajpur	4 „ 5
Pabna	4 „ 5
Dacca	6 „ 7
Faridpur	3 „ 5
Chittagong	5 „ 8
Chittagong Hill Tracts	4 „ 6
Tippera	6
Calcutta	4 „ 5
Sylhet	3 „ 3-8 in Langai and Singla Valleys (same growing centres) and Rs. 4-8 elsewhere; <i>late gur</i> Rs. 5.
Goalpara	6-4 „ 10 (retail).
Kamrup	5 „ 7-8 „
Nowgong	4-6 „ 7-8 „
Lakhimpur	2-8 „ 6-4

The prices will be found to vary within wide limits. *Jaggery* sells cheapest in the Dibrugarh subdivision of Lakhimpur, where sugarcane is cultivated on an extensive scale by Nepalese immigrants, and in the Langai and Singla Valleys of Sylhet and the northern parts of the Faridpur district.

Lakhimpur exports a large quantity of *jaggery* to different places in Assam. A great deal of *jaggery* is exported from Sylhet to Tippera, from Rangpur to Assam and different districts of Eastern Bengal and from Faridpur

to Dacca, Tippera and Bakarganj. Much of the *gur* consumed in the southern districts of Eastern Bengal is date *jaggery* imported from the Jessore district in Central Bengal. The high price of *jaggery* returned by some of the Assam districts is due to the fact that the article is usually sold retail by the cultivators and is seldom sold to wholesale dealers. The same may also be the case in other places.

There is no export of *jaggery* from Eastern Bengal and Assam to places outside the Province; on the contrary, a large quantity of *jaggery* as well as of refined sugar has to be imported annually from Bengal and the United Provinces to supplement local production, as will appear from the statistics quoted below.

For trade purposes, Assam and the transferred districts of Bengal, (*viz.*, Dacca, Rajshahi and Chittagong Divisions) have been hitherto considered as separate areas. The latter till recently formed part of Bengal and were included in three large trade blocks—Eastern Bengal, Northern Bengal, and Dacca—which covered, besides, a few districts of Bengal. The statistics of trade of these three blocks which will be quoted in this report should, therefore, be regarded as applicable to a somewhat larger area than the present sub-province of Eastern Bengal. They also exclude the trade by river between the blocks and the rest of Bengal (except Calcutta), which has never been registered. The plains districts of Assam are divided into three trade blocks—the Surma Valley, comprising the districts of Sylhet and Cachar, Upper Assam and Lower Assam, the last two comprising all the districts of the Assam Valley.

The average annual imports of raw sugar (*jaggery*) into the Assam Valley for the five years ending with 1905-1906 amounted to 101,409 maunds, out of which 78,467 maunds came from Bengal, and almost the whole of the rest from the United Provinces. During the same period, the imports of raw sugar into the Surma Valley amounted to an annual average of 225,330 maunds, all but 119 maunds of which came from Bengal. In these statistics, the imports from Bengal included those from Eastern Bengal, and there is no means to distinguish between the districts which now remain to the present Province of Bengal and the Eastern Bengal districts of this Province.

The imports of raw sugar into the three trade blocks of Eastern Bengal, Northern Bengal and Dacca amounted on the average of three years ending with 1904-1905 to 933,224 maunds, distributed as to their origin as below:—

	Mds.
Calcutta	497,562
United Provinces	246,105
Behar	183,767
Rest of Bengal and other parts of India	5,790
TOTAL	933,224

The imports of refined sugar of country and foreign origin will be dealt with in paragraph 40.

38. *Profit and loss on sugarcane cultivation.*—The normal yields of *jaggery* per acre are given below for each district of Eastern Bengal and Assam. These have been obtained from the latest quinquennial return of normal yields of crops.

<i>Eastern Bengal—</i>	lbs.
Jalpaiguri	2,000
Rangpur	2,800
Dinajpur	2,400
Malda	2,800
Rajshahi	2,400
Pabna	2,800
Bogra	2,400
Mymensingh	2,400
Dacca	2,400
Faridpur	2,400
Bakarganj	2,000
Tippera	2,100
Noakhali	2,400
Chittagong	2,000

Assam—

Cachar	3,200
Sylhet	2,400
Kamrup	1,800
Darrang	1,800
Newgong	1,800
Sibsagar	2,200
Lakhumpur	2,400

The normal rate of yield in Eastern Bengal as a whole is taken at 22 cwt. or 2,464 lbs. per acre, and in Assam at 2,200 lbs. per acre. These are to be regarded as the normal or average yields of *jaggery*. Some of the district reports mention much higher yields, and although these have been reported as average yields, they no doubt represent the usual outturn that is expected from a good crop. Thus, the Collector of Faridpur gives 30 maunds of *jaggery* as the produce of one *bigha* or one-third of an acre, at Pangsa in the Goalundo subdivision and 24 maunds per *bigha* in the Sadr subdivision of his district. Calculated to the acre, these yields would amount respectively to 7,200 lbs. and 5,760 lbs., which are 3 and 2½ times as much as the accepted average for the district. The Superintendent of the Chittagong Hill Tracts returns the yield of one acre of cane at 100 maunds or 8,000 lbs. of *jaggery*. The area under sugarcane in that district is yet too small to affect the provincial average. From the Superintendent's report it would appear that the soil and climate of the district are eminently adapted to the cultivation of sugarcane.

Estimates have been received of the cost of cultivation, manufacture and outturn from several districts of the Province, but very few of these can be accepted as sufficiently trustworthy. With one or two exceptions, all the estimates are so far agreed that the cultivation of sugarcane leaves a handsome net profit to the cultivator. A few of the more carefully prepared estimates are quoted below:—

At Pangsa in Faridpur.

Rent	Rs. a. p.
Ploughing 12 times and harrowing	3 12 0
Manure and cost of spreading it	18 0 0
Seed cuttings, 15 <i>kahans</i> (<i>kahan</i> =1,280)	18 0 0
Cost of planting (36 men at 4 annas)	39 0 0
After cultivation, including tying up	9 0 0
	25 8 0
Total cost of cultivation	113 4 0
Reaping and manufacture (inclusive of cattle)	60 0 0
Other expenses	6 0 0
Rent for mill	9 0 0
Earthen jars	6 0 0
Total cost of manufacture	81 0 0
Grand total of cost	194 4 0
Outturn: 90 maunds of <i>jaggery</i> at Rs. 3	270 0 0
Net profit [Rs.]	75 12 0

In the neighbourhood of Dacca City.

Rent	Rs. a. p.
8 ploughings and harrowings	3 12 0
Cost of manure (150 maunds of dung)	15 0 0
Seed cuttings (19,500 at Rs. 2 per 1,000)	7 8 0
Cost of planting cuttings in seed bed, making pits, trans-planting, and watering	39 0 0
After cultivation and fencing	27 0 0
	19 8 0
Total cost of cultivation	111 12 0

	Rs. a. p.
Reaping (98 men)	36 0 0
Hire of 3 pairs of bullocks for 9 days	10 2 0
Fuel	3 0 0
Hire of mill and pan for 9 days at 12 annas	6 12 0
Quick lime	0 3 0
Earthen pots	7 8 0
Contingencies	9 0 0
Total	71 9 0
Grand total of cost	138 5 0
Outturn 45 maunds of <i>gur</i> at Rs. 6	270 0 0
Net profit	131 5 0

To this may be added another Rs. 30 from the sale of cuttings, after keeping enough for the raiyat's own field.

In new alluvial soil in Rangpur.

	Rs. a. p.
Rent of land	3 12 0
12 ploughings with harrowings	25 5 0
Cowdung 450 maunds Rs. 15, and cost of applying, 3½ men at 6 annas	16 6 6
Seed cuttings, 7½ <i>kahans</i> (<i>kahan</i> =1,280) at Rs. 4	30 0 0
Cost of seed beds, transplanting	12 3 0
After cultivation (2 weedings, 2 ploughings filling up blanks, 4 tyings and 150 bamboos)	50 10 0
Total cost of cultivation	139 0 6
Harvesting and <i>gur</i> making, 105 men at 8 annas	52 8 0
Fuel for first day	3 0 0
38 earthen pots	12 5 0
Hire of mill and bullocks	30 0 0
Cost of clearing roots for next crop by ploughing	8 7 0
Total cost of manufacture	108 4 0
Grand total of cost	245 4 6
Outturn 59 maunds at Rs. 5-5-8	315 0 0
Net profit	69 11 6

In old alluvium the cost of cultivation is a little more, and the outturn is less, the net profit may be Rs. 45 to 50 per acre.

In Tippera.

	Rs. a. p.
Rent	4 8 0
Seed cuttings	40 0 0
Cowdung 36 cart loads	12 0 0
8 ploughings, hoeings and weedings	20 0 0
Fencing	4 0 0
Total cost of cultivation	80 8 0
Reaping and fetching home	50 0 0
Cost of milling	20 0 0
Earthen pots	6 4 0
Total cost of manufacture	76 4 0
Grand total of cost	156 12 0
Outturn 35 maunds of <i>gur</i> at Rs. 6	210 0 0
Net profit	53 4 0

To this may be added the income from the sale of cuttings, which is estimated at Rs. 60.

In the Dibrugarh sub-division of the Lakhimpur district, the cost of cultivation by Nepalese cane-growers per *pura* (1½ acres) is estimated as follows for three years in succession :—

	1st year.	2nd year.	3rd year.
	Rs. a. p.	Rs. p. a.	Rs. a. p.
<i>Cultivation—</i>			
Land revenue	2 4 0	2 4 0	2 4 0
Jungle cutting (one month's wages of one labourer)	12 0 0	...	...
Planting (ditto)	12 0 0	...	...
Price of seed	20 0 0	...	...
Weeding and hoeing 3 times (3 months' wages of one labourer)	36 0 0	36 0 0	36 0 0
Total	82 4 0	58 4 0	38 4 0
<i>Manufacture—</i>			
Labour for reaping, crushing and boiling (one month's wages for three labourers)	36 0 0	36 0 0	36 0 0
Hire of mill, pan, and buffaloes	15 0 0	15 0 0	15 0 0
Earthen pots	6 0 0	16 0 0	16 0 0
Total	57 0 0	67 0 0	67 0 0
Grand total of cost	139 4 0	105 4 0	105 4 0

The total cost for the three years amounts to Rs. 349-12, or say Rs. 350. The outturn is estimated for the first year at 150 pots and for the second and third year at 400 pots each. Each pot holds from 6 to 8 seers of *gur* or say 7 seers in the average. The total outturn of *jaggery* in the three years, therefore, amounts to 166 maunds and the average price per pot being 12 annas, the total estimated income amounts to Rs. 712-8. Calculated to the acre, the cost of cultivation would be Rs. 119-1, and of manufacture Rs. 143-4 and the whole cost from commencement to end Rs. 362-5. The outturn of *jaggery* would be 712½ pots valued at Rs. 534-6, which would leave a net profit of Rs. 272-1 per acre in three years, or about Rs. 90 on the average per annum. During the first year of cultivation, there is a net loss, which is more than made up by the profit of the ratoon crop in the two following years.

The following is an abstract in round figures of the estimates quoted above :—

	Cost of cultivation per acre.	Cost of manufacture per acre.	Total cost per acre.	Yield per acre.	Value of yield per acre.	Net profit per acre.
1	2	3	4	5	6	7
	Rs.	Rs.	Rs.	Mds.	Rs.	Rs.
Faridpur (Fangsa)	118	81	194	90	270	76
Dacca (near City)	112	71	183	45	270	87
Bangpur (new alluvium)	139	106	245	59	315	70
Tippera	81	76	157	35	210	53
Lakhimpur (Dibrugarh, average of three years)	40	48	88	42	178	90

Comparing the cost of cultivation and net profit in Dibrugarh with those of other districts, the extremely profitable character of cane cultivation in the virgin forest soil in that subdivision would be at once evident. But the system

of cultivation which the Nepalese pursue results in the wholesale destruction of forest, and it cannot be expected to continue for an indefinite time. The cost of cultivating forest land is so low that a few years ago *gur* was selling in the Dibrugarh market at such a low price as Rs 2-8 per maund. Unfortunately, the Nepalese cane-growers are in a state of chronic indebtedness to Marwari money-lenders who appropriate a large share of the profits that would otherwise remain to the cultivators.

39. *Character and richness of the juice.*—There is no analysis on record of the richness and purity of cane-juice in Eastern Bengal and Assam. In the experimental harvestings of sugarcane made in Assam during the nineteen years from 1883-84 to 1901-02 to which reference has been more than once made, the outturn of *jaggery* was found to average 8.42 per cent. on the weight of cane and 17.73 per cent. on the weight of juice. In some instances, 50 to 60 per cent. of juice and 10 to 13 per cent. of *jaggery* has been obtained from a given weight of cane, but these should be regarded as exceptional cases, and do not represent the sugar-yielding capabilities of the common cane of the Assam Valley.

40. *Sugar-making.*—Sugar is produced on a very small scale in Eastern Bengal and Assam. The only districts where it is known to be manufactured are Rangpur and Faridpur. The process of manufacture followed in Rangpur is as follows. The *jaggery* is mixed with water and boiled for an hour or so. The scum that arises is removed, and the concentrated mass is churned till it becomes reduced to powder. The resulting sugar (if sugar it can be called) is known as *bhura*. A better class of *bhura* is prepared by placing the *jaggery* in four bamboo baskets placed one above another and covering it with a kind of grass locally called *khar*. An earthen vessel is placed below to receive the treacle. After an interval of two days the *khar* is removed, and the sugar, which forms a coating an inch or so thick on the surface, is scraped off. Fresh *khar* is then placed on the exposed surface and the process repeated three or four times. The scraped mass is reboiled with water, the syrup being clarified with the help of milk; and when sufficiently thick it is churned into a powdery mass.

The process of manufacture followed in Faridpur is described in the following extract taken from Dr. Watt's Economic Dictionary:—

“The process of refining sugar is the same, whether it is obtained from the juice of the date or of the cane. Two modes of manufacturing sugar from *gur* are reported on. By the first method, the boiled juice in the form of *gur* is placed in stout gunny or sackcloth bags. The molasses or refuse is squeezed out partly by twisting and tightening the mouths of the bags and partly by laying weights upon them for additional pressure. The article thus produced is of a brownish colour. By far the largest quantity of sugar manufactured in the district, however, is prepared in a different way. The process, rather a cumbrous one, is as follows:—The *gur* is at first boiled with a certain proportion of water in a large iron vessel, a quantity of diluted milk being added from time to time to separate the impurities, which are skimmed off as soon as they form on the surface. When no more skim appears, the thickened liquor is poured into a number of circular earthen pots or strainers, made wide at the top and pointed below, with a hole in the centre, called *bharnis* and left for two or three days in the open air to cool. It is then removed to the refining house, where the final separation of the solid crystalline portion from the treacle is effected. The straining pots are generally arranged in rows on a bamboo frame at a certain height from the ground, and earthen pitchers are placed under each to receive the molasses as it slowly drains from the refining pot above. To complete the arrangement, as well as to quicken the operation, fresh moist leaves of a water weed called *pata saola* are now placed on the top of the refining pot, and as soon as a layer of sugar from one to two inches thick is formed at the top, it is removed by scraping with the knife, fresh weed being laid on the remainder, and the same tedious process is repeated several times until the entire quantity of sugar is made. The native confectioner makes extensive use of this sugar for the purposes of his art; but before it is fit for use, it has to be clarified again by further boiling with the addition of a solution of milk as in the last process. When this is allowed to cool, it forms a hard crust which requires to be broken and pounded before it can be

employed. The molasses which drains off from the sugar in the process is employed for preparing *hooka* tobacco, inferior sorts of sweetmeats, etc., and the rest is sold for making country rum."

There is no sugar factory in Eastern Bengal and Assam which is equipped with modern machinery, if we leave out of consideration the few sugarcane farms in Chittagong and Sibsagar, where steam-power mills are employed in crushing the cane. Very little information is available about these farms or about the exact character of the machinery employed. The Barpathar farm in the Sibsagar district grows cane for its own mill and does not purchase any from the neighbouring raiyats. The same is probably the case with the cane-planters in Chittagong. *Jaggery* is the only product produced in these farms.

Two old rum or sugar factories existed many years ago at Gauhati and at Dobapara in the Goalpara District. Nothing is known at this day of their history or of the cause of their failure. The efforts of Mr. Herriot, who owned the factory at Gauhati, to introduce a better kind of cane were so far successful that the best cane of the present day in Kamrup and Darrang traces its origin to them. There also existed in the eighties two rum factories near Golaghat and Dibrugarh. Situated as they were in the centre of thickly-peopled tracts, these factories stimulated the production of cane considerably within the limited area on which they drew for their supplies of *jaggery*.

The crushing of oilseeds, cotton-ginning and rice-husking are industries which can be suitably carried on in a sugar factory during the season when the machinery would have to remain idle.

We might get an answer to the question as to what price the raiyat will be willing to accept for his canes placed at the factory door from a consideration of the cost of production and the profit which he can reasonably expect therefrom. The cost of transport to the factory should also be taken into consideration. We may assume that the yield of *jaggery* is 10 per cent. on the weight of cane, and that the raiyat would expect 20 per cent. on the cost of cultivation as his profit (besides being remunerated for his own labour). The cost of transport would vary with the distance from the field to the factory. Taking the average distance to be (say) 3 miles, the cost of conveyance by cart may amount to about an anna per maund. Now, if we turn back to the estimates of cost of cultivation quoted in paragraph 38, we may calculate the cost of a ton of cane as below:—

	Yield of cane (ten times <i>jaggery</i>).	Cost of cultivation.	Add 20 per cent. for profit.	Add cost of transport at one anna per maund.	Total cost.	Cost per ton (27½ mds.)
	Mds.	Rs.	Rs.	Rs.	Rs.	Rs. a.
Faridpur . . .	900=33 tons	113	23	56	192	5 13
Dacca . . .	450=16½ "	112	22	28	162	9 13
Rangpur . . .	590=21½ "	139	28	37	204	9 7
Tippera . . .	350=12½ "	81	16	22	119	9 5
Lakhimpur . . .	420=15½ "	40	8	26	74	4 12

The cost of a ton of cane would then seem to vary from about Rs. 5 to about Rs. 10. Whether it would pay a factor to pay for cane at the lowest of these prices is a question to which it is not possible to give an answer without knowing the cost of manufacture in a factory. The Agricultural Department does not possess any data on the subject. The cost of cultivation can no doubt be reduced to a considerable extent by improved cultivation; and it may not be too sanguine to expect that in favourable conditions a raiyat should be able to deliver cane at the factory door at Rs. 4 or even less per ton. If people could take their canes to a factory, and dispose of it there at a rate which would leave them a fair margin of profit, many persons who are now deterred by the cost and trouble involved in the crushing of sugarcane and the manufacture of *jaggery* would be induced to engage in the cultivation of sugarcane. The great majority of raiyats keep barely enough cattle to cultivate their holdings, and

cannot spare any for the crushing of sugarcane. Central mills, where the cane would be crushed by steam-power, are expected, therefore, to be popular, once the riyats are persuaded to sell their canes instead of making *jaggery* for themselves.

There are several classes of refined sugar imported into the Province. These are (1) country sugar, which comes mainly from the United Provinces and Behar and is ordinarily known as Benares sugar, (2) foreign sugar imported through Calcutta, (3) country date sugar from Central Bengal, and (4) Cossipore sugar from the Cossipore sugar factory near Calcutta.

The average annual imports of refined sugar into Assam during the five years ending with 1905-1906 amounted to 80,514 maunds; out of this quantity, 59,387 maunds came from Calcutta; and 6,725 maunds (Benares sugar) came from the United Provinces.

The three trade blocks already mentioned, in which Eastern Bengal is included, imported 565,264 maunds of refined sugar annually on the average of the three years ending with 1904-1905. Out of this quantity 508,680 maunds, or almost 90 per cent was obtained from Calcutta. The balance of the imports was, for the most part, Benares sugar from the United Provinces and Behar.

It is not possible to ascertain the countries from which the sugar imported from Calcutta into Eastern Bengal and Assam was derived, but presumably the bulk of these imports was of foreign origin. It appears from a perusal of the Bengal Customs Reports that the countervailing duties on bounty-fed sugar imposed by Act XIV of 1899 had no visible effect on the importation of sugar from the continental countries of Europe. But it received a serious check when additional duties were imposed in 1902 to meet what is known as the cartel system. While the imports of beet sugar have greatly fallen off in recent years as the effect of these duties, those of cane sugar have steadily increased and more than made up the decrease in the imports of beet sugar. The bulk of the cane sugar imported into Calcutta comes now from Java, which has thrown every other sugar-producing country in the shade in the Calcutta market. *Pari passu* with the increasing imports, the price of imported sugar has fallen, with the result that the imports of sugar from Calcutta into the interior of the country have greatly increased in recent years, as will appear from the statistics of price and imports quoted below:—

Refined Sugar.

	Imports into Calcutta by sea.	Average price per cwt.	Imports from Calcutta into Assam.	Imports from Calcutta into Eastern Bengal and Assam.	
	Cwt.	Rs. a. p.	Mds.	Mds.	
1896-1897	483,500	11 3 1	36,644	Not available.	
1897-1898	1,063,878	11 4 5	41,475		
1898-1899	989,925	11 12 1	54,385		
1899-1900	750,965	10 13 1	33,973		
1900-1901	1,340,844	11 2 7	56,126		
1901-1902	1,514,727	10 2 10	41,506		
1902-1903	1,506,623	9 0 8	54,603		420,793
1903-1904	1,876,965	9 5 5	63,422		575,910
1904-1905	2,107,460	9 7 6	60,628		529,336
1905-1906	78,977	

PART IV.

IMPROVEMENTS.

Mr. Barber has suggested the various directions in which improvements may be effected. These are briefly considered below.

First introduction of new varieties of canes.—Any effort to introduce new varieties should necessarily be preceded by an investigation of their merits. It will be necessary to study their field, milling and chemical characters. A research of this kind can only be successfully carried out on a properly-equipped experimental station conducted on the same lines as the

sugarcane stations in the West Indies, under the control of the Imperial Commissioner of Agriculture and the Samalkota Farm in Madras. An experimental station to be devoted mainly to the sugarcane crop has been recently started at Jorhat in the Assam Valley, and it will be one of its main objects to investigate the merits of the indigenous varieties of cane and of new varieties imported from abroad.

Secondly, more careful attention to the details of cultivation.—Not much improvement is to be expected under the existing conditions of the country, so far as the tillage of the land and the after treatment of the crop are concerned. There is no doubt that the cultivation of sugarcane as practised in Eastern Bengal and Assam can be improved in many respects, but the general apathy of the agriculturists and the low standard of agriculture current in the province stand in the way. The use of rape-cake as a profitable manure for sugarcane appears to be known in most districts, and although it is available everywhere, it is but seldom used except in a few localities such as Sylhet. The reason why a manure so readily available is not used as widely as it could be is not quite clear. If it be that the raiyats are too poor to purchase the manure, the problem should be one which the rural Co-operative Credit Societies now being established might well take in hand. But it seems the real reason is not poverty, but is to be found in the fact that the cultivation of sugarcane in Eastern Bengal and Assam, though it may be less careful than in other parts of India, is still found to be so profitable that the cultivators have no stimulus to improve their methods.

Mention has been made of several large sugarcane farms in Chittagong and Shibsagar. The cultivation of these farms is decidedly less careful than what obtains among the cultivators. These farms consist of land newly reclaimed from jungle, and do not demand an intensive cultivation. But sooner or later the owners will have to adopt improved methods of cultivation if they intend to continue growing cane on the same land.

Thirdly, increased facilities for irrigation.—Not much is to be expected in this direction in Eastern Bengal and Assam. Most parts of the Province are sufficiently damp to be able to dispense with irrigation altogether. The old alluvium tracts in Northern Bengal and Dacca may be benefited by irrigation, but where so much land needing no irrigation is available, it is hardly to be expected that these tracts will be preferred for sugarcane cultivation. It is possible that the old alluvium soil is more suitable for sugarcane than the ordinary alluvial and deltaic soils of the country, and may pay better under an intensive system of cultivation than the latter. But the point is one on which no opinion can be expressed without a critical study of the methods and results of sugarcane cultivation in the two classes of soil.

Fourthly, improvements in the manufacture of jaggery or gur.—The quality of jaggery can certainly be improved, and by means which are well within the power of the raiyats. Jaggery of excellent quality is prepared at the Burdwan and Sibpur Experimental Farms. The same appliances as are used by the neighbouring cultivators are used, but attention is paid to a few simple details about which the raiyats are as a rule careless. The juice is received in pots, which are cleaned and sweetened every day; and as soon as the pot is full, the juice is poured into the boiling pan and kept sufficiently hot to prevent fermentation until the full charge has been collected. The pan used is of iron and of the shallow circular type now used in many parts of Bengal. The pan is so placed over the fire that its outer six inches or so projects beyond the furnace, the object being to prevent the burning of the jaggery as it thickens in the pan. After the juice has been clarified and the first scum that rises has been removed, the boiling is pushed on as fast as possible. This simple method, which entails no additional cost, can be further improved by defecating the juice with the help of such substances as soda and the mucilaginous extract obtained by crushing the stems of the *bhindi* plant.

But unfortunately the raiyats are too slow to change their methods. The jaggery they produce is sufficiently good to meet the taste of the consumers. No general improvement is, therefore, to be expected until the public have acquired a taste for a better product.

It is doubtful whether refined sugar can be prepared on a large scale from country-made jaggery so as to be able to compete with imported cane and beet

sugar in the open market. The products of the Cossipore Sugar Factory do not enter into competition with imported sugar. The factory caters for a select class of customers, and has after all a very limited market. If India is to compete successfully with foreign countries in her own market, she should be able to produce sugar direct out of the cane. *Jaggery* has a very large market of its own, and its price is governed by causes other than the demand for it for refining purposes. Hence it will never be safe for a refinery to depend for its raw material on country *jaggery* if it has to compete with the outside world. It is said the Cossipore Sugar Factory has of late been using raw sugar from Java as being cheaper than the country product.

Fifthly, introduction of small plants for sugar-making.—The questions mooted by Mr. Barber are such that no opinion can be expressed without a minute study of the system of sugar manufacture followed in modern factories.

B. C. BASU,

Assistant Director of Agriculture.

SHILLONG.

The 28th January 1907.

APPENDIX.

Varieties of Sugar-cane.

District.	Local name of variety.	Description.
1	2	3
Dacca	<i>Khagra</i>	White hard rind. Rich in sugar, is grown for <i>gur</i> .
	<i>Deahi</i> or <i>Normi</i>	Looks like <i>khagri</i> , but is thicker and softer, not so rich as <i>khari</i> , but produces better <i>gur</i> .
	<i>White Bombay</i> or <i>Gandari</i> (chewing cane).	Rind very soft; internodes long; very sweet to the taste, and is used generally for chewing purposes; yields also very good <i>gur</i> .
	<i>Sharong</i>	Very soft rind; internodes long, tallest and thickest; rich in juice and best for chewing purposes.
	<i>Kajli</i>	Deep violet, with very hard rind; not liable to attacks of wild animals.
Bakarganj	<i>Ikri</i>	Ash-coloured, with hard rind; rich in sucrose; good for making <i>gur</i> ; not liable to attacks of wild animals.
	<i>Khagri</i>	Very hard canes of reddish yellow colour; good for <i>gur</i> ; resists disease, and not liable to attacks of jackals.
	<i>Bombai</i> or <i>Turpen Nara</i>	Yellow, with soft rind; juice poor in sucrose. Red; rich in sucrose; liable to disease and attacks of wild animals.
	<i>Kajla</i>	<i>Pinkish</i> cane; poor in sucrose.
Fardpur	<i>Dhalsundar</i>	White with a reddish tinge.
	<i>Kajla</i>	Deep purple, with hard rind; can stand stagnant water; makes good <i>gur</i> .
	<i>Khala</i> or <i>Lata</i>	Yellow, with a shade of purple; hard and thin; too hard for jackals and white-ants; can stand stagnant water.
	<i>Choona</i>	Yellow; thinner than <i>khala</i> ; <i>gur</i> produced is black.
	<i>Khagri</i>	Reddish with hard rind; not liable to disease; produces good <i>gur</i> .
	<i>Ikri</i>	Yellow, can stand 8 feet water
Chittagong	<i>Bombay</i>	White; grows thick and very tall; a chewing variety.
	<i>Chewing cane</i>	Soft rind.
Tippera	<i>Khari</i>	Hard rind; grown for <i>gur</i> -making.
	<i>Khagra</i>	Greenish white; hard rind.
	<i>Bombay</i>	Red; soft rind.
	<i>Dhalsundar</i>	White, with dark blotches; hard rind; richest in juice.
Rajshahi	<i>Kajli</i>	Red hard rind, richest in sucrose.
	<i>Khari</i>	Reddish brown; thinner than <i>Khagra</i> ; soft rind, rich in juice and is grown for <i>gur</i> -making.
	<i>Khagra</i>	Dark colour, hard rind; rich in juice, and is grown for <i>gur</i> -making.
	<i>Bombay</i>	Purple; chewing cane; poor in sucrose.

APPENDIX—continued.

District.	Local name of variety.	Description.
1	2	3
Dinajpur	<i>Sakaban</i>	Reddish; very soft rind; rich in juice.
	<i>Patasi or Kajli</i>	Deep purple with dark tinge; hard rind; not subject to attacks of wild animals.
	<i>Kheri</i>	Ash coloured; softer than <i>Patasi</i> .
	<i>Moogi</i>	Pale brown; soft rind; rich in juice.
	<i>Basna</i>	Greyish; hard rind; poor in juice.
Bogra	<i>Bhelan Mukhi</i>	Reddish white; cultivated for <i>gur</i> .
	<i>Bombai</i>	Yellow; grown for chewing.
Pabna	<i>Dhalsunder</i>	White.
	<i>Kajla</i>	Red.
	<i>Khatia</i>	Ashy.
Malda	Chewing cane	Red.
	Chewing cane	White.
	<i>Khagri</i>	Greenish yellow.
Rangpur	<i>Venda Mukhi</i>	Yellowish brown; soft rind and tall; gives high class of <i>gur</i> .
	<i>Kajli</i>	Purple; harder than <i>Venda mukhi</i>
	<i>Kheri</i>	Thin and tall; hard rind; very rich in sugar and is grown for <i>gur</i> -making.
	<i>Mugi Malei</i>	White; hard rind; poor in sugar.
	<i>Samras</i>	A small variety, with short internodes.
	<i>Sakaban</i>	Red, with violet tinge, soft rind; tallest and thickest, used for chewing.
Assam Valley Districts.	<i>Bagi</i>	White; soft and juicy; grows 7 feet long and the canes measure a little more than an inch in diameter; makes good <i>jaggery</i> .
	<i>Mugi or Mag</i>	Amber colour; otherwise same as <i>Bagi</i> .
	<i>Rangi</i>	Deep red; hard and thin; 5' or 6' high and $\frac{1}{2}$ in diameter; hardy.
	<i>Kais or Teliya</i>	
	<i>Bangala or Bambo or Bam (Bombai cane)</i>	Red or yellow; soft and juicy, grows 8' long and $1\frac{1}{4}$ " in thickness. An imported variety.
		Juice poorer than the preceding varieties, and cane apt to break into small pieces in crushing; cultivated as a garden plant and eaten as chewing cane.
	<i>Asmaiya or Ketekipura</i>	A degenerate variety of <i>Bangala</i> or <i>Bombai</i> cane.
	<i>Malaha Mahla, Magora, Megala or Majara (reed cane)</i>	Hard, thin and dry. Requires no protection from beasts.
	<i>Bhabeli</i>	Resembles <i>Mugi</i> , but with shorter internodes.
	<i>Kamraugi</i>	A cross between <i>Mugi</i> and <i>Teliya</i> .
Manipur	<i>Tekhao-chu</i> (Assam-cane)	White, but sometimes violet. Soft, juicy and tall.
	<i>Chu-nagang</i>	Red, harder and thinner, and less juicy than <i>Tekhao-chu</i> .
	<i>Awa</i>	Yellow; softer and larger than <i>Chu-nagang</i> ; introduced from Burma.
	<i>Chunagaw</i>	White, with soft rind, and is the softest variety.
	<i>Haucha</i>	White, harder than <i>Chunagaw</i> .

BARODA STATE.

The cultivation of sugar-cane varies greatly in the different districts three distinct kinds of cultivation being practised in the Baroda, Naosari, and, Amreli Divisions of the State. Even within the districts, minor differences in practice are noticeable due to variations in soils.

Baroda District.

2. The average rainfall in Baroda is 30 inches distributed in one monsoon period from June to September. The average temperature is 50° mean minimum of January and 107° mean maximum of May, and the atmosphere is generally dry for the greater portion of the year.

3. The cultivation is practised from ancient times and no recent introduction of cane has been heard of in any part.

4. The area under sugar-cane was being gradually reduced even before the great famine of 1899-1900, but the reduction has been heavy since the famine which has reduced the capital of cultivators and the waters in wells, and increased the attack of white-ants. The area in 1905-06 was 128 acres against 724 acres before the famine.

The cultivation of cane is fairly intensive and takes its place in regular rotations. The soil is alluvial of a rather sandy character. In the preparation and manuring of land, in the adoption of the system of rotation, in the selection of seed and in the system of irrigation, cultivators seem very well up.

5 & 6. Only a red hardy variety of cane is generally grown, the full grown cane is 8 to 12 feet long and has a diameter of 1½ to 2 inches. It has a hard rind and is moderately juicy. It stands the ravages of jackals, grubs, borers, &c., better than white canes which were tried by people in various places on account of their superior qualities, and given up as unsuitable.

7. At times sports have been found, e.g., a whitish colour was found in red canes in isolated places, but no attempt seems to have been made to multiply them. Similarly inflorescence does appear in canes at times and seeds are formed from it, but in trials by some curious cultivators, the seed has failed to germinate.

8. No sugar is made in the district, jaggery (*gur*) of a very superior kind being made from the cane. Sorghum has been tried and given up as the jaggery produced was too sticky and dark. No spirit is made in the district from the jaggery as the Mahua flower (*Brassica*) is an abundant and cheap source for the manufacture of spirit. A syrup made from these flowers is also used in mixing with tobacco for the *hukkah*.

Cultivation.

9. The planting season lasts one month from the beginning of the bright half of *Vaisakh*, that is, the month of May. The earlier in the month of May, the better, as hot moist climate which conduces to good development, prevails at the time. Planting before and after May is not considered good.

The harvesting season lasts about 7 weeks from the first week of February to the end of March. If cut later, the people think that the jaggery will be very liquid. Labour is dear at the reaping time, but if cut early, the cold season interferes with the formation of jaggery. At this time labour is employed in cotton picking, watching castor, *tur*, etc.

10. The following rotation is generally practised:—

- (1) Fallow, with rabi castor or brinjals at very wide intervals to allow of repeated ploughings; or a green manuring crop of *san* (only lately introduced).
- (2) Sugar-cane.
- (3) *Kodra* mixture, including *tur*, *til* and *sheria*.
- (4) *Bajri* mixture, including *mug*, *math* and other pulses.
- (5) *Kodra* mixture.
- (6) *Bajri* mixture followed by fallow.

So sugar-cane comes again after the 6th year and it is not considered good practice to take another irrigated crop in the interval.

The cane is never rotated with rice and attempts to grow it in *Kyari* land have failed, resulting in stunted growth of the cane on account of these lands being lowlying and water-logged. In the cane field no catch crops are taken and no mixed cropping is practised. People grow *tur*, castor, *cal* and other vegetables of the cucurbitaceæ order on the outskirts to utilize the moisture, but they never grow sorghum as a trap crop, for moth borer. Maize as a trap crop has recently been introduced since last year and efforts are being made to extend the practice.

11. Ratoon is never practised probably on account of the white-ants and other diseases.

12. Before setting-in of the monsoon, previous to the cane crop, about 25 tons of well rotted cattle manure per acre are applied to the land and ploughings begin with the first fall of rain. Sheep folding is also practised if available. In all 20 or 22 ploughings with the indigenous plough are given while the land is kept fallow throughout the rainy season and the winter, wide intervals being left between the plants of the fallow crop for this purpose.

13. On removal of the fallow crop, the land is well ploughed and made even, furrows and ridges are formed, and beds are made. Each bed contains at least 4 ridges and is 12' x 10' each. Water is then allowed to pass in the furrows, and soon after sets of cane each having 3 eyes are put in the furrows in a line and pressed with the foot nearly 4 to 5 inches deep. Each furrow contains nearly 10 sets.

14. As there is an intervening period of from 2 to 2½ months between harvesting and planting in the middle of the hot season, the canes intended for seed have to be kept standing and irrigated. On this account it has been the practice of some villages to grow cane only for seed and all the others buy the seed from them. There is also a belief that seed brought from a place where well water is a little saltish gives a good yield. The result most often is that a man has to buy even diseased seed or go without it.

15. Sets from all parts of these standover canes are used, those from the middle portion being considered the best. The rooting lower portion of the cane is rejected and there is no special belief one way or the other about tops.

16. No solutions are used for dipping the sets against diseases; people do not seem to believe in such preventives.

17. The number of sets per acre for planting is from 18,000 to 22,000 sets, each having 3 eyes. 20,000 is considered average, more sets being planted in poorer and less in better class of soils.

18. Planting in rows is considered better as it facilitates digging between the rows. The distance between the individual sets is generally from 4 to 6 inches and the distance between the rows themselves nearly one foot. The planting and reaping seasons are not at the same time as said before, and the depth to which the sets are put is nearly 4 inches. The soil is light and free and does not retain moisture for more than 5 to 6 days. Again at the time of planting the weather is very hot and withering of the sets is possible if planted less than 4 inches deep.

19. Ryots are not in the habit of supplying vacancies and do not consider it feasible as no sets can be preserved for more than 4 to 6 days. The practices of keeping extra sets in pits or of planting the outskirts too thickly are unknown.

20. The system of making seed beds for canes is unknown here as there is no uncertainty as regards the supply of water.

21. Stool-planting is not practised and has never been known to be practicable.

22. Irrigation is the all-important item in the cultivation of cane. When people think that the supply of the underground current of water may be weakened they never attempt the cultivation. The only mode of irrigation is from wells by native methods of using leather *Kos* and rope. People understand the superiority of using oil-engines in preference to *Kos* and an individual or two have set up the plant on their wells, but the initial investment is too great to venture and the supply of water in many of the wells is not sufficient for a full day's pumping. Cane is irrigated every 6th day except in the four months of the rainy season, when, if the rain holds off for more

than 8 days at a time, the cane requires watering. Cane lands being sandy no draining is necessary.

23 The object of the after-cultivation are to destroy weeds and to conserve moisture. In a period of 2 to 3 months the canes shade the ground and the after-cultivation ceases. Cane crop is weeded 20 days after planting and after putting castor-cake top dressing (1,000 lbs.), the whole field is dug with a spade. Again after 15 days the above-mentioned processes are repeated. Thus 4 to 5 weedings and as many diggings with a country spade are given in 2 to 3 months' time. After the canes have reached 4 feet high permanent furrows and ridges are made and nothing is done after that except giving waterings at regular intervals. The process of weeding is of course very deep and thorough.

24. The system of manuring has already been explained. The essential idea is not only to apply well rotted manure, but to give it time enough for a thorough mixing with the soil and oxidation, &c., as a safety from white-ants which are believed to be fond of fresh manure. The place of artificial manures is taken by castor-cake which is applied in two top dressings of thousand lbs. each. The cake is broken into rough powder and it is either applied plant by plant or put in bags and placed in the water channel. The water easily dissolves it and distributes it evenly. Trash is burnt after the crop is removed and believed to remove the ill-effects of the heavy irrigation and to act as a manure for the next crop in the rotation.

Manurial experiments:—Manurial experiments carried out for several years with locally available manures have shown that an application of 20 cart-loads of dry night soil per acre can well replace 25 tons of farmyard manure and 2,000 lbs. of castor-cake. Experiments with artificial manures are now in progress.

25. Stripping of old leaves does not exist as it is believed to scorch the canes and expose them to the attacks of jackals.

The practice of tying the canes with lower leaves is prevalent instead, as that is believed to prevent the canes from falling and lodging and affords some safety against jackals.

Another method resorted to for guarding against animals is to build a mud wall all round the plantation. But this is done only by careful cultivators in places where few other cane fields exist. People are too religious to kill them.

26. Watering the cane crop just before cutting is universally prevalent.

It tends to increase the quantity of juice and withholding water before cutting is said to spoil *gur* and make it sticky.

36. The yield of cane in Baroda is from 50,000 to 60,000 lbs. per acre and the yield of jaggery is from 6,000 to 7,000 lbs. per acre.

Naosari District.

The cultivation of cane in the Naosari District is the best in the whole State. It is intensive and the people seem to possess a good knowledge of the cultivation of cane and the manufacture of *gur*.

2. The average rainfall in Naosari is 43 inches, distributed in one monsoon period from June to September. The average temperature is 47° mean minimum of January and 102° mean maximum of May and the atmosphere is warm moist with sea-breezes.

The cultivation is practised from ancient times and no recent introduction has been heard of in any part.

4. As in Baroda Division, the area under cane has been considerably reduced since the last famine and the subsequent bad years. The capital of the cultivators has been greatly reduced and the water in wells has gone low and in some cases turned saltish. The area in 1905-06 was 1,044 acres against 1,704 acres before the famine.

The cultivation is not uniform. In some parts, for instance, cane is rotated with rice and is grown in *Kyari* land having embankments, and where cane of a particular variety called Malbary which stands water-logging to some extent is grown. In others, other varieties of cane as Khajuri, Rati, &c., are grown in ordinary black soil called *Talia* land having no embankments, where cane is rotated with *fur*, castor, beans, &c., which will be considered later on. This

Talia land is a loam of a rather clayey nature and retains moisture splendidly.

5. The following varieties of cane are grown :—

- (1) *Malbari*—a white variety with plenty of juice.
- (2) *Kajuri* or *Surti*—also a white variety but moderately juicy.
- (3) *Bati* or red variety moderately juicy.

There are sub-divisions of *Bati* as *Kali Jadi* having a darker appearance, *Kharedi* having stripes, *Goli* having a lighter colour, and *Bati* proper.

(4) *Vansi*—white, very thin, hard, and with little juice.

People having very humble means and thus not affording money for seed of superior variety of cane grow *Vansi*—the poorest variety.

Gandi Sherdi is another variety of *Vansi*. There is a cane called *Mani* which is believed to be poisonous. When small-pox prevails, some low caste people dedicate it to the goddess to cure the sick. This cane is only found grown in the courtyards of houses of lower people.

Of all these canes, *Khajuri* is the softest and *Vansi* the hardest.

6. *Malbari* cane was introduced some 75 years ago from Bassein and it is believed to be an original Mauritius variety. This variety is taller, thicker, heavier and produces a more abundant crop than all the rest. But it has since been deteriorated both in weight and juice. However it is still considered best amongst all the varieties mentioned above.

No cases have been reported of local canes having been exported.

7. The varieties named *Kharedia* or *phus-bhuri* having stripes and *Kali Jadi* are believed to be sports from the red variety. In cane fields flowers do appear at times, but no seeds are formed and hence no seedlings.

8. The State tried to produce sugar in a sugar factory and the results have been noted under manufacture. People used to manufacture spirit from flowers of *Mahua* tree (*Brassica*) and from the scum of boiled juice, but these practices have ceased to exist since the manufacture of spirit has been considered illegal.

Cultivation.

9. The planting season begins soon after the rains have ceased and it lasts for two months, October and November, and should cease when cold season begins to set in.

The reaping time lasts for 8 weeks, from the beginning of October to the end of November, and lasts up to the end of January for late varieties. Thus eleven months are believed to be sufficient for ripening. But this period differs with different varieties of cane; thus *Malbari* ripens first, then comes *Bati*—red variety and next comes *Khajuri* and lastly comes *Vansi* in maturity. *Bati*, *Khajuri* and *Vansi* can stand for 12 or 13 months, not so the *Malbari*. At the reaping time labour is dear, being employed in cutting rice, grass, *Kodra*, &c. It runs as high as 6 annas a day with food and little of cane juice.

10. The following rotation is generally practised in *Kyari* lands :—

- (1.) Sugar-cane after rice is cut.
- (2.) Rice in the rainy season and beans (*Val*) in the Rabi season.
- (3.) Do. do. do. do.
- (4.) Do. do. do. do.

So sugar-cane comes on the 5th year again and the land gets manure every year.

In other lands the following rotation is practised :—

- (1) Sugar-cane.
- (2) *Tur* and coarse rice.
- (3) *San* and after ploughing in the *San* plants, castor and beans as *Rabi* crops.
- (4) *Udid* and *san* ploughed up.

So sugar-cane comes again on the 5th year. The cane field is manured in the year in which *San* and *Udid* are grown.

People thoroughly understand the value of *San*, *Tur*, *Udid* being leguminous plants in the rotation and of the green-dressing of *San* and *Udid*. No irrigated crop is taken in the interval. Tobacco is sometimes grown as a catch crop in the beginning, but this is considered bad practice. People grow vege-

tables of the cucurbitaceæ order on the outskirts to utilize the moisture, but they never grow sorghum as a trap crop.

11. Batoon is generally not practised and in some trials by cultivators the resulting crop had been a failure, the plants having been withered.

12. In *Kyar* land, manure is applied every year. In the cane year, after the rice is cut, nearly 10 ploughings with the native plough are given and the land is made level with the *samar*.

In the *Talia* land previous to the cane crop, about 25 tons of well rotted cattle manure per acre are applied in the month of May and ploughings begin with the first fall of rain. Sheep folding is also practised if possible. In all, 20 ploughings and in some places even 25 ploughings are given and a crop of *San* and *Udid* is sown. After it has reached some height it is ploughed up and the land is made thoroughly even. It is believed that the greater the number of ploughings, the lesser the amount of irrigation required. People know the value of tank-mud and put it on the land whenever they can.

13, 14 & 15. After bringing the land in good heart, whole canes are planted with a very heavy plough called *Nangar* drawn by from 6 to 8 bullocks. By this plough, canes are laid in the soil fairly deep, *viz.*, 6 to 9 inches. The bullocks are driven in a circle round the field and canes are laid underground in concentric furrows. Three to four men drive the bullocks according as the number of bullocks are (6 or 8); one man passes the canes in the tube in the *Nangar* and one man hands over the canes to the former. Thus in the planting operation 5 to 6 men are employed.

Whenever the crop is without diseases, people are in the habit of keeping a portion for seed. Otherwise they purchase seed from the neighbourhood. This is easy as harvesting and planting are practically done at the same time. Tops are not considered good for seed.

16. The people do not seem to believe in dipping the canes in any solution against diseases.

17 & 18. The number of canes used as seed for one acre is 1,750 whole canes having the length of 6 cubits each. If the canes are longer or shorter, the number varies accordingly. Generally speaking there is a tendency to plant too many rather than too few. People prefer whole canes to sets as they want to plant them deep in the moist under soil and save irrigation for at least 2 months after planting.

19. If vacancies occur, canes of inferior quality which can be had a month after planting are planted by hand. Seed canes are planted within 2 days after cutting.

20. Seed beds or nursery are not in vogue.

21. Stool planting is not practised and has never been known to be practicable.

22. Irrigation is necessary but more or less according to the nature of the soil and the ploughings given to it. The crop is irrigated either from wells or tanks. The soil is very retentive and not many waterings are needed. Thus in certain lands on the banks of rivers where cane fields are kept fallow a whole year before planting and ploughed throughout to conserve moisture, the first watering is given three months after planting and in all 5 to 6 waterings only are given. No watering in the monsoon and after the rains have ceased, one more watering before harvesting is given. At other places 10 to 12 waterings in *Kyari* land and 15 to 20 in *Talia* land are needed. The water in wells is not plenty and no oil-engine will get work for a full day's pumping. Two oil-engines with pumps have been set up by people on rivers and water is pumped for sugar irrigation for the owners' fields as well as sold to neighbours.

23. The object of the after cultivation is to conserve moisture. No weeding is done, as there are few weeds.

Nearly 20 to 25 days after planting, land is ploughed keeping the share shallow so as not to touch the canes below with a view to loosen the surface. Another month after, the land is dug and watered. Such diggings and waterings continue till the following June when they cease with the arrival of monsoons. The objects of digging between furrows are to keep down weeds, to loosen the surface and to cut the surface roots of the cane.

24. The system of manuring has already been explained. The essential idea is not only to apply well rotted manure, but to give it time for a thorough

mixing with the soil. The practice of green-dressing with *san* is universal and the place of artificial manure is taken up by castor-cake. People are not very particular about giving cake, and in *Talia* soil many people do not put it. Whenever it is applied, it is given at the rate of 1,600 lbs. per acre and in monsoon only with a watering. It is believed to stimulate the growth of cane and to kill white-ants. People believe that the application of cake is a safety against water-logging.

25. The practice of burning trash exists but no green-dressing after the canes are planted.

Stripping of old leaves does not exist as it is believed to scorch the canes and expose them to the attacks of jackals.

Similarly, canes are not tied and neither bamboo nor any other thing is used as a precaution against lodging or for straightening. A hedge of castor plants and thorns is made round the field and the fence is covered with fisherman's net against jackals and other wild animals. In the centre of field, a raised platform is made and a figure resembling a man with a bow and arrow is erected upon it to frighten the animals. *Vansi* has a very hard rind and is not touched by jackals, so it is planted round the field as a protection for the main crop. Some men hire the services of some low class people who keep hounds and thus get the jackals destroyed. Beating of drum is also practised, but is of no avail.

When the canes are very young, rabbits destroy the shoots and a watchman is kept throughout night with fire by his side.

26. Cane is watered 8 to 12 days before cutting as watering cane immediately before cutting is believed to make *gur* sticky and increase the cost of fuel.

36. The yield of cane in Naosari is from 45,000 to 60,000 lbs. and of jaggery is from 5,600 to 7,000 lbs.

Amreli Division.

The cultivation of cane in the Amreli Division of the Baroda State comes last in importance from all the rest.

2. The average rainfall is only 20 inches distributed in one monsoon period from June to September. The average temperature is 60° minimum and 107° maximum and the mean is 89°. The atmosphere is warm for the greater portion of the year tempered with sea breezes.

3. The cultivation of cane is known from ancient times and no recent introduction has been heard of in any part.

4. The area under sugar-cane was being gradually reduced even before the great famine, but the reduction has been heavy since the famine which has reduced the capital of cultivators and the water in wells and increased the attacks of white-ants. The area in 1905-06 was 150 acres against 934 acres before the famine. The cultivation of cane comes only once in 12 years and the crop is irrigated from wells. The cane soil is dark coloured and is fairly deep derived from Kathiawar trap rock.

5. Two varieties of cane are cultivated, one red variety with hard rind and the other white variety with soft rind. The white variety is richer in juice and yields more *gur*. However white cane is not much planted as its seed is very costly and requires a richer soil and wants more irrigation. Of the white variety there are two kinds:—*Dhokadiya* thick and having short internodes, and *Vansada*, having long and thin internodes. Of these two, *Dhokadiya* is considered higher as it weighs more and produces more *gur* than *Vansada*.

A good white cane weighs from 10 to 20 lbs. each and the red one from 5 to 7 lbs. each.

6. It is believed that the white variety of cane has been introduced some 100 years ago from Mahua port in Bhavnagar territory, but ultimately from the Konkan coast. This white variety is spreading but the red variety, though poor, will not disappear as it is believed that a soil upon which the white variety has been once grown will not produce sugar-cane next time until after 25 to 50 years, as it is very exhausting.

7. Sports have been found in canes. Sometimes stripes of yellowish or white colour have been found in red cane. In white canes though no change

of colour is visible the internodes become smaller. Such sports are believed to be sweeter than the original canes.

Similarly, flowers have appeared on individual plants of the white variety but no seeds are formed and consequently no seedlings have resulted.

8. In the District no Sorghum nor palm nor any other plant are used for making *gur*.

Similarly no spirit has ever been produced from the scum or any other thing. The whole tract is treeless and hence palm or Brassica are few there. Beet was once grown by a curious cultivator, seeds having been supplied by the Department. According to his opinion the roots were large and well developed but no attempt could be made to make sugar out of it.

Cultivation.

9. The planting season begins after the cold season is over and it lasts for one month in the whole of March. The harvesting season lasts about six weeks from the middle of January to the whole of February. At the harvesting season, labour is dear as cotton picking and wheat cutting are in progress. The white cane ripens a bit earlier, say a fortnight. If allowed to stand longer it would be hollow and the *gur* will be decreased.

10. The following rotation is generally practised :-

Sugar-cane.
Bajro and *Mug*.
 Cotton and *Udid*.
Jowar and *Mug*.
Bajro and *Mug*.
 Cotton and *Udid*.
Jowar and *Mug*.
Bajro and *Mug*.
 Cotton and *Udid*.
Jowar and *Mug*.
Bajro and *Mug*.

Fallow with *tii* ploughed up in September.

Thus sugar-cane comes again after 12 years, and no irrigated crop is taken in the interval. But as said before, white sugar-cane is not grown on the same soil except after a very long period, say 25 to 50 years. Cane is never rotated with paddy. *Mug* is sown broadcast and then cane is planted. This is considered a good practice, as *Mug* plants are considered a protection of the cane against sun. *Mug* plants are not dug up in the soil but are cut up and fed to bullocks and the roots allowed to rot in the ground.

On the outskirts castor and vegetables of the cucurbitaceæ order are grown to utilize the moisture. Similarly *okras*, *guar*, watermelon, &c., are grown on the water channels for green vegetables, but sorghum as a trap crop is never grown. There is a practice of sowing *Bajri* along with *Mug* with a belief that *Bajri* plants will act as a preventive against rabbits who will eat them as they are soonest out.

11. Ratoon is not practised. It is believed to be unprofitable as the resulting crop is much attacked by diseases and there is a good deal of foliage and not much of cane stem.

12. The land is kept fallow and ploughed throughout the year. In all, 20 to 25 ploughings are given. With the arrival of the rains, *tii* is sown and ploughed up in September. The plough is used in the hot and cold seasons, while in the rainy season only *karab* is used.

No manure is used except just before planting the cane sets. There are cases where people do not keep the land fallow, and after removing the monsoon crop, the land is ploughed 4 to 6 times and cane is planted though on a small scale. The soil can be ploughed at any time and no puddling is necessary. Manure is put on the soil after the land is well ploughed and ready for planting canes. Nearly 30 tons of cattle manure or village manure along with, are applied to the land. Sheep folding is practised wherever practicable. As people are in the habit of burning cattle dung owing to scarcity of firewood, it is largely replaced by village manure which is of a very poor quality.

13. When the land is well ploughed and made level, beds are formed and manure is put and spread on the top of the beds. Then the beds are filled up to the brim with water and one man standing in the beds with cane sets, each having three eyes, in a banging cloth behind his back, throws the sets in two rows at a time and presses them with his feet alternately. He tries to throw sets in rows judging by the eye but generally the sets are not in perfect line as is the case in Baroda. The rows are one foot apart.

14 & 15. Cane takes nearly 11 months to ripen and sometimes crushing and planting are carried on simultaneously. Whenever this is the case, tops and lower portions are set apart for planting as they are considered bad for making jaggery, and the rest of the canes are crushed. As a practice, a portion of the crop is kept apart for planting and the rest is crushed. Whenever one month elapses between planting and crushing all parts of the cane are used for seed, but as said above, tops and lower portions are preferred when both the processes are carried on at the same time.

16. No solutions are used for dipping the sets against diseases. People do not seem to have heard of such practices.

17. The number of sets per acre is from 20,000 to 25,000, more sets being planted in poorer and less in better class of soils. The sets are pressed some 6 inches deep as sets pressed less deep are liable to wither.

18. Vacancies are never supplied, and canes are never kept purposely but planted soon. In an emergency, however, 8 to 10 days elapse before cut canes are planted. In such cases canes are kept in shade and water is sprinkled over them.

20. The system of making seed beds for cane is unknown as there is no uncertainty as regards supply of water.

21. Stools are not planted but they are considered good for planting.

22. Irrigation is the most important point in cane cultivation. When it is feared that the supply of underground water is weak, people do not attempt the cultivation. The usual mode of irrigation is from wells by *Sundhia Kos* and rope. Since leather became very dear after the famine, a kind of iron bucket locally manufactured has been introduced and an iron bucket with a leather trunk is considered the best. In the southern part of the District, the Persian wheel is used. Irrigation is continuous throughout the period of growth every 8 to 10 days, except when it is actually raining. The rainfall being small, a day after the rain ceases the crop is irrigated. The land is naturally drained. Oil engines have in no place replaced the *Kos*, as the wells generally are small.

23. No digging or hoeing is attempted or is possible as the sets are not in perfect line. In all, 4 weedings and stirrings of the soil with a *Khurpi* are done after *mug* plants are cut up in June, and up to September when the cane shades the ground and weeding is impossible.

Bajri plants which are planted as a protection against rabbits are taken off in April.

24. The system of manuring has already been explained. As cattle dung is burnt as fuel, as is to be expected in a treeless country, village manure generally of a very inferior kind is used. Unlike the system in other places, manure is spread on the ground after the thorough cultivation is finished. The place of artificial manure is taken by castor cake. It is not always that castor cake is applied, but when the crop looks poor and yellow, it is applied as a top dressing only once in September at the rate of 500 lbs. per acre.

25. No practice exists to burn trash and no green dressing applied after planting. The catch crops are taken off in June and July.

The stripping of old leaves does not exist as they are considered a protection against wild animals. The disease called 'salo'—insect boring into the stem—is believed to increase its attacks by stripping the leaves. The practice of tying the canes with lower leaves is prevalent instead, as that is believed to prevent the canes from falling and lodging and thus from putting adventitious roots. No bamboos are used to support the canes, but several canes are tied up together by a string.

26. The practice of guarding the canes against jackals and other wild animals are :—

- (1) Bamboo trellis is made round the cane crop and the thorns of *bor* (*kusuba*) are put round it.

- (2) People engage the services of *Vaghari*, Mahomedans, &c., who keep hounds to kill them. These *Vaghari*s put a pot in which pieces of bread and *gur* are put in the run of jackals and when they come they are destroyed. This latter practice is not very general.
- (3) Beating of tin boxes is practised, but to no purpose.
- In spite of these expedients the damage done is very great.

Paragraph Nos. 27 to 35 are common to all the districts.

27. The cultivation of cane is not only expensive but is considered to be most risky due to various diseases.
28. Diseases affecting sets—
White ants destroy them and jackals eat them up.
29. Diseases affecting the whole plant—
Kasdo—the growth is arrested and the cane turned into a tuft of leaves. This is rare and occurs in poorly manured fields of low class cultivators.
Koylo—This is a fungus disease, as a result of which the top turns into a black powdery mass.
Ratdo—Red rust.
Borer.
30. Diseases affecting the underground parts—
A large white little grub over an inch in length and with an orange red colour.
White ants.
Root parasite—called *agio*.
31. Diseases affecting the stem—
Mealy bugs.
32. Diseases affecting the leaves—
Weavils, flea beetles, some caterpillars and scale insects (*mashis*), the last being the most important.
33. *Harvesting*.—When the rind gets yellowish and the top leaves concentrated and tufted the cane is considered to be ripe for cutting.
34. Cut and striped canes are not allowed to remain uncrushed for more than a few hours, and people know that the juice becomes acrid if cut cane is kept uncrushed for a longer period.
35. The cane is cut very low, a little below the ground, with a hand *khurpi*, the roots, leaves and tops being removed at the same time.
36. The yield of cane is from 40,000 to 60,000 lbs. and of jaggery is from 5,000 to 7,000 lbs.

Manufacture.

37. *Mills*.—In Baroda two roller wooden mills are used. The rollers are over a foot in diameter and have corresponding screws in the top part for motion. In Nacsari wooden rollers are being gradually replaced by three roller iron mills of Poona type, the rollers being placed side by side. The cane is fed between rollers 1 and 2 from one side and fed for repressing between 2 and 3 from the other side. In Amreli two roller wooden mills are used but the rollers are thinner and larger than the Baroda rollers and there is a greater space between the rollers necessitating repressing a greater number of times.

The percentage of juice to cane varies so much between cane and cane and also among the roller mills of the same type that no general average can be given.

The juice is collected in a large round earthen pot wider at the top than the bottom. This pot is sunk in the ground near the mill in Baroda and Amreli and beyond the bullock run in Naosari. The juice passes through a bamboo sieve into this pot. The pot is big enough to hold juice for one charge of the boiling pan which averages 50 to 60 gallons.

The juice is not kept standing for any length of time, but removed to the boiling pan by *chattis*. The removal of juice gives time for changing bullocks and rest to the workers at the mill and after a little more rest the crushing begins again. Crushing cane for one charge takes a little less time than boiling and the work is continuous. The juice is poured into the iron pan through a basket which serves the purpose of straining.

The boiling pans are shallow, evaporating pans about 7 inches deep in Baroda and Amreli and a little deeper in Naosari.

Megass is used everywhere for fuel but it is not quite enough and it has to be supplemented by tamarind twigs and *tur* stalks in Baroda and by thick *Jowar* stalks in Amreli and Naosari.

The juice is not allowed to boil till the scum comes up. The scum is then removed and the fire increased. During boiling also any little scum that may come up is removed. In Baroda the scum is thrown into the oven. In Naosari it was formerly used in making spirit for the labourers, but is now thrown away as spirit making is now illegal, while in Amreli it forms part of bullocks' feed. Fine white ash is used for cleaning the juice in Baroda and ash and Soda-bicarbonate are used in Naosari and Amreli. Liming is not done in any part.

The correct point for striking a pan is determined by taking a little of the mass between fingers and drawing out the threads. Cooling iron pans are used in all places. The boiling mass is removed to these pans and worked for a time with flat wooden ladles till it is sufficiently cool and consolidated. In Baroda round pits are made in the ground each large enough to hold the full charge of a pan. The pit is lined by a piece of cloth and the mass thrown in and covered over. The jaggery settles hard in a day and is removed. The weight varies with the quality of the cane and juice from 60 to 100 lbs.

In Amreli the boiling is a little harder than in Baroda and the mass is removed from the cooling pan on to a *leaped* floor and divided into small masses of about 6 to 10 lbs. each, and worked into shape by hand. In Naosari, the pan is struck a little softer and after working in the cooling pan the jaggery is poured into earthen pots which are covered over and sealed.

These are the forms in which the jaggery is put on the market. In Baroda and Amreli, it is sold by weight of jaggery while in Naosari by weight of the full pot, and a fixed deduction is made on account of the pot. On account of this system, pots are being manufactured with a very heavy bottom.

No process of preservation is either used or necessary as the jaggery in these forms can be kept without deterioration.

The prices realised by the cultivator vary from Rs. 7 to 10 per pucca maund in Baroda, Rs. 6 to 9 in Amreli, and Rs. 4 to 5 with pots in Naosari, one-sixth being deducted for the pot while it may actually weigh into a third.

The markets being usually fully stocked according to requirements, there are no heavy fluctuations in bazar prices.

In Baroda, local jaggery is the heaviest priced lot; it is not enough to meet the demand and jaggery is imported from Naosari, Poona, Sangali and Cawnpore.

In Amreli also the local demand is higher than the supply and jaggery is imported from Naosari and Cawnpore.

Naosari exports jaggery to Gujarat and Kathiawar and even to Bombay in addition to supplying local demand.

The pots for export are weighed by professional weighers and the weight scratched on the pots by nails. This weight is accepted wherever the jaggery goes and whole pots change hands.

33. The following is the profit and loss account on sugar-cane cultivation:—

Expenditure per Bingha.

	Rs.	As.	P.
20 ploughings, a pair of bullocks and one ploughman, one rupee per day	20	0	0
10 <i>Karabing</i>	10	0	0
Manure-cartage and spreading 15 tons	22	8	0
Ridging, making water channels, beds, &c., one bullock and six men at 4 annas each	2	0	0
Castor cake, 1,200lbs.	15	0	0
Value of sets	30	0	0
Carrying sets and planting them, 4 bullocks per 6 annas and 6 men per 4 annas each	3	0	0
Hand weeding 6 times, 10 labourers each time at 2½ annas each	9	6	0
Digging 4 times, 4 men each time at 4 annas each	4	0	0
Putting castor cake plant by plant 2 times, 2 men at 4 annas each	1	0	0
Making new furrows and ridges once, 3 men at 4 annas each	0	12	0
Tying canes once	2	0	0
For crushing and cutting canes, 13 men at 4 annas each and 6 pairs of bullocks at 8 annas a pair for 15 days	93	12	0
Hire of cane-crushing mill and pans	7	8	0
Fuel	10	0	0
Irrigation from wells for 6 to 7 months when there is no rain, four waterings each month, five men and four bullocks	70	0	0
TOTAL	300	14	0

So there is expenditure of nearly Rs. 300 per bingha and Rs. 525 per acre. We get from 150 to 175 maunds of *gur* (maund=40 lbs.) per acre and one maund fetches Rs. 4 to 5, consequently the income from one acre is from Rs. 600 to 900.

39. No careful analysis has been made of the canes and juice but the variation in the quality of the juice can be gauged to some extent by the pan results in Baroda, where the same volume of juice, *viz.*, 55 gallons from the same variety of cane gives in different fields and even in different parts of the same field, *gur* varying from 60 to 100 lbs.

40. *Sugar-making*.—No native process of manufacturing is in vogue in any part of the State. The central factory system was introduced in Gundevi in the Naosari District by the State, where cane was brought from the cultivators and sugar made direct. This however did not pay and refining of palm jaggery had been added. The factory has recently been sold and it is being re-arranged for working sugar-cane in the season and refining palm jaggery throughout the year. The failure of coarse jaggery to compete with palm jaggery for refining purposes is probably due more to its first cost than a smaller percentage of crystallizable sugar. Palm jaggery can be brought from all the way from Malbar and carried in the factory at Rs. 100 per ton against Rs. 120 to 150 per ton, the price of local jaggery.

Imported sugar.—Three kinds of sugar are imported, beet, Mauritius and Java cane, and Bengal dabhota (*khand*). The first which is cheapest is used for all general purposes, the second for sweets in which milk forms a part, and the last which is the dearest is used for sweet balls at large caste dinners. All crystal sugar is locally called *Morus* (Mauritius) and although it is believed to be not so sweet as dabhota or jaggery it is slowly gaining ground on account of its cheapness.

Improvements.

Direction of improvements.

Manuring.—Some cheaper manuring that would give an equal effect and release the local manure for other crops.

Irrigation.—This forms the largest part of the improvement in sugar-cane cultivation.

Seed.—In the Baroda District seed difficulty is great and some system of preserving cut seed for two months without deterioration will not only save the cost of seed but also check a great lot of diseases which come with the sets.

RAOJIBHAI B. PATEL, M.B.A.O.,

—*Director of Agriculture.*

APPENDIX I.

PAPERS ON VETERINARY MATTERS.

SUMMARY OF OPINIONS RECEIVED FROM VARIOUS OFFICERS.

Curtailment of grazing grounds.

Lieutenant-Colonel Raymond says :—

I have consulted the District Officers of Bengal and their reports go to show that the curtailment of grazing lands has taken place, more or less, in almost all the districts of this Province. This is attributed chiefly to the extension of cultivation due to the gradual increase of population and partly to other minor causes—such as construction of railways and dwelling-houses, encroachment of lands by mill-owners and brick-manufacturers, etc. Some District Officers report that the curtailment of grazing lands has caused deterioration of the cattle, while others report that, although a certain amount of grazing lands has been utilised for other purposes, there is still sufficient waste land for grazing purposes. In some districts sufficient pasture lands have been set apart during the settlement operations and protected by law against encroachment, while in others they are not diminishing owing to the gradual decrease in population of recent years, and are not likely to diminish much in extent in the immediate future. Little or no land has been absorbed by the extension of irrigation work. The Conservator of Forests, Bengal, reports that there has been practically no change in grazing arrangements in the Bengal forests for over 20 years, and there is nothing to show that the forests which are now closed to grazing were ever largely used for that purpose, or that their closure has affected one way or another the breeding of cattle. The Deputy Commissioner of Darjeeling, on the other hand, contradicts this statement by saying that his district appears to be eminently fitted to illustrate in a striking manner the gradual tendency of the Forest Department to bring, within its reserve, lands which hitherto afforded sufficient space for cattle to graze on.

None of the District Officers have been able to state definitely to what extent the grazing lands have been curtailed during the last 20 years and what encroachment is likely to take place in future. It is, however, apparent that there is a general tendency towards the encroachment of grazing lands and it is probable that it will continue if steps are not taken to check it.

The measures suggested by the District Officers for the preservation or extension of grazing lands are—

- (i) The reservation of existing grazing lands by legislation.
- (ii) Owners to be prohibited from leasing out their grazing lands to the tenants for crops.
- (iii) The zamindars and land-holders to see that a fair share of their land is always preserved for grazing purposes.
- (iv) The existing grazing lands should be demarcated and the Local Officers should be directed to report further encroachment, which must be disallowed. Also a register of existing grazing lands might be maintained in the district and sub-divisional offices.
- (v) The preservation of lands for pasturage may be effected through the agency of the new Chaukidari Union System by reserving lands for a convenient group of villages, if Government gives the power to do so by some legal enactment.
- (vi) Reafforestation by the Forest Department.

My own opinion is (Lieutenant Colonel Raymond's):—

That encroachment in Bengal of grazing land proceeds steadily owing mainly to an equally steady increase of population and to the demands of commerce; the absorption of grazing land is inevitable, but may be regulated,

retarded and controlled by carefully considered legislation. If, however, the population continues to increase, grazing, except on a small scale and on fallow land between crops, is doomed, for it must give way ultimately to land hunger.

There is yet time to work out remedies and I think they will be found in the study by the Agricultural Societies of forage crops and the simplest method of storage of forage. I am inclined to suggest that these subjects as well as the further consideration of legislation are perhaps ripe for systematic study in Bengal.

The subject of water-supply in very dry seasons appears to be an important one.

United Provinces. For the purpose of this enquiry the provinces fall into three divisions, the submontane districts, Bundelkhand, and the rest.

In Bundelkhand, cultivation has contracted during the last 20 years, while the grazing-grounds of the breeding-tracts consist either of ravine-systems (which tend naturally to extend), or of hill sides and valleys which are not suitable for cultivation. There is therefore no question as regards this tract.

The rest of the provinces show no extension of cultivation during the last 20 years. There was not then, and there is not now, any breeding industry in them. People who can afford it keep cows for milk and the male progeny is reared for field-work; but the extraordinary diversity of the type of cows renders it practically impossible to do anything to help this form of breeding. In this tract there are, with local exceptions, no regular grazing-grounds; the extensive barren plains are used as exercise-grounds, but by December any grass that may have grown is usually grazed off, and for six or seven months they afford no feed at all.

In the remaining tract (submontane), considerable curtailment of the grazing-grounds is undoubtedly in progress. It is not due to canals, as none exist, while the additions to forest area during the period specified are immaterial. It is the normal result of the progress of the country; the land is almost entirely in private hands and its owners find that cultivation pays better than grazing.

The question of securing sufficient grazing land to save the great breeding industry in these tracts has at my instance been referred to a small committee for enquiry during the present cold weather. Pending their report, it is unnecessary to say anything further on this point.

Mr. Oliver, Officiating Superintendent, Civil Veterinary Department, submits a detailed report on this subject as affecting each important district. From which it will be observed that of 38 districts reported on, it is said that although the cultivated area has increased, no noticeable decrease of grazing grounds has taken place in 22 districts, nor are the cattle reported to have suffered.

But in the remaining 16 districts, the reduction in the area of pasturage has told severely on the cattle.

Bombay
Presidency.

Mr. Hewlett, Superintendent, Civil Veterinary Department, Bombay, states that as regards grazing grounds the conditions of the Presidency vary in different parts. In Gujrat there is no flow irrigation and no lands reserved by the Forest Department other than genuine forest areas—the Godhra forests, for instance. Grazing grounds are, at present, adequate in the Ahmedabad district—as well as in the districts of Broach and Surat. In the Konkan, including Thana, Kolaba and Ratnagiri, there has been no curtailment of grazing grounds, which is amply sufficient. In the Karnatak, Belgaum, Bijapur, Dharwar and Kanara districts some diminution has taken place in the last 20 years by waste lands—formerly used for grazing—having been brought under cultivation. In the Deccan there is but little grazing. The majority of land is under cultivation and affords very little grazing of any description after the middle of November. In parts of Khandesh there is still ample grazing as also in the vicinity of the Ghats. In Nasik, the grazing area has diminished and is likely to diminish still more, in the future owing to keen competition for waste lands for cultivation purposes. In Ahmednagar, Poona, Sholapur and Satara there has been little or no diminution of grazing grounds.

Is of opinion that the Forest Department is in the best position to arrange for the conservation of grazing areas, by preserving their Kurans and forests, as far as possible, for grazing purposes, and not with the object of attempting to grow forests where none have existed and where the more valuable varieties of timber cannot be grown. Some of the grazing grounds belonging to the Forest Department are sold, for grazing purposes, by public auction. Mr. Hewlett thinks that, if possible, this system should be discontinued as it introduces the middleman. Suggests that either the Forest Department collect grazing fees of 2 to 4 annas from cattle owners, or, if this is not practicable, to give the villagers of the villages adjoining the Kurans, &c., preference at the auction sales.

Mr. Hewlett is of opinion that except a few favourable localities, the majority of districts in the Bombay Presidency are not specially suited for cattle breeding.

In Sind, large areas of land have been, are being, and will be brought under flow irrigation; but as these areas were, more or less, waterless deserts, their being brought under the plough will not effect pasturage for cattle. Reservation by the Forest Department has not caused diminution of grazing grounds as the Forest areas are available for grazing on payment of a small fee.

Sind, Baluchistan
and Rajputana.

Fodder crops are the main feeding stuffs of Sind cattle; therefore increased irrigation and consequent increased yield of fodder crops makes up amply for any diminution of grazing areas.

In Baluchistan there are 234 square miles of reserved forests, of which 69 square miles are available for grazing. In some districts, the diminution of grazing grounds is severely felt by the people, especially in the Quetta District.

In Ajmer-Merwara, (Rajputana) grazing grounds are stated to be sufficient if the rains are good. There has been no increase of forest reserve for the last 20 years, and no encroachment on grazing grounds by cultivation.

Mr. Hewlett states he is not sufficiently acquainted with the districts to warrant his offering an opinion or making any suggestions.

The Collector of Sukkur (Sind) informs Mr. Hewlett that the want of suitable grazing grounds is leading to a deterioration in the stamp of camels bred in Sind. Increased irrigation has brought under cultivation much land that was formerly waste and on which any number of camels could graze without restriction.

Captain Walker submits copies of correspondence with the Director of Land Records and Agriculture, and the Conservator of Forests, and states that the curtailment of grazing grounds during the last 20 years has been great; but has been counterbalanced to some slight extent, by the extension of forests. Recommends for each group of villages, a certain forest reserve, and the grazing rights of these areas to be held by the villages concerned under the usual payment of fees.

Punjab.

From Major Evans' report as well as from its enclosures, it appears that there is no curtailment of grazing grounds in Burma. Necessary grazing grounds have been provided and demarcated and the boundaries, from time to time, are verified. Persons found encroaching are prosecuted and ejected.

Burma.

THE PROVISION OF FODDER IN TIMES OF FAMINES.

Lieutenant-Colonel Raymond says:—

Fodder-famine is of rare occurrence in this province. As far as I can see from the Famine Reports of 1873-74, 1896 and 1897, there was never any great difficulty about fodder, as there was enough to feed the cattle with a reduced allowance. The proposals for the provision of fodder, in times of famine, laid down in Chapter XV of the Bengal Famine Code, appear to be sufficient (copy below). The storage of forage in years of bumper crops would, no doubt, render great help in times of famine.

Bengal.

251. *General.*—It may be noted, as a matter of general experience, that, where possible, it is far more effective to bring fodder to cattle than to take cattle to fodder, and that to keep cattle in a village helps to keep the inhabitants of the village together.

252. *Growth of fodder crops.*—When, therefore, fodder-famine is imminent, liberal advances should be given to the cultivators, with a view to the construction of temporary wells for the growth of fodder crops. The influence of land-owners and others may also be usefully employed, with the object of stimulating the growth of such crops.

253. *Importation of fodder.*—The importation of fodder and other food-stuffs, such as cake, shall be left mainly to private enterprise; but the District Officer shall—

- (a) assist private enterprise by publishing the fact that fodder is wanted in any tract;
- (b) give liberal advances for the purchase of fodder; and
- (c) report to the Local Government for orders any case in which he thinks the State should guarantee the sale of fodder imported.

254. *Report to Local Government.*—When a fodder-famine is imminent in any district, the District Officer shall report the matter, through the Commissioner, to the Local Government, which may, if it thinks that this course is desirable, order that the provisions of the four following sections of this chapter shall be applied.

255. *Levy of fees for grazing in State pasturages.*—In a fodder-famine the preservation of agricultural cattle is a matter of far greater importance than any revenue which might be obtained from grazing fees levied on account of the admission of cattle to State pasturages. If, therefore, such fees are levied at all, they should be imposed on administrative grounds, and not as a source of income.

256. *General principles.*—Areas in which grazing is ordinarily permitted should be thrown open to free grazing, and areas which are ordinarily closed to grazing should be reserved for the supply of grass for export. It may be necessary to supplement the latter by reserving portions of the former areas for grass-cutting; or it may be possible to throw open portions of the latter at once, when the supply is in excess of the demand for export. But, the needs of local cattle being provided for, the supply of grass for export should be the first consideration. When the grass has been cut from the areas thus reserved, they also may be thrown open to free grazing, if necessary. Browsers should not be admitted without payment to any areas which contain forest growth of any importance and should in no case be admitted to areas ordinarily closed to grazing. No grazing should ever be allowed in areas under plantation or regeneration, unless the trees are old enough to be safe from attack.

257. *Restrictions.*—If it is found that cattle are resorting to a State pasturage in numbers greatly exceeding its grazing capacity, it may become absolutely necessary to limit their number. This may be done by restricting admission to cattle of villages in the immediate vicinity of a forest, such villages having the first claims upon its pasture.

258. *Fees to be levied in special cases.*—The cattle of professional graziers and cattle-breeders may properly be charged for grazing, even when agricultural cattle are admitted free.

259. *Cattle Camps.*—When a fodder-famine is severe, a cattle camp may, with the previous sanction of the Local Government, be instituted in each district under veterinary supervision. Only selected cows and a few selected bulls shall be accommodated in the camps, the chief object of which is to preserve valuable breeds. The District Officer may, if he considers this desirable, purchase the cattle admitted to the camp, and at the end of the famine, re-sell them.

260. *Selection of pasturages.*—The Local Government shall, in communication with the Commissioner, the Director of Land Records and

Agriculture, and the Conservator of Forests, determine what areas of Government forest or waste land are, in accordance with the principles enunciated in section 256, available for pasturage in each district which is liable to famine, and what number of cattle can advantageously be admitted to such areas in the event of a fodder-famine. The list of such areas shall be revised annually in the month of January. The orders of Government shall be communicated to all officers concerned.

261. *Register of pasturages.*—From the information received under the previous section, the District Officer shall prepare and maintain a register in Form J showing—

- (a) the pasturages available; and
- (b) the number of cattle that may be sent to them.

FORM J.

Register of pasturages and cattle in the District for 190

1	2	3
Description and general indication of boundaries of pasturages available.	Number of cattle that may be sent from the district to the pasturages.	REMARKS.

The Director of Land Records and Agriculture states :—

The call made for suggestions on this grave question has had very little result; the suggestions that have reached me are either not new or are obviously impracticable. United Provinces.

A fodder-famine is much rarer in these provinces than an ordinary famine and cannot be expected more than once in 30 years. It would obviously be bad economy to devote cultivated land to meet this emergency as the loss would be greater than the capital value of the stock saved; and apart from this there is no chance of our landholders doing anything of the kind. Something can be done in particular villages if it is found practicable to turn the bare ravines into rough grazing, but this would have a very local effect. Our experience is that fodder-famines are least felt where the practice of stall-feeding is most developed; and all indications point to the conclusion that the best measure to take is the extension of irrigation, which not only minimises the loss of fodder in a drought, but enables special fodder crops to be grown and—more important still—increases the wealth of the people.

As regards utilization of forests, there are certain well-known regions of migration, where the cattle are transferred seasonally according to need. These should of course not be interfered with, but apart from them all recent experience goes to prove that the forest grass should be railed to the cattle—except only in the case (very rare in these provinces) where water is available in the forest and not available in the famine-tract. The Conservator of Forests is at present working out for use in emergencies a table showing the price at which grass can be laid down at each important railway station in the tracts liable to fodder-famine; and this step might possibly be found useful elsewhere.

The large question of storing grass in the forests for, say, a year ahead is one on which I cannot enter for want of data regarding the cost involved and the annual loss in good years. I hope it may be possible to get the Forest Department to experiment on this question on an adequate scale, but I fear that where fodder-famines are as rare as they are with us the process on a large scale would be very costly.

Speaking generally then, the best safeguard in these provinces is the increase of wealth of the cultivators, which extends the local resources; to supplement these, the forests must be utilized to the utmost.

In these provinces, the Civil Officers whose opinions and suggestions were asked by the Superintendent, Civil Veterinary Department, have submitted various proposals for the provision of fodder during famine, viz. :—

- (a) Opening of closed forests for free grazing.
- (b) Storage of a year's produce to meet demands in a year of drought.
- (c) Waste land within reach of Canal Water to be reserved for growing grass and be watered free of cost.
- (d) Minimum area of land be left uncultivated in each village and be planted with such trees, the leaves of which can be used as fodder for cattle.
- (e) Sale of grass on Government lands, or on lands in possession of District Municipal Boards, to cattle owners.
- (f) Cutting and stacking hay at close of rains.
- (g) Railways to carry fodder at rates sufficient to cover cost of haulage.
- (h) Establishment of fodder reserves by Government and big Zemindars.
- (i) Takavi advances to cattle owners to purchase grass.
- (j) Government to purchase cattle, transport them to the forests, and re-sell at the end of famine to the districts from which they were exported.

Bombay Presidency. Mr. Hewlett says he does not think he can give any information or can arrive at any conclusion which is not contained in the Report of the Famine Commission of 1901. The question of the classes of cattle worth preserving in famine camps and supplying them with fodder, are :—Gujarat—Krishna Valley—Kharali—Gir—and the Malvi breeds—also the Jafferabadi and Surati breeds of buffaloes.

Sind, Baluchistan and Rajputana. Mr. Hewlett refers us again to the Report of the Famine Commission of 1901.

Punjab. Captain Walker recommends the establishment of fodder reserves by the Agricultural and Forest Departments. The scheme to be run on commercial principles. Fodder to be supplied on the spot at a moderate price.

Burma. Major Evans states that the trouble in Burma, usually, is excess of water—floods, &c.

Many cattle die from starvation during the rains when the high floods occur, owing to all grazing land having been suddenly submerged. He thinks that the cattle might well have been saved had the people been less indolent, as there was no lack of such fodder as young Kaing-grass and Bamboo leaves, which, in default of better, could have been stored against such a possible contingency.

Should famine occur, forest reserves would be thrown open for grazing. When fodder is short, cattle appear to eat all sorts of bushes. Suggests the planting up of dry areas with fodder bushes that grow in other arid, hot countries.

THE BEST METHODS OF UTILIZING THE SERVICES OF VETERINARY ASSISTANTS, *i.e.*, BY STATIONARY WORK IN DISPENSARIES, BY ITINERATING WORK IN VILLAGES.

Bengal. Lieutenant-Colonel Raymond's opinion :—

Though itinerating work is the better at present, the services of both itinerant and stationary Veterinary Assistants are essential. The establishment of dispensaries at the district and sub-divisional head-quarters is very necessary, inasmuch as most of the well-to-do people reside there, and they keep valuable animals, which, when sick, require treatment. With regard to the treatment of village cattle, the services of peripatetic Veterinary Assistants are important. They tour in the villages, advising the villagers how to look after the health of their animals and treating and inoculating the cattle during outbreaks of epizootic diseases. Itinerating men in large outbreaks require assistance from a reserve kept at head-quarters for that purpose. They also require constant supervision.

I am in favour of both systems: they have their advantages and will develop.

On this point Major Maxwell writes as follows :—

" I have for some time been of opinion that the best way to get the most satisfactory work out of all Veterinary Assistants would be to have a dispensary in every district, with all Veterinary Assistants of that district attached to it. Only one man to remain at head-quarters at a time, then the dispensary would never be closed, and a man (or men) would always be moving about as Sanitary Officer in their districts. The men could advise as to treatment and get cases sent in to the dispensary. Under the present system there is a great waste of money in supplying two or three sets of instruments and large quantities of medicines for one district, for, as you know, if there were 20 Veterinary Assistants in one district they would all want to have exactly the same things to work with; if one man has a paper of pins all the others will immediately indent. Of course I am aware that at present there are only a few dispensaries in working order, but I would recommend a trial of this system where they do exist. I think it could be so organized that we might find out more as to the individual value of our men as they would all have a turn at both medical and sanitary work, and would not get into such grooves as they now do."

The Director of Land Records and Agriculture states :—

" I have not heard of this suggestion before; it seems to me to be well suited to all districts containing three or more Veterinary Assistants, and I commend it as deserving of full consideration. But for the present, when most of our districts have either one or two Veterinary Assistants, its defect is that it would (by retaining one man at the dispensary) weaken the very small force available for fighting epidemics. In these provinces (outside the localised breeding-tracts) the employment of Veterinary Assistants can be justified only by their success as Sanitary Officers, and so long as not more than two men are available in a district, I consider that to fulfil their chief duty they must both be peripatetic. Experience shows that a dispensary which is liable to be closed at irregular times is of very little use, as persons who come and find it closed give it a bad name among their neighbours; and I would avoid starting more dispensaries until it is certain that they can be kept open continuously without trenching on the staff required for handling epidemics."

Mr. Oliver, the Officiating Superintendent, Civil Veterinary Department, points out that, at present, the subordinate Veterinary staff is much below actual requirements; and that as it stands, it would be unwise to withdraw itinerating Veterinary Assistants and place them in charge of dispensaries; but is convinced that as the subordinate establishment is increased, it will be essentially necessary to augment the number of dispensaries in each district.

Mr. Hewlett is of opinion that in each district there should be one stationary man in charge of the Head-Quarter Veterinary Hospital. This man's services could also be utilized in visiting a few neighbouring villages within a radius of, say, 10 miles, and should also be available for emergent outbreaks of contagious disease.

Considers itinerating Veterinary Assistants very useful, if men of the right stamp are available and if they are not given too large an area to tour over. Does not think that such men can do any real good work if he is given a bigger charge than 2 Talukas.

Mr. Hewlett—the reporting officer—records precisely the same opinion as above under the head "Bombay Presidency."

Captain Walker sends a copy of a note he has prepared at the request of the Director of Agriculture. In this note Captain Walker explains at some length—the formation of the subordinate establishment—the present position—the disadvantages of the present system—&c., &c. Captain Walker is not in favour of itinerating Veterinary Assistants and gives preference to stationary men. Ample reasons and instances are quoted to warrant his arriving at the opinion expressed, and adds :—" Instead of having one stationary Veterinary Assistant at the head-quarters of the district, and one itinerating man in each Tehsil, it is proposed to have a stationary man in each Tehsil, and one itinerating man for the whole district." Full details are given as to the respective duties of the stationary and itinerating Veterinary Assistants.

United Provinces.

Bombay Presidency.

Sind, Baluchistan
and Rajputana.
Panjab.

In the note above alluded to, Captain Walker has embodied recommendations as to the best method of obtaining reports concerning outbreaks of contagious diseases, and the registration of the total mortality for the province. Forms of monthly returns and Post Card intimations are attached. Briefly the method recommended is:—

- (a) At the end of every month all Veterinary Assistants to send copies of their Diaries to the Tehsildar concerned who will forward them to Deputy Commissioners.
- (b) At the end of every month every Patwari to send a Return of epidemic disease among animals, to the Sudder Kanungo.—
- (c) The Sudder Kanungo to hand over the Returns to the itinerating Veterinary Assistant who will, after perusal, send them to the Superintendent, Civil Veterinary Department, through the Veterinary Inspector.

Burma-

Major Evans lays great stress on the necessity of Veterinary work in Burma being, in the first instance, directed towards the suppression of contagious diseases among cattle. He states that, in his opinion, Dispensary (stationary) Veterinary Assistants would only treat such cases as might be brought to them; they certainly would not seek for work. He further adds:—

“I personally would have every man I could on district work. I can see no real advantage to the bulk of cattle owners in maintaining Dispensary Assistants; in fact, I think it would be necessary for them to seek cases here (Burma) to make a decent show of cases treated.”

NOTE ON VETERINARY MATTERS, BY THE DIRECTOR OF LAND RECORDS AND AGRICULTURE, UNITED PROVINCES.

(a) CURTAILMENT OF GRAZING GROUNDS.

For the purpose of this enquiry the provinces fall into three divisions, the submontane districts, Bundelkhand and the rest.

In Bundelkhand cultivation has contracted during the last 20 years, while the grazing grounds of the breeding tracts consist either of ravine-systems (which tend naturally to extend) or of hillsides and valleys which are not suitable for cultivation. There is therefore no question as regards this tract.

The rest of the provinces show no extension of cultivation during the last 20 years. There was not then, and there is not now, any breeding industry in them. People who can afford it keep cows for milk, and the male progeny is reared for field work; but the extraordinary diversity of the type of cows renders it practically impossible to do anything to help this form of breeding. In this tract there are, with local exceptions, no regular grazing grounds; the extensive barren plains are used as exercise grounds, but by December any grass that may have grown is usually grazed off, and for six or seven months they afford no feed at all.

In the remaining tract (submontane), considerable curtailment of the grazing grounds is undoubtedly in progress. It is not due to canals, as none exist, while the additions to forest area during the period specified are immaterial. It is the normal result of the progress of the country; the land is almost entirely in private hands, and its owners find that cultivation pays better than grazing. The question of securing sufficient grazing land to save the great breeding industry in these tracts has at my instance been referred to a small committee for enquiry during the present cold weather. Pending their report, it is unnecessary to say anything further on this point.

(b) EMPLOYMENT OF VETERINARY ASSISTANTS.

On this point Major Maxwell writes as follows:—

“I have for some time been of opinion that the best way to get the most satisfactory work out of all Veterinary Assistants would be to have a dispensary in every district, with all Veterinary Assistants of that district attached to it. Only one man to remain at head-quarters at a time, then the dispensary would never be closed, and a man (or men) would always be moving about as sanitary officers in their districts. The men could advise as to treatment and get cases

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I have not heard of this suggestion before; it seems to me to be well suited to all districts containing three or more Veterinary Assistants, and I commend it as deserving of full consideration. But for the present, where most of our districts have either one or two Veterinary Assistants, its defect is that it would (by retaining one man at the dispensary) weaken the very small force available for fighting epidemics. In these provinces (outside the localized breeding-tracts) the employment of Veterinary Assistants can be justified only by their success as sanitary officers, and so long as not more than two men are available in a district I consider that to fulfil their chief duty they must both be peripatetic. Experience shows that a dispensary which is liable to be closed at irregular times is of very little use, as persons who come and find it closed give it a bad name among their neighbours; and I would avoid starting more dispensaries until it is certain that they can be kept open continuously without trenching on the staff required for handling epidemics.

(c) PROVISION OF FODDER IN FAMINE.

The call made for suggestions on the grave question has had very little result: the suggestions that have reached me are either not new or are obviously impracticable. A fodder-famine is much rarer in these provinces than an ordinary famine and cannot be expected more than once in 30 years. It would obviously be bad economy to devote cultivated land to meet this emergency as the loss would be greater than the capital value of the stock saved; and apart from this there is no chance of our landholders doing anything of the kind. Something can be done in particular villages, if it is found practicable to turn the bare ravines into rough grazing, but this would have a very local effect. Our experience is that fodder-famines are least felt where the practice of stall-feeding is most developed: and all indications point to the conclusion that the best measure to take is the extension of irrigation, which not only minimises the loss of fodder in a drought, but enables special fodder crops to be grown and—more important still—increases the wealth of the people.

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The large question of storing grass in the forest for, say, a year ahead is one on which I cannot enter for want of data regarding the cost involved and the annual loss in good years. I hope it may be possible to get the Forest Department to experiment on this question on an adequate scale, but I fear that where fodder-famines are as rare as they are with us the process on a large scale would be very costly.

Speaking generally then, the best safeguard in these provinces is the increase of wealth of the cultivators, which extends the local resources; to supplement these, the forests must be utilized to the utmost.

APPENDIX J.

NOTE ON AGRICULTURAL ENGINEERS BY SIR EDWARD BUCK, K.C.S.I.,
LL.D.

Attached to my Report on the utilization of silt is a note by Professor Giglioli, Principal of the Agricultural School at the Milan University, in which it is explained that Germany was the first to train a corps of Agricultural Engineers, that France followed the example and that the agricultural leaders in Italy are anxious to do the same. The position in these countries was, as it is still in Italy, much the same as that which existed in India when I came to the North-West Provinces. All engineers in the districts as well as in special departments were under professional direction and control. A step in advance has since been made in placing district engineers under the control of local authorities, their duties being mainly concerned with communications, roads, bridges, &c. They have few functions which can be classed as agricultural.

The fact remains, however, that we have in India what they had not or have not in the European countries, an existing machinery. We have not, that is to say, to create a corps of agricultural engineers. We have only to train an existing corps of engineers (or perhaps I should say the recruits of the future for that corps), in agricultural engineering.

It will be asked what would be the duties of an agricultural engineer as distinct from those of an ordinary professional engineer. The answer does not seem to be difficult. One main duty would be in each district the promotion of irrigation other than canal irrigation, and the execution of works connected therewith. They would have the direction of boring operations; of well construction; of lifts and other irrigating machinery; of the construction of dams and bunds and so on. Another would be the control of surface drainage, with the objects detailed in my report, *viz.*, the utilization of silt and the prevention of erosion. A third duty would be the introduction and general supervision of new agricultural machinery. This would probably involve eventually the maintenance and supervision of district workshops. They could also study the needs of the agricultural population for wood, timber, iron and other material for the construction of agricultural implements, of houses, &c.—a question which does not appear to come, at present, within the scope of any other department. This duty would include the formation of plantations in co-operation with land-owners. An important duty would also be the maintenance and supervision of the working plan for famine relief which it may be hoped will become more and more agricultural in character and include such operations as the 'doctoring' of ravines; the trenching of fields; the construction of dams and bunds and of temporary wells. This principle is indeed followed in the United Provinces where a working plan for temporary wells is under preparation.

It may be conceived that, as time goes on, a working plan would be prepared for each district not merely in connection with famine relief, but also for the improvement of agricultural conditions in every direction in which engineering assistance is required. Such working plans would require the initial direction of professional engineers in co-operation with the agricultural department of the province. Executive operations of important character would of course also demand the general supervision and direction of professional engineers.

At present, in the north of India, the only class of engineers who are brought into direct contact with agricultural interests are those employed on canals. The ability with which our irrigation works have been constructed, developed, and maintained, has not been surpassed in any country in the world. But it is a question whether the absence of association of the professional engineer with those authorities who are more directly concerned with agricultural interests has not been the cause of occasional incompleteness in results.

The immediate question, *i.e.*, if it is desired to manufacture agricultural engineers, is how they are to be trained. In Italy the suggestion is engineering training first, agricultural education second. It is possible that in India the best course might be agriculture—engineering—agriculture. Boys could be selected from the agricultural school to be sent to the engineering college and return to study higher class agriculture and the practical application of engineering methods afterwards. I will not, however, offer further suggestions. It is essentially a question for discussion by the Board.

I may only add that if selections are to be made from our corps of agricultural recruits the prospects offered them in the engineering line should not be inferior to those open to them in the establishments of revenue administration.

E. C. BUCK.

PROCEEDINGS

OF THE

BOARD OF AGRICULTURE IN INDIA

HELD AT

PUSA

ON THE

17th February 1908, and following days

WITH APPENDICES



CALCUTTA
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No. C-1397, dated Camp Pusa, the 5th March 1908.

From—J. MOLLISON, Esqr, M R A C, Inspector General of Agriculture in India,
To—The Secretary to the Government of India, Department of Revenue and
Agriculture, Calcutta

I have the honour to submit the Proceedings of the 4th Meeting of the Board of Agriculture held at Pusa on the 17th February 1908 and subsequent days. These Proceedings have been recorded by Dr. Butler, who kindly agreed to again act this year as Secretary. The Proceedings have been approved by the Board.

Proceedings of the 4th Annual Meeting of the Board of Agriculture in India, held at Pusa on the 17th February 1908, and succeeding days.

LIST OF MEMBERS.

1. J. MOLLISON, M.R.A.C., *Inspector General of Agriculture in India, President of the Board.*
2. E. J. BUTLER, M.B., F.L.S., *Imperial Mycologist, Pusa, Secretary to the Board.*
3. B. COVENTRY, *Director, Agricultural Research Institute, and Principal of the Agricultural College, Pusa.*
4. J. W. LEATHER, Ph.D., F.I.C., F.C.S., *Imperial Agricultural Chemist, Pusa.*
5. H. M. LEFROY, M.A., F.E.S., F.Z.S., *Imperial Entomologist, Pusa.*
6. C. J. BERGTHEIL, *Imperial Bacteriologist, Pusa.*
7. E. SHEARER, M.A., B.Sc., *Imperial Agriculturist, Pusa.*
8. A. HOWARD, M.A., A.R.C.S., F.C.S., F.L.S., *Imperial Economic Botanist, Pusa.*
9. G. A. GAMMIE, F.L.S., *Imperial Cotton Specialist.*
10. F. M. HOWLETT, B.A., *Second Imperial Entomologist, Pusa.*
11. Captain A. T. GAGE, I.M.S., M.B., M.A., B.Sc., F.L.S., *Director of the Botanical Survey of India.*
12. FRED NOEL-PATON, *Director General of Commercial Intelligence.*
13. I. H. BURKILL, M.A., *Reporter on Economic Products to the Government of India.*
14. C. M. HUTCHINSON, B.A., *Scientific Officer to the Indian Tea Association.*
15. W. R. GOURLAY, I.C.S., *Director of Agriculture, Bengal.*
16. F. SMITH, B.Sc., *Deputy Director of Agriculture, Bengal.*
17. H. H. CORBIN, B.Sc., *Principal of the Agricultural College, Bengal.*
18. E. J. WOODHOUSE, B.A., *Economic Botanist, Bengal.*
19. C. SOMERS-TAYLOR, B.A., *Agricultural Chemist, Bengal.*
20. E. A. MOLONY, I.C.S., *Director of Agriculture, United Provinces of Agra and Oudh.*
21. J. HAYMAN, D.V.S., *Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
22. H. M. LEAKE, M.A., B.Sc., *Economic Botanist, United Provinces of Agra and Oudh.*
23. G. CLARKE, F.I.C., *Agricultural Chemist, United Provinces of Agra and Oudh.*
24. A. PARR, Ph.D., M.A., *Second Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
25. W. C. RENOUF, I.C.S., *Director of Agriculture, Punjab.*

26. S. MILLIGAN, M.A., B.Sc., *Deputy Director of Agriculture, Punjab.*
27. A. C. DOBBS, B.A., *Principal, Agricultural College, Punjab.*
28. D. MILNE, M.A., B.Sc., *Economic Botanist, Punjab.*
29. J. H. BARNES, B.Sc., A.I.C., F.C.S., *Agricultural Chemist, Punjab.*
30. H. H. MANN, D.Sc., *Principal, Agricultural College, Poona.*
31. J. B. KNIGHT, M.Sc., *Profes. or of Agriculture, Agricultural College, Poona.*
32. G. S. HENDERSON, N.D.A., N.D.D., *Second Deputy Director of Agriculture, Bombay.*
33. M. E. COUCHMAN, I.C.S., *Director of Agriculture, Madras.*
34. H. C. SAMPSON, B.Sc., F.H.A.S., F.B.S.E., *Deputy Director of Agriculture, Madras.*
35. C. J. W. SHEPPERSON, B.Sc., *Principal, Agricultural College, Madras.*
36. W. H. HARRISON, M.Sc., *Agricultural Chemist, Madras.*
37. RAO BAHADUR C. K. SUBBA RAO, B.A., *Acting Economic Botanist, Madras.*
38. F. G. SLY, I.C.S., *Director of Agriculture, Central Provinces.*
39. D. CLOUSTON, M.A., B.Sc., *Deputy Director of Agriculture, Central Provinces (South Circle).*
40. F. C. PLYMAN, A.C.G.I., *Agricultural Chemist, Central Provinces.*
41. G. EVANS, B.A., *Deputy Director of Agriculture, Central Provinces (North Circle).*
42. R. J. D. GRAHAM, M.A., B.Sc., *Economic Botanist, Central Provinces.*
43. S. G. HART, I.C.S., *Director of Agriculture, Eastern Bengal and Assam.*
44. RAI BAHADUR B. C. BASU, M.R.A.C., *Assistant Director of Agriculture, Eastern Bengal and Assam.*
45. A. A. MEGGITT, B.Sc., *Agricultural Chemist, Eastern Bengal and Assam.*
46. R. S. FINLOW, B.Sc., F. C. S., *Fibre Expert to the Government of Eastern Bengal and Assam.*
47. J. MACKENNA, I.C.S., *Director of Agriculture, Burma.*
48. A. MCKERRAL, M.A., B.Sc., *Deputy Director of Agriculture, Burma.*
49. L. C. COLEMAN, Ph.D., *Mycologist and Entomologist to the Government of Mysore.*
50. M. A. SITOLE, *Director of Agriculture and Industries, Baroda.*
51. L. C. SHARMA, M.R.A.C., P.A.S.I., *Bar-at-Law, Director of Agriculture, Kashmir.*

VISITORS.

52. H. E. ABBOTT, *Editor, Indian Fowl Fanciers', Gardeners' and Farmers' Gazette.*
53. A. G. BIET, B.Sc., *Supernumerary Agriculturist, Pusa.*
54. W. ROBERTS, B.Sc., *Supernumerary Agriculturist, Pusa.*
55. C. W. MASON, *Supernumerary Entomologist, Pusa.*
56. H. E. ANNETT, B.Sc., *Supernumerary Agricultural Chemist, Pusa.*
57. G. P. HECTOR, M.A., B.Sc., *Supernumerary Economic Botanist, Pusa.*
58. M. E. VANDERKERKHOVE, *Flax Expert to the Behar Planters' Association.*

FIRST DAY.

1. The President welcomed the members present at the 4th Meeting of the Board of Agriculture. He referred in an appreciative manner to the work done by Mr. Sly in organising the proceedings of previous meetings and to Dr. Butler's work in recording the proceedings. He suggested that some of the items put down for discussion on this occasion should be threshed out by Committees appointed to consider them before being discussed by the full Board. This

suggestion being adopted, the following Committees and terms of reference were decided upon.—

(A).—To consider and report on the future constitution of the Board of Agriculture.

Sub-Committee.—The President (Chairman), Mr. Noel-Paton, the Directors of Agriculture, Bengal, United Provinces, Punjab, Madras, Central Provinces, Burma and Eastern Bengal and Assam, Mr. Coventry, Dr. Butler, Mr. Gammie and Dr. Mann.

Terms of reference.—To consider carefully the suggestions† of the Government of India that the Board of Agriculture be reduced to 32 members as follows:—

†Revenue and Agriculture Department Circular No 23-23-24, dated the 15th August 1907, to all Local Governments

Imperial Officers.	Provincial Officers
Inspector General of Agriculture, President Inspector General, Civil Veterinary Department, Director, Botanical Survey of India. Director General of Commercial Intelligence, representing the Commerce and Industry Department	The Director of Agriculture and one Provincial Expert from each of the following Provinces to be selected by the Director.— Bombay Bengal Eastern Bengal and Assam. Madras Burma.
Director, Agricultural Research Institute, Pusa Imperial Agricultural Chemist.	Central Provinces. United Provinces. Punjab.
Imperial Mycologist	* A representative of the Provincial Biologists
Imperial Entomologist Imperial Agriculturist Imperial Economic Botanist	* A representative of the Provincial Chemists.
Imperial Bacteriologist	One member each of the Agricultural Depart- ments of Mysore, Baroda and Kashmir.

In addition to the members of the Board, the Government of India further trust that Local Governments will allow a certain number of their experts to be present as visitors, although they would not take part in the deliberations of the Board unless specially invited by the President to do so.

To consider whether the Chemical, Biological and Educational Sections of each Province should be more fully represented on the Board than above suggested.

To consider whether, in the event of expanding these suggestions, Provincial representation will not be fully secured by appointing the 8 Directors of Agriculture and 12 provincial experts, and whether the latter should be selected in consultation by the Directors themselves.

To make any other proposals on the subject.

(B).—To consider and report on the form of report of the Proceedings of the Board of Agriculture.

Sub-Committee.—Mr. MacKenna (Chairman), Mr. Renouf and Dr. Butler.

Terms of reference.—To consider the suggestions† of the Government of India that the arrangement now adopted for printing the Proceedings of the Board is not a convenient one and that the addition of an index would enhance their value for purposes of reference.

† Revenue and Agriculture Department letter No. 208-23-38, dated the 1st February 1908, to the Inspector General of Agriculture.

*These two members to be selected as follows.—Three days before the general meeting of the Board, the Biological Experts, Imperial and Provincial, that is, the Botanists, Entomologists, Mycologists and Bacteriologists should hold a meeting for the discussion of matters specially affecting their branches of research and should arrive at their own conclusions on such matters, to be placed before the general meeting of the Board. The Provincial Biological experts should select one of their number to be their representative on the Board. Similarly the Imperial and Provincial Chemists would hold a separate meeting three days before the general meeting of the Board, would draw up their conclusions on chemical matters, and appoint a Provincial Chemist to be a member of the Board.

To consider whether such voluminous appendices as were published in the report of the Proceedings of the 3rd Meeting of 1907, should not be excluded from the report and otherwise dealt with.

To give an opinion regarding the best means of publishing notes like those submitted by Mr. Clouston on "Sann hemp, Agave and Ambari as Fibre crops in the Central Provinces and Berar" and "the Introduction of Improvements into Indian Agriculture," and whether these notes are not more suitable for the Agricultural Journal than for the report of the Proceedings of the Board of Agriculture.

(C).—To consider and report on the programme of work of the Imperial Agriculturist and how the other experts of the Imperial Department should collaborate in this work.

Sub-Committee.—The President (Chairman), Messrs. Sly, Coventry, Couchman, Dr. Leather, Mr. Lefroy, Dr. Mann, Messrs. Shearer, Bergtheil, Sampson and Milne.

Terms of reference.—To consider and report how far the permanent experiments proposed for Pusa are likely to give work-a-day results which will have general practical application in Indian Agriculture and also the important directions in which the work of the Pusa Experts should be collaborated in relation to these experiments.

(D).—To consider and report on the best methods of bringing experimental work of proved value to the notice of cultivators.

Sub-Committee.—Mr. Sly (Chairman), Mr. Gourlay, Dr. Mann, Messrs. Hayman, Clouston, Knight and Subba Rao.

Terms of reference.—In addition to recommending methods, specific instances of agricultural improvements which have been introduced by Agricultural Departments should be given with details.

(E).—To consider and report on the cultivation in India of fibre plants and the probable effect of extending such cultivation on the material prosperity of the country.

Sub-Committee.—Messrs. Gammie (Chairman), Burkill, Finlow, Clouston and Subba Rao.

Terms of reference.—To consider and report in concise form all that is generally known on this subject in each province in which important fibre crops are now grown.

(F).—To consider and report on the scope of Poultry breeding in India.

Sub-Committee.—The President (Chairman), Messrs. Abbott, Shearer and Evans.

Terms of reference.—To consider the following request* of the Government of India in forwarding a letter (Appendix E) from Mr. H. Abbott on this question :—
"The Government of India are inclined to think that something might be done by the Agricultural Department to improve the breed of poultry in India, but before making any definite suggestions to Local Governments on the subject, they would be glad of the advice of the Board of Agriculture and I am to request that the subject may be considered at the next meeting of the Board."

(G).—To consider and report on the Syllabus of studies in the Pusa and in Provincial Colleges.

Sub-Committee.—Mr. Renouf (Chairman), Dr. Mann, Dr. Leather, Mr. Dobbs, Dr. Butler, Messrs. Evans, Gammie, Clarke, Barnes, Knight, Sampson, Meggitt, Howlett, Shepperson, Plyman and Leake.

Terms of reference. (a) To make recommendations as to what class of instruction, given at Pusa, will be of the most advantage to the Provinces, and submit a suitable syllabus.

(b) Whether an advantage will lie in the appointment of a permanent committee of officers from the Provinces to co-operate with the Pusa staff in regulating the courses of instruction at Pusa, so as to secure the requirements of the Provinces.

(c) To report if any alteration is needed in the standard curriculum for Provincial Colleges as drafted in the Board's Proceedings for 1906 and, if so, to submit a revised curriculum.

(H). -To consider and report on the Agricultural Chemistry Section of the Programme of the Imperial Department of Agriculture for 1908-09.

Sub-Committee—Mr. Sly (Chairman), Mr. Coventry, Dr. Leather, Mr. Bergethell, Dr. Mann, Messrs. Barnes, Hutchinson, Harrison, Clarke and Molony.

Terms of reference.—To suggest whether any modification in the Programme of the Agricultural Chemistry Section of Pusa is necessary.

SECOND, THIRD AND FOURTH DAYS.

These days were occupied in the deliberations of the Sub-Committees appointed on the first day.

FIFTH DAY.

CONFIRMATION OF THE PROCEEDINGS OF THE LAST MEETING.

2. The minutes of the Proceedings of the last annual meeting of the Board of Agriculture held at Cawnpore on the 18th of February 1907, and following days were confirmed.

A note was presented by the President showing the action taken on the recommendations of the last Board.

THE FUTURE CONSTITUTION OF THE BOARD OF AGRICULTURE.

3. The report of Sub-Committee (A) on the future constitution of the Board of Agriculture was considered.

Mr. Smith advocated the holding of an informal conference of all members of the Agricultural Departments in India and the limiting of the official Board to 10 members, composed as follows :—The Inspector-General of Agriculture (President), one representative of each Province, and the Director of the Imperial Institute. If necessary, one representative each of the Chambers of Commerce, the Zemindari interest, and the Planting industry might be added. Mr. Milligan held that it will be impossible to criticise the Provincial programmes if the men specifically responsible for the work be not present at the meeting. Mr. Hayman suggested that the expert mentioned in item 13 should be selected at a meeting of the whole of the staff in each Province with the Director as Chairman. Messrs. Hayman, Milligan and Knight considered that the Provincial Deputy Directors of Agriculture are not sufficiently represented in the proposed constitution. Mr. MacKenna pointed out that, ordinarily, the expert selected by each Director of Agriculture under item 13 would belong to this class. The President also explained that the six nominations suggested in item 15 are intended to secure additional representation in regard to specific subjects set down for discussion in any particular year; and that Deputy Directors are likely to be included in these.

The Board adopts the report of Sub-Committee (A) as follows :—

4. The Sub-Committee recommends that the Board of Agriculture be constituted as follows :—

Imperial Members—

1. The Inspector General of Agriculture (President)	..	..	1
2. The Director, Agricultural Research Institute, Pusa	..	..	1
3. The Imperial Agricultural Chemist	..	..	1
4. The Imperial Mycologist	..	..	1
5. The Imperial Entomologist	..	..	1
6. The Imperial Bacteriologist	..	..	1
7. The Imperial Agriculturist	..	..	1
8. The Imperial Economic Botanist	..	..	1
9. The Imperial Cotton Specialist	..	..	1
10. The Director General of Commercial Intelligence, representing the Department of Commerce and Industry	..	..	1
11. The Reporter on Economic Products or an Economic Botanist from the Botanical Survey of India	..	..	1

Total Imperial Members .. 11

Provincial and Non-Official Members—

12. The Directors of Provincial Departments of Agriculture	8
13. One member from the Expert Staff of each Provincial Department of Agriculture to be nominated by the Provincial Director from any section of his staff	8
*14. Provincial Deputy Director of Agriculture	1
Provincial Agricultural Chemist	1
Provincial Botanist	1
Provincial Principal of an Agricultural College	1
	4
15. Members to be nominated each year by the President	6
16. One representative of the Agricultural Departments of Native States to be nominated each year by the President	1
Total Provincial and Non-official Members	27
	Grand Total .. 38

*The four officers under No. 14 to be elected by all the Provincial representatives of each section by correspondence before the nomination of the members in the item No. 13

The Sub-Committee further recommends that when the meeting is held at Pusa (i.e., in each alternate year) all members of the Agricultural Departments in India, including Native States which have an organised Agricultural Department, be invited to attend, not as members of the Board but as visitors.

THE FORM OF REPORT OF THE PROCEEDINGS OF THE BOARD OF AGRICULTURE.

5. The Board adopts the report of Sub-Committee (B) on the form of report of the Proceedings of the Board of Agriculture as follows:—

(1) The Sub-Committee is of opinion that the "Proceedings of the Meeting" should be recorded in the form hitherto adopted.

(2) With regard to appendices the Sub-Committee considers that the programme of the Meeting, the programme of the Imperial Department of Agriculture and the programmes of the Provincial Departments of Agriculture should be included, but that the latter should be as concise as possible.

(3) The Sub-Committee is of opinion that the inclusion of a note showing the action taken on the Proceedings of the preceding Board is unnecessary. In many cases it is improbable that the action taken on such recommendations can be completed within a year and such a note is apt to give a totally inadequate idea of what Agricultural Departments are doing in the matter.

(4) With regard to papers on special crops, e.g., wheat, sugarcane, etc., which form the subject of discussion by the Board, the Sub-Committee is of opinion that these papers, being absolutely relevant to the discussion and an instructive summary of past work in each Province, should be included amongst the appendices. It is recommended, however, that such notes should be as brief as possible.

(5) With regard to papers on general subjects, e.g., papers on commercial Fertilizers, the Improvement of Indian Agriculture, etc., the Sub-Committee is of opinion that such articles should not be incorporated in the appendices but should be published in the Agricultural Journal.

(6) The Sub-Committee considers that a detailed index is unnecessary. A carefully prepared table of contents appears to be all that is required.

PROGRAMMES OF PROVINCIAL DEPARTMENTS OF AGRICULTURE.

6. Mr. Sly proposed for consideration two matters of principle applying, in greater or less degree, to all the programmes submitted to the Board. In the first place, it appears necessary to secure a fuller recognition of the essential function of the Board in helping Provincial Departments with advice and criticism regarding the lines of work proposed in each Province. To secure the proper exercise of this function the Board requires to have available in the printed

programmes a certain amount of detail in matters such as the objects aimed at in opening new experiment stations and the lines of work of new experiments. In the second place, the impetus given to the development of Agricultural work in the last few years appears to have led to the danger in some Provinces of a more rapid development of agricultural stations than the existing staff can cope with. The President and Mr. MacKenna expressed general agreement with these views.

7. The Board is of opinion that the Programmes submitted to it should show concisely (1) in the case of new experiment stations the general scheme of work to be undertaken, and (2) in the case of new lines of experimental work, an account of the methods which it is proposed to adopt.

8. It is further of opinion that the form of the Madras and Central Provinces Programmes is, with some additions, explaining more fully the schemes of experiments, the best suited to meet the requirements of the Board.

9. The Board deprecates increasing the number of Provincial experiment stations until the following essential requirements can be secured in each case:—

- (1) Efficient supervision by the superior staff.
- (2) Efficient management by a trained subordinate staff.
- (3) Sufficient equipment for all the experimental work that is to be under taken.

10. Mr. Renouf raised the question of the area with which it is advisable to commence in opening new farms or in extending existing farms particularly for seed distribution and demonstration work. In the Board's Proceedings for 1906, item 23, it is recommended that experimental farms should be opened in each definite agricultural tract. Seed production should be provided for, either on separate farms or on separate portions of existing farms. An area of from 300 to 500 acres has been recommended for combined experimental and seed farms. This he considered unnecessarily large in some cases and he desired the opinion of the Board, in view of the high value of the land in certain areas, whether a commencement cannot be made on a considerably smaller scale, say not exceeding 100 acres. When expansion for seed production is required it will be possible to take up land on hire for the purpose. This should also be done in the case of areas required for demonstration.

The President stated that in Bombay the commencement was made on a modest scale. The farms at first started were about 50 acres in area. Gradually, as occasion arose, an extension outside the farm was made. Small plots were taken up, such as a 5-acre patch in an outside cultivator's field, for purposes of demonstration. This was worked on methods within the reach of the ordinary cultivator and under his eye, and he was shown that practical improvements can be obtained by improved methods of cultivation. Seed growing and seed distribution can be arranged for in a similar manner.

Mr. Smith considered an area of 50 acres too small. In Bengal 200 acres have been taken up as a standard, part being reserved for experimental work and part for seed growing.

Mr. Coventry held that the area required depends entirely on the uniformity of the soil. Where the land is known it is usually possible to select 50 or 100 acres sufficiently uniform to provide for all the experimental work likely to be required. Where, however, the character of the land is not known, probably some 200 or 300 acres must be taken up from which the area required for experimental work can be selected. For seed-growing use can probably be made in most cases of the land of the cultivator.

Mr. MacKenna considered that the matter is one which depends largely on local conditions. In Burma it pays to take up considerable areas for farms because prices are low at present but are rapidly rising. Areas not immediately required can be temporarily sublet.

11. The Board is of opinion that the area of an experiment station should be limited to the land required for the conduct of the experimental programme and that each Provincial Department should be free to make such arrangements for seed growing and demonstration as it thinks best.

12. It further considers that when an experimental farm is founded, it should be established to solve a definite problem or series of problems. It deprecates

the founding of experimental farms merely in order to represent agricultural tracts unless the special requirements of the particular tract have been previously ascertained, and experiments are considered necessary in order to decide how best to meet them.

13. Mr. Knight suggested that in the case of a programme divided into sections, the name of the expert officer who is actually in charge of the work should be indicated. This is done in the Central Provinces programme which illustrates clearly what he means. Mr. Henderson supported this suggestion. Mr. Couchman did not believe that this procedure is advisable or even possible in some cases. It would mean splitting the programme up into sections and would emphasise a division which should not exist. This view was supported by Mr. Molony. Mr. Milne agreed with Mr. Couchman and said that the proposal would be most difficult of application in practice especially where collaboration between officers exists. The Board considers that this matter is sufficiently covered by the resolution (item 8) approving of the form of the Madras and Central Provinces programme.

14. The Board is of opinion that at least in the alternate years when it meets at Pusa, the Imperial and Provincial programmes should be referred to sectional committees of (1) Deputy Directors, (2) Chemists and (3) Biologists, to consider the items pertaining to their sections with a view to co-ordinating the work of the whole Department, and report their recommendations to the Board.

PROGRAMME OF THE BENGAL DEPARTMENT OF AGRICULTURE.

See Appendix C., page 41.

15. The President stated that he was struck by the extent and varied nature of the Bengal programme. He would be glad to know whether the Bengal Director considers that his staff is sufficient to carry out the proposed work.

Mr. Gourlay detailed the available subordinate staff in Bengal. Besides the men previously available, three students with an advanced training have recently joined the Department. These men first graduated from the Calcutta University, then took the Agricultural course at Sibpur College, then went through a practical training in Bengal and finally were sent to one of the best Agricultural Colleges in the United States for a further course. Four more similarly trained men will be available shortly. These men will be put in charge of Agricultural Stations. Mr. Sly considered it unwise to place men of this class in independent charge of Agricultural Stations unless they are first put for a considerable time on one of the existing stations to become practically acquainted with the lines of work likely to be of advantage to the Province.

Dr. Mann feared that there is a tendency apparent from the Bengal programme to start farms without a definite object in view. He considered that in every case a definite object should be borne in mind. Mr. Milligan agreed that farms should not be started without a definite object in view. Mr. Smith said that in every case such an object was in view when founding the farm.

16. The Board accepts the Bengal programme.

PROGRAMME OF THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE

See Appendix C., page 43.

Mr. Hayman, in response to an enquiry by Mr. Sly, promised to give the details of the investigation regarding the renewal of the seed stock of potatoes in the hills mentioned in the first paragraph of the programme, to any members of the Board interested in the matter.

17. The Board accepts the United Provinces programme.

PROGRAMME OF THE PUNJAB DEPARTMENT OF AGRICULTURE.

See Appendix C., page 43.

18. The Board accepts the Punjab programme.

PROGRAMME OF THE BOMBAY DEPARTMENT OF AGRICULTURE.

See Appendix C., page 46.

19. Mr. Knight, in response to inquiries, explained that the experiments in dry farming mentioned in the programme of the Poona College Station are intended to ascertain the best means of conserving soil moisture in dry years by tillage and other similar methods.

20. Dr. Mann explained that no programme in Agricultural Chemistry was included in the programme as he had had no opportunity of submitting one.

21. Mr. Knight stated that the farm at Muvaha is situated in the most backward agricultural tract of the Presidency and is intended to introduce better general methods of cultivation in the neighbourhood. It is in some respects rather a demonstrational than an experimental farm.

22. Mr. MacKenna considered that no advantage is gained by inserting details of area, meteorology and the like into the list of farms given in the programme. Such details can be obtained from the special farm reports. Mr. Sly objected to the form of the programme, which he considered to be framed in such general terms as to render it impossible for the Board to express an opinion on its merits. Such items as that insect pests are being investigated or that an endeavour is being made to introduce into Sind a common Egyptian rotation may mean very much or very little according to the details of the work. Dr. Mann said that the Bombay officers would be glad to give details. Mr. Henderson said that the details of the alkali investigations could be furnished on the following day to any member interested in the question.

23. The Board decides that in the light of the remarks made above, the Bombay programme requires revision.

PROGRAMME OF THE MADRAS DEPARTMENT OF AGRICULTURE.

See Appendix C., page 50.

24. The Board suggests that the reference to systematic work performed by the Government Botanist in his capacity as an officer of the Botanical Survey be omitted in future from the programme of the Madras Agricultural Botanist.

The Board accepts the Madras programme.

PROGRAMME OF THE CENTRAL PROVINCES DEPARTMENT OF AGRICULTURE.

See Appendix C., page 51.

25. The Board accepts the Central Provinces programme.

PROGRAMME OF THE BURMA DEPARTMENT OF AGRICULTURE

See Appendix C., page 53.

26. Mr. MacKenna stated that the full programme of the Hmawbi Farm cannot be carried out this year, owing to a recent curtailment of the Government grant for the purpose. Government sanction has now been received for the entertainment of the Assistant Botanist mentioned in the first paragraph of the programme. The enquiry in connection with silt will be carried out in consultation with the Irrigation Department.

27. The Board is of opinion, that, as the question of alkali lands is of minor importance in Burma, and is being treated in detail in other Provinces where it is of greater urgency, the Agricultural Chemist might be more usefully employed in other and more important investigations.

PROGRAMME OF THE EASTERN BENGAL AND ASSAM DEPARTMENT OF AGRICULTURE.

See Appendix C., page 56.

28. The Board is of opinion that the expert staff of this Department is insufficient to carry out the work set down in the programme.

29. Mr. Sly considered that the appointment mentioned in paragraph 2 of a student trained in Bengal and the United States, directly to the post of Agricultural

Supervisor, is unwise in the extreme. Considerable experience of local work and conditions is required before a student can be given a post of such responsibility. Mr. Hart explained that owing to the fact that the present staff contains only one expert Agriculturist (the Assistant Director), whose time is fully occupied by other duties, there is no officer who can undertake the training of the Agricultural Supervisor. The latter can, however, do much useful work in the shape of local enquiries and will be expected gradually to familiarise himself with the work on all the farms. Until he has acquired experience he will not be placed in charge of any farm and even then only under the immediate supervision of the Assistant Director.

30. In response to enquiries, Mr. Hart explained that the experiment outlined in paragraph 5, section 3, together with the whole of the Dacca Farm programme, had been discussed during the present meeting with certain members of the Board. The experiment is really an attempt to bring a barren field on the farm into a state of fertility for future use. It is in no sense an experiment intended to be applied in ordinary cultivation.

31. Mr. Sly considered that the experiments suggested in paragraph 13 to be tried on Government and Wards Estates can serve no useful purpose as they are not likely to be properly carried out. Such Estates may be useful for demonstration purposes. Mr. Hart agreed but wished to point out that demonstrations carried out in a new locality partake of the nature of experiments. They are experiments which the Department expects to succeed.

32. Mr. Couchman referred to paragraph 17 and considered that the supervision of road-side arboricultural operations is an enormous undertaking for an Agricultural Department. Mr. Hart explained that the work will be carried out by district Officers, the Department only advising. Mr. Molony described the method adopted in the United Provinces, where the whole administrative and executive work is in the hands of District Officers in localities where no Forest Officers are available. The details are submitted to the Agricultural Department which gives advice as far as it can.

33. The Board is of opinion (some members dissenting) that arboricultural operations of the sort referred to in paragraph 17 of the Eastern Bengal programme are outside the scope of the Agricultural Department.

PROGRAMME OF THE MYSORE DEPARTMENT OF AGRICULTURE.

34. Dr. Coleman stated that owing to considerable administrative changes, the programme of the Mysore Department as submitted is unlikely to be carried out, except in certain items where the work is already well advanced. It is impossible to decide on definite work until the intentions of the Mysore Government are more fully known.

35. The Board decides to omit this programme from its proceedings for the reasons stated above. It further regrets to learn that the prospective change in establishment of the Department will, in a great measure, bring agricultural work in Mysore to a standstill.

PROGRAMME OF THE BARODA DEPARTMENT OF AGRICULTURE.

See Appendix C., page 63.

36. The Board is of opinion that the experiments in paragraph 2 of this programme are unlikely to lead to any useful results.

37. Mr. Bergtheil expressed the opinion that the experiment mentioned in paragraph 14 is useless, if by "nitrogen bacilli" are meant the ordinary nodule bacilli of legumes. It is well established that the presence of a rich organic manure tends to neutralise any benefit which may result from the application of these bacilli.

38. The Board considers that the programme of the Baroda State is much too ambitious to be efficiently carried out by the available staff.

PROGRAMME OF THE KASHMIR DEPARTMENT OF AGRICULTURE.

See Appendix C., page 64.

39. The Board considers that the varietal experiments in paragraph 1, section I, should be restricted to the more important crops of the State and should include only such as are likely to be easily improved by selection.

Mr. Sharma explained, in response to enquiries, that the "dal" soil referred to in paragraph 1, section 3, is the lake-bed silt, taken out and applied to the land.

Subject to the above restriction the Board accepts the Kashmir programme.

THE SCOPE OF IMPROVED POULTRY BREEDING IN INDIA.

40. The report of Sub-Committee (F) appointed to consider and report on the scope of improved poultry breeding in India was considered.

Mr. Dobbs enquired whether the Committee had considered the question of poultry breeding from the point of view of the fancier or as a commercial matter. The President replied that the latter was chiefly considered. Mr. Abbott remarked that he had expended at least Rs. 2,000 per annum in importing birds and had made it pay. Where a European can succeed there is much greater prospect of a native succeeding, as his difficulties in guarding against theft and other similar disadvantages are less.

Mr. Molony referred to the prejudices of Hindoos against poultry. If the question is taken up at Agricultural Stations it may interfere with the utility of the Station owing to these prejudices. Mr. Abbott said that even excluding Hindoos there was great scope for the work with Mahomedans, Parsees, Eurasians and others. Mr. Subba Rao stated that the prejudice against poultry only exists in the Brahmans amongst Hindoos. The Sudra caste and the lower castes are free from it.

The President said that if the work is to be attempted at all, it must be systematically and thoroughly taken up. A good trained Assistant will be required to carry out the experiments. A good Mahomedan would probably be the best class of man. Mr. Abbott considered that a special European Assistant such as a non-commissioned officer, who could be got for about Rs. 200 a month, should be appointed to supervise the experiments wherever they are being carried out to point out mistakes, select sites for runs and so on.

41. The Board adopts the report of Sub-Committee (F) as follows :—

Mr. Abbott, who has had long practical experience of poultry breeding in India gave much valuable information and stated that he had tested in India practically all breeds except Faverelles.

He considered that the following breeds were generally unsuited for India :—

- (i) Cochins, Brahamas and all breeds with heavily-feathered legs because they do very badly in the monsoon.
- (ii) Dorkings because they are too delicate.

He considered that the most suitable breeds for general utility purposes are :—

- (i) Plymouth Rocks—the best strain of these probably being the Barred Rock.
- (ii) Orpingtons of all strains.
- (iii) Wyandottes of all strains but probably Silver or White Wyandottes will be found best.

As regards the crossing of imported with indigenous breeds, the Sub-Committee has very little information but it is believed that the lighter laying breeds, especially the Minorcas and Leghorns, would be the most suitable imported breeds for a first cross and at a later stage Plymouth Rocks, Orpingtons and Wyandottes might be utilised to provide good table fowls. Mr. Abbott considers that the best of the native breeds for crossing purposes are :—

- (1) Hyderabad Black Games.
- (2) Penang Black Langshans.
- (3) Chittagong.

The Sub-Committee discussed the best means of obtaining well-bred birds for experimental work, and recognised the necessity of selection by a good judge when dealing with native breeds, as these are very often mixed and dealers often do not recognise the importance of selling for breeding purposes only birds of correct type. In introducing foreign breeds the only practicable way is to bring the birds, as the eggs are invariably bad after the sea voyage. The housing of poultry was next discussed and after pointing out the impracticability of a free range for the breeding stock owing to the loss caused by jackals, etc., it was decided that the method at

present in use at Pusa was the most suitable, but the runs though large in comparison with those used in Europe might with advantage be still larger. Growing chickens up to the age of four or five months can, on shaded grass land, run together in flocks (each flock not exceeding 100 birds) provided cockerels and pullets are kept separate. The position of breeding pens and of pens for young stock should be regularly changed and very frequently, if chicken cholera or other infectious disease occur. Absolute cleanliness and disinfection against disease, lice and such like, must always be secured. Defective ventilation in poultry houses is a frequent cause of death by heat apoplexy. This point always requires attention.

The feeding of fowls was next discussed and the Sub-Committee considers that many cheap Indian grains are very suitable. The best general food for grown fowls is crushed wheat or crushed oats, but where these are difficult to obtain or of prohibitive price, jowar, and the smaller millets will be found suitable. A mixture of the common small millets roughly crushed is well suited for growing chickens from 10 days to 6 weeks old. Maize is unsuitable in India as its effects are far too fattening; the importance of green food was insisted on and a regular supply of crushed green bone, broken kanker or broken shells and grit is essential. Bad water is a frequent cause of disease and a small quantity of Condry's fluid should be added to the drinking water before it is placed in the drinking troughs. In hot weather the water troughs should always be placed in the shade. The Sub-Committee then briefly touched upon the improvement of other classes of poultry.

Ducks.—Mr. Abbott stated that the Aylesbury breed is the most suitable as a pure breed and for crossing purposes in India. The Black and White Benares duck was the best indigenous Indian variety some years ago. The Sub-Committee recommends that the United Provinces Department be asked to make an enquiry as to the extent to which this breed now exists.

Geese.—It is known that geese of good type occur in India and that good breeds of the Chinese variety can readily be obtained in Calcutta. The Sub-Committee considered that good work can be done by selection and by crossing with European breeds particularly with the Embden variety.

Turkeys.—The Sub-Committee considers that local breeds can be greatly improved by crossing with the American-Bronze Turkey. This breed should also be maintained pure. Birds can best be obtained from Australia or England. These breeds in Australia are probably preferable for India.

Guinea Fowls.—Do not require much improvement as the present Indian breed is excellent in most respects.

The Sub-Committee then discussed the extent to which larger table birds and bigger eggs were likely to be in demand and whether the increase in prices necessitated by the increased cost of production could be realised.

The Sub-Committee recognised the difficulty experienced in most Indian towns in obtaining decent table fowls and believed that at least in the larger towns good fowls and large eggs would readily sell at profitable prices. Europeans and well-to-do Mahomedans and Parsees especially are anxious for poultry of better quality and are willing to pay any reasonable prices. Mr. Abbott estimated that a good cross-bred fowl would fetch Rs. 1-8-0 in the larger towns and considered that good eggs would easily repay the cost of production. The Sub-Committee recommends—

- (I) that the breeds indicated in this report as suitable for India should, in a practical way and on the lines suggested, be dealt with at Pusa.
- (II) that it is necessary to have a specially-trained assistant for the purpose.
- (III) that the chief object should be to provide a means of producing general utility fowls in India.
- (IV) that from Pusa selected birds should be distributed for pure breeding and for crossing.
- (V) that if the preliminary work at Pusa shows that poultry breeding on the above lines gives promise of becoming a remunerative industry, the work should be extended through all useful agencies in India, such as Provincial Agricultural Stations, Grass Farms, Missions, European Planters, Eurasians and well-to-do Parsees and Mahomedans,

THE LINES ON WHICH ENTOMOLOGICAL AND MYCOLOGICAL WORK
IN THE PROVINCES SHOULD BE CONDUCTED.

42. The president opened the discussion of this subject by referring to the printed note (see Appendix D) containing his proposals for the expansion of different sections of the Provincial Departments of Agriculture. He suggested that the general question of the rates of pay and prospects required to attract the best sort of men to the Department should be first considered.

Dr. Mann held that the important point which the Board should consider is the possibility of suggesting an ultimate prospect of pay sufficient to attract the best men. The actual number required in each Province is immaterial at present. To obtain the type of men required for the upper subordinate posts in Agricultural Departments, it is necessary to offer prospects equal to those which obtain in other Government Departments.

Mr. Molony believed that the scale of pay must differ to some extent in the different Provinces. This is the case in most departments, and is due partly to difference in the cost of living. In the United Provinces the proposals are to form two divisions, a lower and an upper division. The latter is graded to make it about equivalent to appointments in the Revenue Service as Tahsildars. Five appointments are proposed at Rs. 125, five at Rs. 150, five at Rs. 175, four at Rs. 200 and four at Rs. 250. Among these if men of really first rate merit and administrative capacity should be found, they should have the prospect of becoming Assistant Directors on graded pay approximating to that of Deputy Collectors. Promotion from grade to grade in the upper division is by merit only, not by seniority. The Agricultural Department should at first offer terms a little better than those in the executive service, because being a new service it will carry less prestige.

Mr. Sly said that the present service in the Central Provinces is graded at from Rs. 50 to Rs. 250. In the short experience of this graded rate, it appears to be insufficient to attract the best men. The best solution is probably to have one general graded service so that any man in any section of the Department may rise to the highest scale of pay. This service should be approximately of the same standing, as regards pay and prospects, as the Revenue Service. There should further be an opportunity of nominating good men from the agricultural service to appointment as Deputy Collectors. He considered that the President's proposals are too definite, as the circumstances vary from Province to Province. In the Central Provinces a student passing into the service from college would begin on Rs. 50. If he is specially good he might pass at once to a higher grade. The ultimate prospect is the point to which the individual will look.

Mr. Hart agreed with Mr. Sly. In Eastern Bengal the higher grades would, if approximating to the Revenue service, be about from Rs. 200 to 800.

Mr. Hayman held that the pay should be somewhat better than that of Tahsildars to attract the same class of men. A subordinate in the Revenue Service is a great man in the village; an Agricultural Assistant will be at first at least a nobody.

Mr. Couchman thought that the Board is inclined to overlook the great competition in the Revenue Service and the very small proportion of men who ever rise even above Rs. 60. In Madras a large proportion of the Revenue Service serve a long apprenticeship on a pay of Rs. 15. Then they rise to Rs. 35. To the vast majority the ultimate scope of their highest ambition is to become a Tahsildar. He considered that for the present a maximum prospect of Rs. 250 would attract the best men. The student might spend a year on probation at Rs. 25 and then commence on Rs. 40 or Rs. 50. As a Farm Manager he will have a prospect of Rs. 50 to 100 at first and possibly Rs. 100 to 250 later on. Finally one or more Assistant Directors would be appointed on pay of Rs. 250 to 400.

Mr. Dobbs pointed out that the Agricultural Department ought to pay more than the Revenue Service, because their field of selection from the lower grades will be so limited that only good men should be taken into the Department from the start.

Mr. Renouf said that the present maximum pay in the Punjab was fixed at Rs. 300. This is probably too low and Rs. 500 might be better. The latter ultimate prospect should, however, be enough to get the right men, and there is, in his opinion, no need to equalise with the Revenue Department which is admittedly the

best in the Province. The scale proposed is Rs. 40 rising to Rs. 70, with further promotion to higher grades of from Rs. 80 to Rs. 120. The College Assistant Professors will get a maximum of Rs. 300.

Mr. MacKenna agreed with Mr. Sly's views since they merely equate the Agricultural Service to the Revenue Service and the actual pay will differ in different Provinces.

Mr. Gourlay considered that it will be necessary to offer definite prospects of high ultimate pay from the commencement, at least equal to those of the Provincial Executive Service.

Messrs. Knight and Bergtheil gave specific instances from their recent experience of the difficulty of keeping promising men in the Department on the present prospects.

43. The Board considers that the present prospects in the Agricultural Department are insufficient to attract the right stamp of men for the upper subordinate posts, such as First Assistants, Assistants to Experts, Superintendents of Experimental Stations and the like. That the prospects for the upper subordinate staff should be somewhat better than those offered in the Provincial Executive Service, in view of the fact that the service is new and specialised. The Board is not in a position to suggest the number of posts or particular grading required for each Province.

44. The specific question of the conduct of Entomological and Mycological work in the Provinces was next considered. The President referred the Board to the notes on this subject furnished by the Imperial Mycologist and the Imperial Entomologist (Appendix D).

Mr. Sly said that it is clear that under present conditions the research work in both these subjects must be done at Pusa. To assist the Pusa Experts it is probable that a small staff must be maintained in the Provinces. Similarly some staff is required to assist in the teaching of these subjects in Provincial Colleges. From the practical aspect he, however, disagreed with the notes submitted. Instead of having a specially-trained staff to do such field work in the checking of pests or diseases as may be required, he believed that this object will be most satisfactorily gained by using the regular staff of Agricultural Assistants. As regards the control of the men the Botanist may in some cases be the best man, but ordinarily the Deputy Directors should supervise the work of the fieldmen.

Dr. Butler expressed general agreement with Mr. Sly's views, except that in the case of the Assistant who would be concerned in teaching at the Agricultural College, he believed that he should form the part of the Botanist's staff. As regards the Field Assistants the opinion of Provincial officers appeared to be that the Deputy Directors could best control their work. He wished on further consideration and discussion with other officers to modify the staff suggested in his note, as it appears probable that immediate requirements in most Provinces will be met by having one College Assistant for teaching, demonstration and care of the collections, and one field assistant for general field work. A collector and mounter on small pay would complete the establishment.

Mr. Lefroy said that it will be impossible to work a scheme of practical work from Pusa. As he understood Mr. Sly's proposals, each Deputy Director would have one field assistant under his charge to assist the expert staff at Pusa. These men should, in his opinion, work up to one highly-trained Native Assistant Entomologist to the Provincial Department. Without this latter appointment Mr. Sly's scheme is incomplete. The latter should be on a pay of Rs. 250 to 500 and should control and co-ordinate the work of the rest of the staff. In cases of importance he should personally visit and advise on outbreaks of insect pests in any part of the Province. He would not be required for the teaching, since this, being elementary, could be conducted by a man of less high training. As regards the control of the staff he considered that it is immaterial under whom it should be placed.

Mr. Milne agreed with Dr. Butler that the Assistant concerned in teaching Mycology should be under the Botanist, since Mycology is merely a branch of Botany and the Botanist will always have some knowledge of it.

45. The Board is of opinion that the Provincial work in Mycology and Entomology should be limited to the employment of a special staff (1) to give such assistance as is required for the research work to be conducted at Pusa and (2) for

the elementary training required at colleges. The practical field-work for the prevention of pests and diseases should be undertaken by the ordinary staff of Agricultural Assistants. Further that the teaching in Mycology at Provincial Agricultural Colleges including any special staff required for the purpose should be under the control of the Provincial Botanist.

SIXTH DAY.

PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

I.—AGRICULTURAL CHEMISTRY.

46. The Board adopts the recommendations of Sub-Committee (H), appointed to consider this programme, that the enquiry into feeding stuffs should be abandoned and that general-analytical work for Provincial Departments and others should be excluded from the programme as they should properly be done by Provincial Agricultural Chemists.

47. The Board adopts the report of Sub-Committee (H) as follows :—

The criticism of the Advisory Committee of the Royal Society of London on the Agricultural Chemistry Programme in the Economic and Industrial Chemistry Section of the Report of the Board of Scientific Advice, 1905-06, was generally discussed.

The Sub-Committee considers that investigations of general problems which can be made as well or better elsewhere should not be taken up in India except in so far as is necessary for the investigation of problems which are of particular reference to Indian Agriculture. It recognises that full advantage should be taken of investigations made elsewhere, and their application to conditions of sub-tropical agriculture is an important aspect of the Indian problem.

The items in the programme were discussed *seriatim*.

Available plant food in soils.—With regard to the general question of the desirability of carrying on investigations into the determination of the available constituents of soil, the Committee considers that the study of plant nutrition is of importance in India; the question of availability of plant food is an essential part of that study in India as elsewhere. The application of existing methods of investigation must in the earlier stages be examined with special reference to Indian conditions.

An attempt is now being made at Pusa to determine what is the actual chemical and physical state of certain constituents of important Indian soils and the effect of some of these constituents on the others both during periods of fallow and when the land is occupied by crops.

The Sub-Committee believes that this line of work may lead to useful results.

Gases in soils.—The Sub-Committee considers that this investigation is an essential portion of the problem referred to above, and that it has special significance in regard to Indian conditions and should be continued.

The testing of calcium cyanamide and calcium nitrate as manures.—The testing of these manures was undertaken at the specific request of commercial firms who are prepared to undertake the manufacture on a large scale, provided the Agricultural Department could establish their utility. If the tests are successful there is every prospect that these materials will be manufactured in India on a commercial scale.

The Sub-Committee therefore considers that the tests should certainly be continued.

The composition of field and garden crops.—The Sub-Committee entirely agrees that the ultimate analysis of crops with the object of obtaining definite information with regard to their manurial requirements is not likely to lead to important results and should not be included in the programme of Agricultural Chemistry. This item was inserted without any reference to Dr. Leather.

Water in soils.—The Sub-Committee considers that this investigation is of particular importance in India, and will have an important application in solving the problem as to how much water various crops require; it should, therefore, be continued.

Cyanogenetic glucosides.—The Sub-Committee considers that this investigation should be looked upon as of minor importance.

Feeding stuffs.—The Sub-Committee considers that this item should be eliminated from the programme.

General analytical work.—As each Province has now an Agricultural Chemist, this item should be excluded from the Imperial Agricultural Chemist's programme.

Training.—This subject has been dealt with by the Sub-Committee (G).

In addition to the above the Sub-Committee considers that the chemical investigations connected with the permanent field experiments at Pusa should be included in the programme.

II.—ECONOMIC BOTANY.

48. Dr. Mann desired the opinion of some of the Botanical members of the Board on the advisability of conducting investigations regarding the agricultural value of races of cultivated crops in any one locality, where these investigations are intended to apply to the whole of India. It appears to be still a moot question whether the characters of a plant do not undergo a certain amount of change when it is transferred to a new locality, especially if outside the natural area of the plant. Captain Gage said that from the botanical standpoint there appears to be no reason to doubt that the more important characters at least will be brought out wherever the work is done. It is not possible to talk of the natural area of a large number of important crops, as the origin of these is often only a subject for speculation. Mr. Gammie agreed with Captain Gage on both points and could see no reason why work of this sort should not be done at Pusa. Mr. Howard said that in any case there is no evidence available to permit of a full discussion and it appears better to await such evidence.

49. Mr. Sly enquired whether it is proposed to continue cotton work at Pusa. The President explained that this work had been started at Pusa because there appeared at one time a prospect of extending cotton cultivation in Behar. This prospect had not been realised and there seems to be no advantage in keeping it, except so far as it would help Mr. Gammie in his work. Mr. Howard said that all that is now proposed is to grow a series of types for students' information.

50. The Board accepts the programme of the Imperial Economic Botanist.

III.—MYCOLOGY.

51. The Board accepts the programme of the Imperial Mycologist and further desires to add that the work in Systematic Mycology, mentioned in the programme, must for the present be done at Pusa in the absence of any other agency in India for the purpose.

IV.—ENTOMOLOGY.

52. At Mr. Hart's request, Mr. Lefroy promised to arrange for a local enquiry into some important insect pests of paddy in Assam, should an outbreak be notified this year. Two other enquiries into important pests will probably be taken up if opportunity arises—the *surul* pest of ground-nut, and pests of stored potatoes. Mr. Henderson enquired to what stage the treatment of the boll-worm epidemic in cotton in Sind has advanced. Mr. Lefroy replied that experience both in the Punjab and Sind points to the re-introduction of the boll-worm parasite as having restored normal conditions. The parasite was introduced in Sind last year with a resulting better crop. The treatment is now beyond the experimental stage and full details will be published.

53. Mr. MacKenna said that lac appears to be a question for the Forest Department and not the Agricultural Department to deal with, so far as Provinces are concerned. Several other members agreed with this opinion.

54. The Board accepts the programme of the Imperial Entomologist and the Second Imperial Entomologist.

V.—BACTERIOLOGY.

Mr. Bergtheil stated that he intentionally drew up as broad and general a programme as possible since he cannot decide, until work is actually commenced at Pusa, what items of the programme can be immediately taken up. The

programme is an outline of work which must necessarily require many years to complete.

55. The Board accepts the programme of the Imperial Bacteriologist.

VI.—AGRICULTURE.

The report of Sub-Committee (C) appointed to consider the programme of the Imperial Agriculturist was considered.

56. Mr. Shearer explained that the proposed permanent wheat and maize manurial series appended to the report has been prepared on the plan of the Rothamsted permanent manurial wheat plots, but as the Sub-Committee has not expressed a definite opinion regarding it, he desired the opinion of the Board whether it should be retained. After some discussion it was agreed to withdraw this series from the programme.

57. Mr. Clarke enquired how far it is intended to carry the work on sugarcane referred to in paragraph 3 of the programme. He considered that this work, especially that portion of it referring to selection, can only be useful if carried out on a large scale and regarded as work of the first importance. Mr. Howard pointed out that the matter was very fully discussed at Cawnpore last year and it was recommended to confine extensive sugarcane work to a very small number of stations. At Pusa there is no intention at present of undertaking extensive work. It is a minor question and, so far as it is confined to securing a good cane for local growing, there is no reason why it should interfere with other more important work. Dr. Mann held that it should be taken up at Pusa on a large scale and made a principal feature of the programme. Mr. Sly disagreed. Pusa is in a tract which is not at present an important sugarcane growing one, and so far as he could see, there are none of the local conditions referred to in last year's discussion which would justify work on a large scale.

58. Mr. Shearer explained that indigo will be grown in rotation with flax, as mentioned in paragraph 4, on the advice of the Flax Expert employed by the Bengal Government. Mr. Bergtheil enquired if improvement by selection will be attempted with both crops. The President stated that if the Indigo Research Station at Surseah be kept on by the Bengal Government, selection of this crop should be done there and not at Pusa.

59. The President explained that there is a prospect of securing assistance in the tobacco curing experiments, mentioned in paragraph 5 of the programme, from an American Tobacco Expert from Monghyr. Unless such assistance can be secured it is doubtful if any work can be attempted at present.

60. Mr. Shearer explained that the varietal work mentioned in paragraph 8 with wheat, rice, maize, opium and castor, was intended to be merely preliminary to other work, should need arise for this. Dr. Mann held that such work should include plant to plant selection. Mr. Shearer and Mr. Howard agreed to this. The Board accepts the remainder of the programme.

VII.—PROGRAMME OF THE IMPERIAL COTTON SPECIALIST.

61. Mr. Gammie stated that he has as yet no definite proposals to make, owing to the recent date of his appointment. Details of work will be arranged in consultation with the Provincial officers. He has arranged to tour in Madras in March and to visit the Central Provinces and Eastern Bengal and Assam probably in November. It will only be possible to visit a portion of the cotton growing tracts this year owing to lack of time.

METHODS OF BRINGING EXPERIMENTAL WORK TO THE NOTICE OF CULTIVATORS.

The report of Sub-Committee (D) was considered.

62. The President invited suggestions regarding the publication of the report which, he considered, should be more widely distributed than can be secured in the published Proceedings of the Board. Several members agreed and offered suggestions.

63. The Board recommends that report of Sub-committee (D) be separately printed in pamphlet form and distributed to all District Officers in India, to

the Press and to others interested in the subject. Several members gave specific instances of means of disseminating agricultural improvements and getting into touch with cultivators not included in the report.

64. The Board desires that specific instances mentioned by various members, of the means of bringing the work of agricultural departments home to cultivators, other than those noted in the report, be incorporated in the latter by the President and that the report thus amplified be again referred to the members of Sub-Committee (D) for revision, prior to publication in separate form.

65. Mr. Howard considered that some of the agencies for securing the dissemination of agricultural improvements mentioned in the report, such as vernacular publications, are of minor value, and that sufficient stress has not been laid on the all-important agency of example. In Java where the problems of agricultural improvement approximate to those in India, everything is subordinated to the work of demonstration. The experiment stations are few and good and in connection with these a system of travelling farms or gardens has been developed and the work of the stations is thus brought home to the cultivators in every district by actual demonstration. Mr. Milligan held that it is dangerous to over-emphasise any one line of work in this connection at the expense of other lines which may be of special value in some places. Mr. MacKenna and Mr. Couchman agreed with Mr. Milligan and gave instances where the publication of vernacular leaflets has been of considerable utility.

66. The Board recommends that the subject of the best means of bringing the results of experimental work to the notice of cultivators shall be included in its programme in each succeeding year in the immediate future. Details should be furnished each year of the methods adopted in the different Provinces and their results, so that officers of the Department and others should know what has been and is being done, year by year, in this matter.

67. The Board adopts the report of Sub-Committee (D), as follows :—

The Sub-Committee desires to acknowledge that much valuable information has been obtained from the note submitted by Mr. Clouston on the introduction of improvements into Indian Agriculture.*

The Sub-Committee has considered in succession the methods which have been suggested for bringing experimental work to the notice of cultivators. It is convinced that it is impossible to lay down any general system which is universally applicable, as the conditions are too diverse for methods to be equally useful in all Provinces or even in all localities in a Province. It proposes, however, to consider the means which have been employed in the various Provinces, and which have proved a success, and also to indicate the conditions which appear to lead to success or failure in each case.

Agricultural Associations.—The formation of local Associations for agricultural improvements has been one of the most common methods of increasing interest in the subject. It has been successful in some cases and more especially in the Central Provinces. On the other hand the success has by no means been universal.

In the Central Provinces, the local Agricultural Association is most directly connected with the Agricultural Department of the Province. The district is taken as a unit and the Collector is Chairman of the Association. The influence and co-operation of the district officers is considered to be an essential condition of success. It is held that the Associations must be in close touch with the superior officers of the Agricultural Department, one of whom always attends the meeting of the Association. The meetings are held half yearly before the opening of the *khari* and the *rabi* seasons, and the Director and Deputy Directors devote some months each year at these times to going from meeting to meeting. Thus they know the members personally. The members are limited in number, and consist chiefly or almost entirely of substantial agriculturists, owners of villages who are also cultivators, heads of sub-divisions of cultivating castes and the like,—and the members undertake to carry out a demonstration of an improvement suggested by the Department. In this they are assisted with seed, implements, or other materials needed for the purpose, and their work is inspected by the Superintendent of the nearest farm or other member of the Departmental staff. At every

*In accordance with the recommendation of Sub-committee (B) (see page 6) this note has not been included in the proceedings but will be published elsewhere.

meeting an actual programme of work is submitted, criticised by the members, modified, if necessary, and the several pieces of demonstration allotted to the members. At the meetings the method of lecturing without any actual programme of work is being given up. In the programme no piece of work is recommended by the Agricultural Department, unless it has been proved by the Department itself to be likely to succeed. Two meetings such as have been described are held annually and though the people clamour for more, it is considered advisable not to add to the number. The time of holding these meetings depends on the system of cropping.

These Associations have been largely instrumental in introducing superior varieties of *tur*, of *jowar* and of sugarcane, and the adoption of improved implements. The greatest advantage is, however, felt to be that they bring the Department into close touch with the best cultivators in each district.

In Madras, the development of Agricultural Associations has taken a more independent line. They are officially patronised but are independent bodies. They usually take the district as the unit, but branch associations are formed in smaller areas. Their utility generally depends on the activity of local men, generally educated men and often substantial land-holders. They have in the deltaic areas been the means of introducing the system of transplanting single seedlings in rice cultivation. Elsewhere they have brought into practice improvements in manure conservation; they have caused the use of the process of green manuring with wild indigo after paddy to be adopted in the Tanjore district, and have introduced iron ploughs. They have been instrumental in extending the cultivation of paddy in Tinnevely, jute in Tanjore and Malabar, and ground-nut in Malabar and South Kanara. They have, however, not been in existence long enough for a definite opinion to be formed of their general utility. There is a Central Agricultural Committee in Madras which forms a link between the various local Associations.

In Bombay there has been comparatively little development on this line, but three District and a number of Taluka Associations exist. They are always independent bodies and often combine in their functions other purposes as well as those of agricultural improvement. The two most active and successful are in Dharwar (a District Association) and in the Sangamner Taluka of the Ahmednagar District. In each case they depend largely for their success on the personal influence of an active local man, and they only have official patronage. In Dharwar the Association has been instrumental in bringing about the extension of the cultivation of Broach cotton in the district, the more careful selection of Dharwar-American cotton seed, and the adoption of the Turnwrest plough. In Sangamner the Association organizes an exceedingly important local agricultural show subsidised by the Agricultural Department and has introduced improved varieties of wheat. It has led to the establishment of a gram bank; while breeding bulls have been introduced as a result of its operations. Many of the Bombay Associations are continually asking for demonstration to undertake, and the difficulty has been and is now to find matters of proved value for them to try.

In Bengal a Provincial Agricultural Association and Divisional and District Associations have recently been formed but it is too early to say what their effect has been. These Associations are largely composed of townsmen, pleaders and Zamindars not themselves cultivators. In fact cultivators' holdings are generally so small that it is considered unlikely that Agricultural Associations on the model of those in the Central Provinces are likely to succeed.

The utility of Agricultural Associations seems to depend largely on the presence of a body of substantial men who are also cultivators, on the *personal* touch of the higher staff of the Agricultural Department with the members, on the definite engagement by the members to do definite pieces of work, and on the regularity of meetings, inspections and reports. In other matters conditions will vary with the districts. It may and will be advisable to have smaller associations than those of a district in some instances. If such smaller associations can be sufficiently substantial and intelligent, the Sub-Committee considers that they should be encouraged.

Demonstration Farms.—Demonstration farms have in some cases had considerable success in Bombay and in the Central Provinces in bringing improved methods to the notice of cultivators and in securing their adoption, but as such, they have not been used to any extent elsewhere. In the Central Provinces, the

system adopted is as follows. In the first place experiment is rigidly separated from demonstration. Nothing is tried in a demonstration farm, which, in the opinion of the officers of the Department, is not actually of proved value for the tract in question, and each demonstration farm has a definite purpose in view. A varying amount of land is taken, which should not be greater than the particular purpose demands and the assistant in charge can efficiently manage; a small area carefully cultivated is much better than a larger area inefficiently managed. The occupation of the land is purely temporary. It is lent to the Department by an annual arrangement and the cultivator to whom the land belongs is guaranteed against loss. He is given also a large share or even the whole of the profits. The plots are selected by the Deputy Director or one of the senior officers of the Department. No difficulty has been found in inducing a cultivator to lend a suitable piece of land. An assistant is then placed in charge specially trained in the particular problem to be demonstrated. Local methods entirely must then be adopted in working the land except as regards the particular point to be demonstrated. The demonstration plot is visited at frequent intervals by the senior assistant of the Department who is also the Superintendent of the experimental farm for that particular tract, and who has a special interest in the success of the demonstration. The assistant in charge sends a weekly diary to the Deputy Director through the Superintendent of the Farm. The final success of the demonstration is judged by the general adoption of the method recommended and demonstrated.

The chief difficulties have been in obtaining suitable men to put in charge of the demonstration and in securing adequate supervision. The assistants placed in charge must be themselves agriculturists and generally they are men who have passed through the Agricultural College.

The demonstrations have proved very successful in the Chhattisgarh District (where rice is as a rule sown broadcast) in bringing the methods of transplanting rice into general practice, in showing how to use irrigation water most economically and effectively, and in showing how to grow additional crops after early rice instead of the present plan of leaving the land bare.

The Sub-Committee considers that there is considerable promise of demonstration farms conducted on lines similar to those followed in the Central Provinces proving useful in other Provinces.

Village Agencies.—It has always been a problem of considerable difficulty to get improved implements of undoubted value adopted by the cultivators, but the institution of village agencies as devised in the United Provinces promises success. These are managed by a local agent with whom implements are placed and from whom they can be hired out or sold. Before the agency is established, the particular implement is always demonstrated carefully to cultivators at the agency. An agricultural assistant then from time to time visits such agencies, accompanied by a *mistri* who can repair the implements, and inspects, gets machines repaired if necessary, visits the cultivators who have adopted them, and ascertains whether they are working satisfactorily. A register is kept of all those who buy the implements and the Deputy Director sends out an occasional note enquiring whether customers are satisfied.

Various implements, but perhaps most notably pumps, have been distributed by this means and the methods seem to get over the difficulty felt in Bombay and elsewhere that new machines are not adopted largely because of the difficulty of repair.

In this connection, it may be noted that a number of cultivators in one of the Canal Colonies of the Punjab (Lyallpur) are this year obtaining reapers on the recommendation of and through the Agricultural Department. About 50 reapers have been supplied. A class for *mistris* has been formed in connection with the Lyallpur farm and these men are trained in the use and repair of the machines. The Sub-Committee would urge the necessity, in this and similar cases, of taking advantage of the experience in the United Provinces, and securing the keeping in order of the machines for some years.

Vernacular Agricultural Journals.—Vernacular Journals have been established in several parts of India.

In the United Provinces, a monthly vernacular paper of six to ten pages edited by the head clerk of the Agricultural Department, is published. It has not been

so successful as it might be made by more careful editing and the appointment of a separate editor is under consideration. It may be considered as principally an attempt to bring the work and aims of the Department to the notice of the cultivators.

In the Central Provinces there is a monthly Departmental vernacular paper. It has been found that to be really useful, it must be very carefully edited, up to date, thoroughly practical, and deal with the immediate needs and interests of the cultivators. The translation into the vernacular must be carefully made by a man who is himself connected with the land. The paper usually contains very popular statements of the work of the experimental stations, with practical directions to enable the cultivators to apply them to their own circumstances. It contains also a "query and answer" column in which the readers are encouraged to ask the Department for advice. It also furnishes a means of advertising improved strains of seed, agricultural machinery and other things for sale at the stations. It consists of about 15 to 20 pages, is published in three languages and has a circulation of 2,500.

In Madras, no vernacular paper is issued by the Department. The Agricultural Department patronises two privately owned agricultural publications.

In Bombay there are three private vernacular agricultural journals, all of which are patronised by the Department. The Department subscribes for a number of copies and contributes articles and plates.

The Sub-Committee considers that where vernacular agricultural journals privately owned and worthy of support already exist, it is wiser to encourage and contribute to these rather than to start a Departmental publication. In many cases it thinks considerable good can be done by vernacular journals, provided they are well edited.

In this connection the Sub-Committee wishes to state its opinion that any journal published by Provincial Departments should be designed to meet the requirements of the cultivators and land owners. They should be essentially vernacular publications, with possibly an English edition. To meet the higher English speaking strata the Agricultural Journal of India published from Pusa should be the only medium.

Leaflets and Circulars.—Leaflets have been published in several Provinces giving information as to the results of experiments and recommendations as to methods to be adopted.

In Bengal a regular series of such leaflets is issued both in English and the vernacular, and they are distributed through agricultural associations but it is too early to draw any conclusions concerning their effect.

In Madras agricultural leaflets have been published in the vernacular in the District Gazettes. So far the effect has not been traceable. The introduction of *Banku* paddy into a large area is partly due to information thus published. As a result of a leaflet widely circulated in Godavari, no compensation has been demanded, for palm trees destroyed in the palm disease operations although some 200,000 trees have been killed.

In the Central Provinces the issue of leaflets has been suspended and such information is published in the journal of the Department which is a better medium. Both in the Central Provinces and in Bombay printed directions in the vernacular are issued, when new seed, new manures, etc., are distributed.

In general the Sub-Committee desires to express its agreement with the resolution of the Board of Agriculture in 1905 that leaflets "to be successful in reaching their object should be brief, perhaps not exceeding a couple of pages, and should contain one definite fact or the description of a single process which it is desirable that the ryot should know or adopt."

Utilization of General Vernacular Press.—At present, in the Central Provinces and Madras no use is made of the general vernacular press for the dissemination of agricultural information, while in Bengal it is only utilised in connection with Co-operative Credit Societies. On the other hand in Bombay considerable advantage has been taken of the press in the past, and matter is freely taken. In the Punjab a press communique is issued once a month to the leading English and vernacular papers and is considered to have been distinctly successful where it is

confined to information on established successes. In 1906-1907 the press was successfully used to bring to the notice of the cultivator remedial measures to check boll-worms.

The Sub-Committee considers that where the local press has a wide circulation it should be recognised as being a possible medium of reaching the cultivators, more particularly where there is no local agricultural paper with a wide circulation.

Agricultural Shows and Exhibitions.—An attempt has been made to utilize Agricultural Shows in nearly all Provinces, but with very varying success. In the United Provinces the attempts have been neither very successful nor popular. Lately, however, there has been an improvement in the method of carrying out the shows. In Bundelkhand, cattle shows lasting one day only, at which substantial prizes are given, have met with success.

In the Central Provinces, agricultural shows have only recently been developed. It is considered essential that one of the leading members of the Departmental staff should be present. It is thought that thus conducted the Department is brought in contact with a class of cultivators who cannot otherwise be reached easily. By combining popular lectures on the exhibits with practical demonstrations of each, much good work is thought to be done. The lecturer carries with him a small travelling case of exhibits to illustrate his lectures. The Superintendent of the Experimental Farm is usually the lecturer, and he is supplied with his lecture from head-quarters.

In Bombay, the use of special shows and exhibitions is new and dates from the Bombay exhibition of 1904. Nearly 500 selected cultivators were taken to that show, the exhibits were demonstrated in four languages and as a result there has been an increased sale of improved implements, and enquiries to the Department have much increased since this time. Since 1904 exhibits have been arranged at Surat, Ahmedabad and Satara, in each case as part of an exhibition arranged by a non-official committee, and similar arrangements were made for instructing cultivators. A good deal of success has followed the organization of a regular agricultural show at Ahmednagar. Here Taluka committees presided over by the Mamlatdar were formed beforehand. Every exhibit was certified as a man's own production by the village officer and in the case of grain a sheaf in addition to the sample was exhibited, while similar methods were adopted with other materials. The prizes were substantial. An attempt to give prizes for standing crops did not meet with great success. The Departmental exhibits, such as "well-jumpers," Ransomes iron plough, etc., were shown in actual operation. Among cattle, prizes were given for the progeny of bulls introduced by the Department. A similar show is being organised in the same district by the Sangamner Taluka Association, with the help of the Department, which is freely given. So far the cultivators are very keen to send their exhibits and great interest is taken in the competitions.

Some successful efforts have been made to hold cattle shows in Madras in recent years, but so far the actual effect on the agriculture of the district is hardly traceable. Local festivals are frequently made use of in popularizing agricultural improvements.

In the United Provinces meetings for the grant of Takavi advances have been made use of to bring agricultural improvements to the notice of cultivators.

The Sub-Committee is of opinion that agricultural shows should usually form a means of bringing matters of importance to the notice of the agricultural classes. It is felt, however, that while local effort may arrange the show, the part taken by the Agricultural Department should be very carefully organised, and attended to by one of the superior staff of the Department. Every effort should be made to make the exhibits in such shows actual specimens of the cultivators' production. It should be remembered too, that a show to be successful must be essentially popular.

Itinerant Assistants.—In Bombay, some of the senior assistants of the Department have been employed in travelling in the districts to introduce new varieties of seed. Large quantities of Broach cotton and of better varieties of groundnut have been sold to cultivators by this means and reports of success have been collected by the same agency.

In the Central Provinces similar means have been adopted successfully to introduce new implements but not for other purposes.

In Madras, assistants employed in going from place to place have secured the adoption of improved sugarcanes in many cases, as well as of better types of ground-nuts.

In the United Provinces itinerant assistants have been employed to spread the use of new seed and implements.

In Bengal travelling Inspectors have been appointed comparatively recently.

On the whole the Sub-Committee thinks that especially for the introduction of new implements which can be demonstrated by travelling assistants and for that of new seed, itinerant inspectors are of great value. It considers, however, that men so employed, should, for each journey, have a definite object in view. It does not approve of mere travelling assistants without specific duties.

In the same connection mention may be made of the Divisional Inspectors recently appointed by the Bombay Department. Their function is to work in the districts, with the experimental farms as head-quarters, with the object of bringing the Department into touch with the agriculturists. The men so employed are among the best in the Department, are practical agriculturists themselves, and are chosen because of their capacity to obtain the confidence of the cultivators.

Seed Farms.—In Bengal two successful jute seed farms have been established and these have been able to spread selected jute seed over the country. The seed is in strong demand among the growers.

In the Central Provinces seed farms and seed selection have had considerable success. Farms for the supply of selected cotton seed have been established in special tracts, and the cultivators have already imitated them in giving more attention than is usual to the cultivation of the plots intended for seed, to the spacing of the plants, to selection of seed, and to the ginning of the cotton.

In Madras, seed farms have been established for cotton, while in the Punjab large quantities of Dharwar American cotton have been grown and distributed. In the latter case agricultural assistants have also toured in the villages regularly, and arrangements have been made to secure a higher price for the improved staple.

On the whole the Sub-Committee considers it has been proved that the general demand for good and pure seed is undoubtedly considerable. If the Departments can establish seed farms, it should be considered as a really good line of work particularly in places which have a local reputation for the production of seed of a superior quality.

Seed Depôts.—In the United Provinces great success has been attained in the spreading of the superior Muzaffernagar white wheat by the use of seed depôts where sale is effected on credit. This system continues to increase greatly in popularity and extension is limited only by the difficulty of providing responsible supervision. The amount of seed so issued in 1906-07 amounted to over 10,000 maunds. The successful restocking of Bundelkhand after the last great famine indicates a line of work that can be usefully followed under similar conditions.

In Bengal, a depôt has been established where a variety of useful seeds can be obtained. Here the quantity of seed available for a single buyer is limited. Almost all the sales are to members of the various local agricultural associations. This depôt seems likely to be very useful.

In Madras, a depôt for cotton seed was maintained at Bellary for several seasons, but has now been closed. There is also a depôt for ground-nut seed at Palur. A great demand for good seed always exists.

The Sub-Committee feels that the establishment of seed depôts is likely to lead to excellent results, provided that only the very best seeds are obtained and sold. A single distribution of inferior seed, by accident or carelessness, is likely to lead to great damage to the Department and should be avoided at any cost.

Importation of Cultivators from district to district.—Two or three cases have been brought before the Sub-Committee where great improvement in local practice has been obtained, by the introduction of cultivators from one district to another. These were the bringing of men to Cawnpore and to Nagpur, to work land treated with night soil and poudrette. In both cases success was ultimately achieved and

the local cultivators have followed the improved methods. A case of failure of a similar method in the Chingleput District of Madras was, however, noted.

In the opinion of the Sub-Committee this is a method which should be considered. It may be possibly applicable in connection with the introduction into Sind of the improved methods of cultivation demanded by Egyptian cotton.

Allied to this, is the method of sending a gang of sugar boilers from the Poona district round the Bombay Presidency (even to Sind) and to the Central Provinces to show better methods for preparing *gur* from sugarcane.

This has been fairly successful in many centres.

Short courses for Cultivators at Experimental Farms.—The only Department which has adopted the system of having short courses of instruction in specific subjects at the experimental farms, is that of Bombay. Here, hitherto, courses limited to a few weeks only, in cotton seed selection have been given on the Surat Farm. It is now, however, proposed to extend these courses considerably. The use of new implements and machinery; better methods of dairying in Guzarat; methods of dealing with sugarcane and several other courses will shortly be taken up.

The Sub-Committee considers this method is worthy of more extended trial if cultivators can be induced to go to the farms for the purpose.

In Bombay too the sons of ryots are taken for two year courses on some of the farms. This is rendered possible by the provision of the funds by a Bombay gentleman for the purpose. In the United Provinces, an offer is made to teach and train labourers if these are sent to the farms. Wages are paid, but not many usually avail themselves of the opportunity. Demand exists for similar facilities in the Central Provinces, but only from Missionary Schools.

The Sub-Committee feels that with suitable precautions such training may be a method of considerable advantage.

Amongst the general operations of Departments which have been instrumental in popularizing them amongst the cultivators, the well-boring work in the United Provinces requires special mention: 180 new wells have been bored and in 117 existing wells the supply of water has been increased. The success attending these operations has been of the greatest value in inclining the people to rely on the assistance of the Department in agricultural matters generally. Not alone in questions of water supply but in other matters, the advice of the Department is freely accepted in many localities where the well-boring work has brought the people into touch with its officers.

Before proceeding to draw general conclusions on the subject referred to it, the Sub-Committee wishes to draw attention to the financial aspect of the introduction of agricultural improvements by the Indian cultivators. It is impossible to estimate the value of any method to a cultivator unless account be taken of his financial conditions. In the past it doubts whether this has been done sufficiently. Ideas of a ryot's financial condition have often been very vague. It is probable that in many parts of India a cultivator does not have any ready capital. He has to borrow every year for the purpose of meeting the expense of cultivation, and the rates of interest which he has to pay in some Provinces are often from 25 to 75 per cent. per annum. It is therefore not sufficient that an expert in agriculture can prove to himself that a new method will give a return of 10 to 20 per cent. over the old method before the experiment is of "proved value." Account must also be taken of the extra capital involved and the rate of interest which the agriculturist will have to pay for this.

As the cultivator has no capital, he takes no risks. Unless we can show that the new method is a certainty, the cultivator will not take it up. A certainty will mean, as a rule, to a ryot something which will give him a return of over 25 per cent. improvement on the extra capital invested. The Indian cultivator is not nearly so conservative as is often supposed, but is quick to see any advantage, but there must be no risk, and he must be able to pay for the capital from the results of the new method.

The Sub-Committee is anxious to emphasise the connection between agricultural improvement and the extension of cheap credit, and hence the close connection and

collaboration which should exist between the Department and the Co-operative Credit organization. The latter is often in the opinion of the Sub-Committee the best possible introduction to agricultural improvement. Improvement of agriculture by co-operation and Co-operative Credit Societies have gone hand in hand in the principal agricultural countries on the continent of Europe.

General.—It remains now to summarise the general conclusions to which the Sub-Committee have come on the questions referred to it. It considers that among all the methods the utility of which it has examined, each is adapted to special conditions. It seems certain that if a really good improvement can be presented to the Indian agriculturist he is ready to take it up. The conservatism of the cultivators is generally exaggerated.

The winning of the confidence of the cultivators is the first condition of success in any of the methods that have been detailed. The cultivators must, in fact, feel that they can turn to the Department for further assistance which will be willingly given to them. With the spread of primary education it will be possible more easily to win their confidence, but success depends much more on the personality of the officers of the Department than on any system.

It must be remembered too, that one great essential is to find by careful local investigation the *actual* needs of the cultivators rather than recommended outside methods which may be improvements, but are not acceptable under the local conditions.

Another point which it seems desirable to emphasise is the necessity of being absolutely sure of the ground before attempting to introduce an improvement, and even in such cases it is inadvisable to try to improve practices in vogue without a carefully considered plan.

Finally, the Sub-Committee desires to urge that work should be concentrated on comparatively small areas at one time and energy not dissipated over a large stretch of country. Once a method is thoroughly established and recognised as an improvement over a small area, a knowledge of it will spread naturally and without effort over similar areas in the surrounding country.

The Sub-Committee feels that its report has reached a much greater length than was anticipated, but in matters of this sort, it feels it essential to go into considerable details, because details which at first sight seem unimportant, very often, in such matters as at present under consideration, have been the determining factor in the success or failure of the work undertaken.

THE CULTIVATION IN INDIA OF FIBRE PLANTS.

The report of Sub-Committee (E) was considered. Several members considered that the report is incomplete and referred to a number of important matters that are not included.

68. The Board decides that the report as submitted be referred by the President to each Provincial Director of Agriculture in order that for each province all information available on the subject be gathered, so that the report before publication should be made as complete as possible. The President will then amplify the report and refer it back to the members of Sub-Committee (E) for revision, and will arrange for its publication in pamphlet form.

THE SYLLABUS OF STUDIES IN THE PUSA AND IN PROVINCIAL COLLEGES.

The report of the Sub-Committee (G) was considered.

69. Mr. Molony stated that he was not aware that the question of the syllabus of Provincial Agricultural Colleges would be considered and that he had been unable to consult all the officers of his department on this most important question. He thought that it would be advisable to postpone the discussion until next year. This was not adopted.

70. Mr. Sly enquired whether advanced students could be taken at Pusa at once. The President replied in the affirmative.

71. Mr. Sly approved the recommendation of the majority of the Sub-Committee that practical training in the field during the first year should form part of the syllabus in Agriculture in Provincial Colleges. It is, in addition to the advantage gained by practical work from the start, the most useful method of weeding out

unsuitable students early in the course. Messrs. Leather, Howard, Gourlay, Sampson, Evans and Meggitt agreed with this view. Mr. Howlett said that the only difficulty appears to be in arranging the course so that no practical work should be undertaken which required for its proper performance any theoretical knowledge, before such knowledge had been acquired. Mr. Barnes said that he looked on Agriculture as a technical art based on several sciences. In similar cases elsewhere the best opinion holds that specialization should be postponed as far as possible until the full educational value of the sciences concerned has been realised. He regards the sciences of Chemistry, Botany, Zoology and the like as primarily educational and hence they should be taken before their practical application is attempted.

72. Mr. Lefroy suggested that the course of Zoology recommended by the Sub-Committee be omitted from the syllabus. It is, as defined, a pure science course, based on dissections, and of no direct value to agricultural students. Mr. Howlett supported Mr. Lefroy. Dr. Mann said that the students come up absolutely ignorant of even the rudiments of Zoology and scarcely know the difference between bone and muscle. He considered that the course suggested should be retained. Mr. Milne agreed with Dr. Mann. An elementary course is all that is required, but he considered it would be a disgrace to give the diploma in Agriculture proposed, to students entirely ignorant of Zoology.

Mr. Leake desired to point out that the Entomology and Zoology courses recommended in the syllabus are incompatible with the views expressed in the note of dissent appended to the report. He looked on Zoology as a subject for general education. To substitute or even to introduce a considerable element of Entomology is to plunge straight into specialization.

73. The Board adopts the report of Sub-Committee (G) as follows, with the omission of the course in Zoology in the standard curriculum for Provincial Agricultural colleges:—

With regard to item (a) of the terms of reference, the Sub-Committee is of opinion that the class of instruction at Pusa which will be of the most advantage to the Provinces is a post-graduate course for students who have already obtained a degree at a Provincial Agricultural College. The Pusa advanced course might also be open with the special permission of the Director of Pusa, after consultation with the heads of the sections concerned, to students who are not graduates of a Provincial Agricultural College, but who, by reason of their education in science, are likely to derive real advantage from the advanced course.

The Sub-Committee is further of opinion that suitable courses should be provided at Pusa for the following:—

- (i) Students who will afterwards discharge the duties of Assistants to Provincial Experts in Agriculture, Agricultural Chemistry and, in particular, in Economic Botany, Mycology and Entomology.
- (ii) Students sent for special purposes.

It recommends that curricula or schemes of study should be framed for each of the courses of training required in class (i) and should be submitted at the next Meeting of the Board of Agriculture. It does not consider it practicable to frame definite curricula immediately, owing to lack of time, and because it is a matter which requires careful consideration in view of the fact that the Provincial staffs have insufficient experience as yet in the working of the Colleges.

The Sub-Committee is of opinion that the consideration of item (b) of the terms of reference should be deferred until the next Meeting of the Board of Agriculture.

With regard to item (c) of the terms of reference the Sub-Committee, having considered the general principles relating to Agricultural Education recommended by the Board of 1906 (Board's Proceedings, 1906, items 5 to 9), desires to make the following remarks:—

The Sub-Committee re-affirms item 5 of the Board's Proceedings of 1906.

The following changes in item 5-A are recommended:—

The word "might" in the first line to be changed to "should" and the word "assist" in the second line to be omitted.

The words in lines 5 to 7, from "*which would fit them*" to the end of the sentence to be altered to "*which would fit them for managing their own or other private estates, for employment as Managers of Court of*

Wards Estate, and District Associations and for upper subordinate posts in Agricultural Departments." The words after "propose" in line 7 to the end of the sentence to be changed to "a course which should admit of a moderate amount either of expansion or reduction to meet local conditions."

In item 6 it is recommended that the words in lines 4 and 5 "private students who may not have in view employment in Government service and who" be altered to "such students as."

Items 7 and 8 are re-affirmed.

The Sub-Committee recommends that the words in item 9 after "course" to the end of the sentence be changed to "and that the only agricultural instruction in the first year should be practical training in the field."

Regarding the standard curriculum for Agricultural Colleges determined upon by the Board of 1906 (Board's Proceedings 1906, item 74), the Sub-Committee desires to re-affirm the rough time-table proposed at the head of the curriculum.

It re-affirms the Agricultural Syllabus.

It re-affirms the Syllabus in Physics and Chemistry, with the addition of the following to the note prefixed to the Syllabus:—

"NOTE—It is to be understood that the student is not expected to possess a comprehensive knowledge of every item in the Syllabus. The object of the course is to enable the student (a) to understand what are the chief chemical and physical properties of matter, and (b) to obtain a knowledge of these properties as regards substances with which he is brought into direct contact in agricultural work. In the Organic Chemistry course only a general knowledge of constitution is required."

It recommends the omission of the note on page 21.

With regard to the Botany Syllabus it recommends that the introductory note (page 22) be omitted, that after the heading *Botany* the words in small print be omitted and the words "two alternative Syllabuses are put forward" be added, the two schemes to be simply numbered 1 and 2.

It is recommended that the Syllabus in Entomology and Zoology be amended to read as follows:—

ENTOMOLOGY.

FIRST STAGE—CLASS WORK.

(1) The structure of a caterpillar, and of various types of winged insects, including only the following:—head, thorax, abdomen, segments, eyes, antennæ, mouthparts, legs, prolegs, wings, spiracles, ovipositor. These are to be shown in as many large types as possible and no other terms are to be used (pages 3-9)*.

(2) The stages in the life of a typical butterfly (e.g., *Danaïx plexippus*, the akh caterpillar) and of a grasshopper or bug. The life of each to be treated in as much detail as in Indian Insect Pests and every stage shown *alive* (pages 15-21).

(3) The distinction between insects with and without a metamorphosis, as shown in different types.

(4) The characters of the seven orders in the winged stage (pages 52-55) and the more prominent immature stages, caterpillar, maggot, grub. The meaning of the terms egg, larva, caterpillar, maggot, nymph, pupa, chrysalis, cocoon, imago (pages 55-57).

(5) The placing in its order of every insect captured and brought to the class by students or lecturer until each order is recognisable at once.

(6) The distinction from insects of allied forms of life, likely to be mistaken, e.g., spiders, mites, ticks, centipedes, millipedes (pages 1 and 2).

(7) A short account in class of every insect found to be injurious on the farm or in the field, of which specimens (alive) are brought into class by students or the lecturer.

(8) Demonstration of the insects maintained alive by the lecturer in the laboratory.

* References to pages and chapters refer to "Indian Insect Pests."

(9) The food of insects, attention being drawn simply to the fact that insects fall mainly into the following classes:—Plant feeding, scavenging, predaceous, parasitic, insects on warm-blooded animals, household insects and aquatic insects. The recognition of biting and sucking mouthparts (pages 10-14, 6 and 7).

FIRST STAGE — PRACTICAL WORK.

Demonstration on the farm or in the field of any available insects; the order they belong to; how they feed, and on what; what stage of life they are in and what they will become or what they have come from. Collection by the students of all available stages of commoner forms which are brought into class. Demonstration of all injurious insects, the student being encouraged to find any stage of the insects previously described by the lecturer in class.

Whenever possible, an hour's field work is followed by an hour's demonstration, in class, of the insects collected and the specimens of damaged plants brought in. Such combined field work and demonstration would alternate with formal lectures or take the whole time during the rainy season or when crops were ripening.

SECOND STAGE — CLASS WORK.

1. A general account of the features of insect life as given in pages 22 and 23 of *Indian Insect Pests*.
2. An account of the Chapters V-VII of *Indian Insect Pests*.
3. More detailed accounts of injurious insects occurring on the Farm or reported from the Province, *when the stages of each pest can be shown*, with an account of such remedies or preventives as can be used.
4. Useful insects, including bees, lac, silk (Leaflet).
5. Insects destructive to grain and stored produce (Chapter XIX, and Leaflet).
6. Insects injurious to cattle; the part played by insects in disseminating disease (Chapter XX).
7. Beneficial insects (Chapter XXI).
8. Form and colour in insects (Chapter III)

The lecturer should revise the notes taken in lecture and those taken of the pests seen in the field and shown in class. Reports should be written by every student of cases of pests seen in the field and these should be corrected by the lecturer, who should draw attention to the important points. Demonstrations of the methods of packing specimens alive for sending through the post.

SECOND STAGE — PRACTICAL WORK.

Demonstration on the farm or in the field of all injurious and common insects, but paying special attention to:—

1. Predaceous insects, insectivorous birds, &c.
2. Parasites.
3. Preventive measures.
4. Remedial measures.
5. Distinguishing important from unimportant insects on a crop, and ascertaining exactly what is the real cause of damage.
6. The meaning of the form, colour and attitudes of insects as seen in the field.

When any remedial measures are adopted in the farm, the students should be present and there should be demonstrations of spraying, with lead arseniate, crude oil emulsion, kerosene emulsion, the last being made on the spot. The use of crude oil emulsion on cattle to destroy ticks, &c., should also be shown.

As before, whenever a pest occurs on the farm, the teacher should have combined field-work and demonstration, following a lecture on that pest.

THIRD STAGE — CLASS WORK.

A complete account of the crop pests of the Province treated crop by crop, as in "*Indian Insect Pests*." For this, the information given in leaflets should be used

where available, but no more detail should be given than is in Indian Insect Pests. As many stages as possible must be shown. Latin names are not to be used for plants or insects. The heads of each lecture are:—

1. The pest, how recognised in the field—Vernacular names.
2. Life history.
3. Habits and destructiveness.
4. Distribution in the Province.
5. Seasons at which it is found.
6. Parasites and enemies.
7. Treatment.

With these lectures alternate the field-work and demonstrations, the lecturer also revises the student's notes of each pest, seeing that he completes them from previous notes and that he has a fairly complete account.

A revision of the more important pests, not crop by crop, but order by order, so that the student may have an idea of the relative economic importance of each order and know what pests are closely allied.

THIRD STAGE — PRACTICAL WORK.

Demonstration of every injurious insect found on the farm or in the field, and of its enemies and checks. The important points to be noted in reports are drawn attention to and the students taught to see and note the facts they require for the reports they draw up in class afterwards.

ZOOLOGY.

The course in Zoology is intended to be introductory to the study of Veterinary Science and Entomology. Students should make themselves practically acquainted with the structure of the following types:—

- (a) A small mammal.
- (b) A frog.
- (c) An invertebrate.

The Sub-Committee re-affirms the Syllabus in Veterinary Science.

In the Syllabus of Agricultural Engineering it recommends the addition of the following words in brackets under the section "*simple dynamics and machines*." "(The training should be practical as far as possible.)"

The Sub-Committee further recommends that the Syllabus as now revised be printed separately for circulation to officers concerned.

NOTE OF DISSENT.

The following note of dissent, by certain Members, to the recommendations of the Sub-Committee under item (c) is added to the report.

The undersigned consider that the students who now attend and for some time to come will attend the Provincial Agricultural College are, and will be, deficient in respect of a good general education.

We consider therefore that it should be clearly recognised that the courses given at the Colleges fall into two definite groups:—

- (1) Subjects taught for their educational value.
- (2) Special subjects directly connected with Agriculture.

We regard agriculture to be an art based on the several sciences and not a science of itself and therefore propose as subjects under the first heading the sciences on which the art of agriculture is founded; but these subjects should be taught in such a way that the main object of a sound education may be achieved

These subjects are Chemistry, Physics, Botany, Zoology and Mathematics. We are of opinion that no sound teaching can be given in the second class of subjects until at least a sound basis is laid in the first.

The first year's course should, therefore, consist only of subjects falling into the first class, that is to say, the exact sciences. This will lay the necessary foundation for the second class of subjects.

It will, however, be impossible to do more in the first year than lay the foundation of a sound education and it will be necessary to continue some of these subjects in the second and possibly the third year. In the second year subjects falling into the second class may be commenced.

Taking into consideration the many disadvantages under which the Indian student approaches the study of science in a foreign language, it seems to us unlikely that it will be possible to do more in the three years than carry the educational subjects retained to the point at which specialization may safely begin and as such specialization is only required in the few who remain in the Department, these would, of necessity, have to undergo a post-graduate training in that special subject.

G. CLARKE.

H. M. LEAKE.

J. H. BARNES.

We thoroughly endorse this view having regard particularly to the fact that the necessary breadth will have been given to the student's education by his having mastered thoroughly one language—English—before coming to the College.

A. C. DOBBS.

F. M. HOWLETT.

SCHEME OF INSTRUCTION FOR INDIAN AGRICULTURAL STUDENTS IN ENGLAND.

74. The President stated that as the Board has already been informed that higher instruction in the sciences pertaining to agriculture will immediately be provided at Pusa, he wished to omit this subject from the Board's Programme. This was agreed to, and the meeting terminated.

APPENDIX A.

PROGRAMME OF THE 4TH MEETING OF THE BOARD OF AGRICULTURE.

SUBJECT I.—*The confirmation of the Proceedings of the last meeting.*

SUBJECT II.—*The programme of work of the Imperial Department of Agriculture.*

A consideration of the programmes of—

- (1) The Director, Agricultural Research Institute, Pusa ;
- (2) The Imperial Agricultural Chemist ;
- (3) The Imperial Mycologist ;
- (4) The Imperial Entomologist ;
- (5) The Second Imperial Entomologist ;
- (6) The Imperial Economic Botanist ;
- (7) The Imperial Agriculturist ;
- (8) The Imperial Bacteriologist.

2. Provincial Directors should examine them to see whether they meet the requirements of their own Provinces ; Imperial Experts should examine them to see whether the programmes of branches, other than their own, meet their requirements.

SUBJECT III.—*The programmes of work of the Provincial Departments of Agriculture.*

A consideration of the programmes submitted by—

- | | |
|----------------------------|--------------------------------|
| (a) Bengal ; | (f) The Central Provinces ; |
| (b) The United Provinces ; | (g) Eastern Bengal and Assam ; |
| (c) The Punjab ; | (h) Burma ; |
| (d) Bombay ; | (i) Mysore State ; |
| (e) Madras ; | (j) Baroda State ; |
| | (k) Kashmere State. |

2. The Imperial Experts should consider whether the programmes meet their requirements and whether they can suggest improvements. The Provincial Directors should consider whether the programmes of other Provinces can be improved so as to meet any special requirement of their Provinces or to co-ordinate the work.

SUBJECT IV.—*The lines on which the Entomological and Mycological work in the Provinces (for which no European Experts have been sanctioned) should henceforth be conducted ; the expansion of the different sections of the Imperial and Provincial Departments of Agriculture and the adequate rates of pay which should be given in order to attract and retain the best men in the Subordinate Agricultural Service.*

A consideration of the note prepared by the Inspector-General of Agriculture (See Appendix D).

SUBJECT V.—*The best methods of getting into touch with cultivators and the instances in which and the means by which experimental works of proved value have already been successfully brought home to the cultivators.*

A discussion as to the best lines for future work.

SUBJECT VI.—*A study regarding the extension of cultivation in India of fibre plants other than cotton and jute, such as hemps, agaves, etc., and the effect of such extension of cultivation on the material prosperity of the country.*

A discussion as to best lines for future experimental work.

SUBJECT VII.—*The scheme regarding the course of instruction which Indian students deputed to England to specialize in Mycology, Botany, Entomology or Chemistry should undergo.*

A consideration of the notes by Mr. C. A. Barber and the Expert Officers of the Imperial Department of Agriculture.

SUBJECT VIII.—*Measures to improve the breed of Poultry in India.*

A consideration of a letter received by the Government of India, Revenue and Agriculture Department, from Mr. H. E. Abbott, Editor of the Indian Fowl Fanciers', Gardeners' and Farmers' Gazette.

SUBJECT IX.—*The future constitution of the Board of Agriculture in India.*

A consideration of the suggestions contained in the Government of India, Revenue and Agriculture Department, Circular letter No. 23-28-24, dated the 15th August 1907, to all Local Governments and Administrations regarding the constitution of the Board. The matter will be referred to a committee before being discussed by the Board.

SUBJECT X.—*The Improvement of the form of the Report of the Proceedings of the Board of Agriculture.*

A consideration of the suggestions contained in paragraph 3 of the Government of India, Department of Revenue and Agriculture, letter No. 208-28-38, dated the 1st February 1908.

J. MOLLISON,

*Inspector General of Agriculture in India and
President, Board of Agriculture in India.*

APPENDIX B.

PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE FOR 1908-09.

Programme of the Agricultural Research Institute, Pusa.

The scientific work of the Institute for the coming year is indicated in the programmes submitted under the different sections.

Among the investigations mentioned, attention may be drawn to the following more important examples :—

- (a) *Rotation Experiments*, in the programme of the Imperial Agriculturist, in which the fertilizing value of leguminous crops and fallows in rotation with cereals and other crops will be investigated. The action of the organisms of the leguminous crops and the bacteria in the soil will be simultaneously dealt with by the Imperial Bacteriologist, and the Imperial Agricultural Chemist will take up the chemical aspect.
- (b) *Grass Experiments*, by the Imperial Agriculturist and Imperial Economic Botanist, to ascertain the effects of manurial and other treatment on the yield and on the varieties of grasses which were initiated during the past year, will be continued, and matters connected with the chemical section will be dealt with by the Imperial Agricultural Chemist.
- (c) The more precise determination of availability of plant food in Indian soils is being continued by the Imperial Agriculturist.
- (d) Investigations on Indian wheat and experiments on Indian fruits will be continued by the Imperial Economic Botanist.
- (e) The investigations into the biting flies of India, commenced by the Imperial Entomologist, will be specially taken up and continued by the Second Imperial Entomologist, Mr. Howlett.

The above-mentioned investigations indicate only the more important scientific work of the Institute during the coming year, including problems of a far-reaching character of great importance to Indian Agriculture. Besides this, the different sections will perform the work connected with minor investigations. The Entomological and Mycological Sections will continue their work on pests and diseases.

The European Scientific Staff of the Institute will for the first time be complete and will consist as follows :—

- (1) The Imperial Agriculturist, with one Supernumerary Assistant.
- (2) The Imperial Agricultural Chemist, with one Supernumerary Assistant.
- (3) The Imperial Economic Botanist, with one Supernumerary Assistant.
- (4) The Imperial Entomologist, with one Supernumerary Assistant.
- (5) The Second Imperial Entomologist.
- (6) The Imperial Mycologist, with one Supernumerary Assistant.
- (7) The Imperial Bacteriologist.

The Phipps Laboratories will be ready for occupation during the year and the apparatus and records will be transferred to the new building.

Regarding the question of the admission of students, the intention has been that distinguished students of the Provincial Agricultural Colleges should be sent to Pusa for a two years' course in specialising, but as some time must elapse before the arrangement can be given effect to, it is proposed that students should be selected by the Provincial Governments and given a general agricultural education at Pusa.

The publication work will be carried on as before and the stocking and indexing of the Library will continue. A Library Catalogue is in the Press and will be issued very shortly.

B. COVENTRY,

*Director, Agricultural Research Institute, and
Principal of the Agricultural College, Pusa.*

I.—AGRICULTURAL CHEMISTRY.

Available plant food in soils.—This subject has been referred to in previous programmes. The work during the past year has been on the lines already indicated, but in addition to work at Pusa, field experiments on the value of super-phosphate are being conducted at a number of centres in Behar, that is, the laboratory results are being tested in the field. Whilst this work is yielding useful information, it must be fully recognised how empirical are our methods, and the laboratory work at Pusa is now being directed to a more thorough examination of the precise state of the compounds in the soil, the phosphates forming the first main objective. The more exact relationship of the carbonic acid gas in the soil to plant foods forms another part of the same subject.

Water in soils.—This subject divides itself under two heads, namely, drainage and evaporation. The four gauges at Pusa are providing interesting data regarding the former, which are supplemented by those at Cawnpore, the Director of Agriculture, United Provinces, being kind enough to allow me to co-operate with his department in this connection. In addition to the gross amount of water passing away, data are being collected regarding the rate of percolation and the nature and amount of dissolved substances which are carried with the drainage water.

The records of evaporation which are being maintained have so far led to two important conclusions, the one being that during dry weather water rises in the soil from a limited depth only, the other that the rate of loss depends (among other things) on the amount of water present. There is some hope, too, that the true relation between physical properties of a soil and its power to retain water may be rendered clearer than it is at the present day. An account of the first year's work is in the press.

A knowledge of the amount of water in a soil is, however, only one factor of a larger subject, for it is equally important to know how much water crops require. Tentative experiments are in progress on this part of the subject. The data which have been published in Europe and America are not only divergent among themselves, but would not, without verification, be applicable to Indian conditions. It is obvious that a more exact knowledge of the movements of water in soils will, at the same time, yield information as to the movements of dissolved substances, whether these are valuable plant foods or deleterious salts; at present this subject is chiefly characterised by its nebulous state.

The Chemical investigations connected with the permanent field experiments at Pusa.

Cyanogenetic glucosides.—It was explained in my last programme that the work on this subject is restricted at Pusa to the ascertainment of the conditions under which these compounds are formed in large quantity in the plant, and I cannot at present say much more than that the work is in progress. Some positive results were obtained last year with jowar (*Andropogon sorghum*), but it would be premature to publish them at present.

J. WALTER LEATHER, Ph. D.,

Imperial Agricultural Chemist.

II.—ECONOMIC BOTANY.

Plant breeding and Plant improvement.—During 1908 the following crops will be studied:—Wheat, tobacco, cotton and barley as well as important *rabi* and *kharif* crops grown in Behar. The determination of the varieties of Indian wheat, tobacco and barley will be continued.

Fibre plants.—The collection and investigation of fibre yielding plants will be continued.

Fruit experiments.—The permanent experiments on the culture of Indian fruits will be continued on the lines laid down in the first report.

Minor investigations.—The study of Cassava as a famine food-stuff (with Dr. Leather). The economic importance of the male plant in Ganja cultivation.

Publications.—The monograph on Indian wheat will be completed.

R. J. D. GRAHAM, M.A.,

Acting Imperial Economic Botanist.

III.—MYCOLOGY.

1. *Training*.—The training of probationers for posts of Mycological Assistants in the Provinces will be continued if any are sent up. Three have been accommodated during the past year and their places are now vacant.

2. *Research and experimental work*.—The amount of Pathological work of pressing importance which has arisen during the past year has led to the temporary abandonment of the work on *soil fungi*, referred to in my last programme. The following are the chief diseases at present under investigation :—

- (a) *Diseases of indigo*.—The introduction of the Java-Natal variety of this plant has led to severe outbreaks of disease. Its successful cultivation at the present moment centres on the checking of these diseases. They have not, however, been previously studied, and much investigational work is needed before even their causes can be determined.
- (b) *Wilt diseases of cotton, gram and pigeon pea (rahar)*.—The prolonged investigation of these diseases will be continued, and others taken up if occasion arises. Sesamum wilt will be investigated.
- (c) *Diseases of citrus fruits*.—A number of these have been recently reported and are under study. The results will probably be ready for publication during the year.
- (d) *Palm diseases*.—The biologic study of the parasite of bud rot is practically completed. Assistance will continue to be given in the operations to check this disease in Godavari.
- (e) *Sugarcane diseases*.—Field experiments with red rot and smut will be continued.
- (f) The identification and study of other crop diseases will continue as usual. A commencement has been made in preparing a text-book of Indian crop diseases, and it is hoped to complete this.

3. *Systematic work*.—The identification and recording of the species of *fungi* collected in India will be continued with assistance from abroad. Three of the main groups have been finished up to date from the Pusa collections. The three largest, however, remain.

E. J. BUTLER, M.B.,
Imperial Mycologist.

IV.—ENTOMOLOGY.

The work of the past year in studying and advising on insects injurious to crops will be continued. Special attention will be paid to insects injurious to indigo, to the problem of controlling Surface Grasshoppers and to pests of rice. Assistance will be given in directing the work of Provincial Assistants and in coping with any outbreaks of pests that may occur; this may form a large part of the work of the year, but the extent to which Provincial Departments of Agriculture will require assistance cannot be estimated until after the meeting of the Board.

No new investigations of an extensive nature can now be proposed. The enquiry into insecticides non-poisonous to cattle will be continued. The experimental cultivation of lac and of eri silk will be continued, and it is proposed to very tentatively take up other wild silks. The transfer of the economic collections to the main laboratory and the arrangement of records, collections, etc., for teaching will occupy some time. Should the teaching of advanced Entomology be taken up, the preparation of the syllabus will also require to be done. Simple leaflets to explain coloured plates illustrating common injurious insects will be prepared primarily for use in the Central Provinces, but this work will be extended to other Provinces, if necessary. To what extent this work will develop cannot now be foreseen, and, if necessary, other work will be dropped to give time for this.

The study of insect-eating birds will be continued by the Supernumerary Entomologist and further inquiry will be made into fumigation methods for treating grain and plants and into methods of checking white ants. A month's course of elementary Entomology will be given at Nagpur by the First Assistant.

No definite arrangements can now be made for further work pending the result of the discussion by the Board of the lines on which Entomological work is to be developed.

H. MAXWELL-LEFROY, M.A.,
Imperial Entomologist.

PART II.

The investigation of the biting flies of India, begun by the Imperial Entomologist, will be continued and extended, the distribution and breeding habits of the various species being especially studied, as being most likely to afford information of value in connection with the spread of disease.

Dipterous pests of crops will be studied as opportunity occurs. The sorting and arrangement of the collection of Diptera will be undertaken, and the species identified, wherever possible, while the care and maintenance of the large general collection will be taken over from the Imperial Entomologist and continued on the same lines as hitherto. The preparation of the text and illustrations of the book on Indian Insects will be continued in collaboration with the Imperial Entomologist.

F. M. HOWLETT, B.A.,
Second Imperial Entomologist.

V.—AGRICULTURAL BACTERIOLOGY.

Some of the following problems will be attacked as opportunity offers and time permits:—

- I.—The chief bacteria characteristic of Indian soils, particularly those taking part in—
 - (a) The fixation of Nitrogen.
 - (b) The rotting of organic material.
 - (c) Nitrification.
- II.—The characteristic organisms growing in association with leguminous crops in India, with particular regard to the inoculation of the soils growing them.
- III.—The bacteria taking part in the rotting of stored organic material under Indian conditions and the bearing of the knowledge gained on the conservation of cattle-manure in India.
- IV.—The fermentation processes accompanying the manufacture of Silage in India.
- V.—The fermentation processes taking place during the manufacture of Tobacco.
- VI.—The fermentation processes taking place during the manufacture of Indigo.
- VII.—Any bacterial diseases of important Indian crops.

C. BERGTHEIL,
Imperial Bacteriologist.

VI.—AGRICULTURE.

- (1) *Permanent manurial experiments.*—These are described in detail in series I below.
- (2) *Permanent Rotation experiments.*—These are described in detail in series II below.
- (3) *Permanent Wheat and Maize Manurial experiments.*—These are described in detail in series III below.
- (4) *Permanent Pasture Experiments.*—These will be continued according to the revised scheme appended. These experiments are not considered of the first order.

(5) *Sugarcane*.—Work on sugarcane will include (1) methods of planting, (2) methods of manuring, (3) selection by sports or otherwise. This work is not considered of the first order.

(6) *Flax and other Fibre Crops*.—The possibility of establishing a flax industry in this country will, in collaboration with Mr. Finlow, be further investigated. Experiments on the cultivation and preparation of flax will be conducted on a larger scale than hitherto. The flax will be grown in rotation with Indigo but these crops will not occupy the same land oftener than once in four years. The work will include plant selection in flax and in Indigo. Sann-hemp (*Crotolaria juncea*), *Sida rhombifolia*, *Hibiscus cannabinus*, *Hibiscus panduriformis* and *Malachra capitata* will be tested on a field scale. This work is not considered of the first order.

(7) *Tobacco*.—A fairly large area of selected indigenous and exotic varieties will be grown and experimental work in curing will be done in the curing house.

(8) *Varieties*.—Varieties tested will include those of wheat, rice, maize, opium and castor. Plant to plant selection will be carried out wherever possible.

(9) *Thrashing Trials*.—These will be continued on the same lines as last year with special reference to wheat.

(10) *Breeding*.—The breeding of bulls for the province of Bengal will be continued. A Dumbha ram has been purchased and he will be crossed with selected ewes. Poultry breeding will be carried on with selected imported and indigenous breeds. In connection with the cross-breeding of sheep and poultry Mendel's Laws will come under study.

(9) The general improvement of the estate will be continued.

Note on the permanent experiments at Pusa.

The problem of agriculture is to secure from the soil the maximum production possible under the existing conditions and with the resources at the command of the cultivator. Next to climate the most important factor in production is the degree of fertility of the soil. Soil fertility is conditioned by circumstances which are still far from being properly understood. While in a large measure a quality inherent in the soil, it may be profoundly modified by agricultural practice with respect to cultivation, manuring and rotation of crops. The proposed permanent experiment detailed below have been arranged with a view to study the conditions which determine soil fertility in a subtropical climate, and in particular the manner in which soil fertility is affected by the application of the important manures, including green manure, by rotation of crops (with special reference to the part played by legumes in a rotation), by cultivation and by fallows.

SERIES I.

Permanent Manurial Experiments.

The object of this series is to determine the specific effect on soil fertility of the more important organic and chemical manures applied alone and in various combinations to a two years' four course rotation.

<i>Kharif.</i>	<i>Rabi.</i>	<i>Kharif.</i>	<i>Rabi.</i>	Manures applied per acre.
1 Maize	Rahar	Maize	Oats	No manure
2 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 10 lbs Nitrogen
3 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 20 lbs. Nitrogen
4 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 30 lbs. Nitrogen.
5 Maize	Rahar	Maize	Oats	Rape cake to supply 20 lbs Nitrogen.
6 Maize	Rahar	Maize	Oats	Sulphate of Ammonia to supply 20 lbs Nitrogen.
7 Maize	Rahar	Maize	Oats	Sulphate of Potash to supply Potash as in Farm-yard Manure No. 3
8 Maize	Rahar	Maize	Oats	Superphosphate to supply Phosphoric acid as in Farm-yard Manure No 3
9 Maize	Rahar	Maize	Oats	Sulphate of Potash to supply Potash as in Farm-yard Manure No 3.
				Superphosphate to supply Phosphoric acid as in Farm-yard Manure No 3.
10 Maize	Rahar	Maize	Oats	Sulphate of Ammonia to supply Nitrogen as in Farm-yard Manure No 3.
				Sulphate of Potash to supply Potash as in Farm-yard Manure No 3.
				Superphosphate to supply Phosphoric acid as in Farm-yard Manure No. 3.

Plots to be $\frac{1}{2}$ acre duplicated and all the crops of each rotation to be grown in the same year. Manures to go on every year on the maize.

SERIES II.

Permanent Rotation Experiments.

This series is designed to determine how far soil fertility is affected by growing in a rotation leguminous crops (1) removed from the land, (2) returned to the land in the shape of green manures. It is complementary to series I, inasmuch as the results obtained will give an indication of how far legumes can replace manures in a rotation.

	Kharif.	Rabi.	Kharif.	Rabi.	REMARKS.
1	Maize	Barley	Maize	Oats	No manure.
2	Maize	Barley	San Hemp	Oats	Green manure on cereal rotation.
3	Maize	Rahar	Maize	Oats	Residual value of deep rooted pulse.
4	Maize	Rahar	Maize	Oats & Peas	Residual values of two legumes one deep and one shallow rooted.
5	Maize	Rahar	San Hemp	Oats	Residual value of a pulse crop plus a green manure.

Plots to be $\frac{1}{2}$ acre duplicated and all the crops of each rotation to be grown in the same year.

SERIES III.

Permanent wheat and maize Manurial Experiments.

This series has been prepared on the plan of the Rothamsted permanent manurial wheat plots but has been modified to suit Indian conditions. It was necessary to introduce maize as an alternate crop with wheat (1) because the land on which the plots will be grown normally carries two crops a year, and (2) because of the difficulty of keeping a bare fallow clean during the monsoon season.

Permanent wheat and maize Manurial Series.

No.	Kharif.	Rabi.	Manure applied per acre.
1	Maize	Wheat	No Manure.
2	Maize	Wheat	Farm-yard Manure=20 lbs. Nitrogen.
3	Maize	Wheat	Rape cake=20 lbs Nitrogen.
4	Maize	Wheat	Sulphate of Ammonia=20lbs. Nitrogen.
5	Maize	Wheat	Sulphate of Potash to supply potash as in Farm-yard Manure.
6	Maize	Wheat	Superphosphate to supply $P_2 O_5$ = that in Farm-yard Manure.
7	Maize	Wheat	Sulphate of potash to supply potash } as in Farm-yard Manure. Superphosphate to supply $P_2 O_5$ }
8	Maize	Wheat	Sulphate of Ammonia to supply Nitrogen } as in Farm-yard Manure. Sulphate of Potash to supply Potash } Superphosphate to supply $P_2 O_5$ }

Plots to be $\frac{1}{2}$ acre duplicated and all the crops of each rotation to be grown in the same year. The question of fallows will not be taken up this year.

*Permanent Pasture Experiments.**Manurial Scheme for Pasture Experiments.*

No.	Details.	REMARKS.
1.	No manure	To be applied once; thereafter at the end of 3 years or other date to be subsequently fixed to be followed by 10 tons farm-yard manure repeated every fifth year.
2.	Superphosphate = 150 lbs Phosphoric acid per acre.	
3.	Basic slag = 150 lbs. Phosphoric acid per acre	
4.	Superphosphate = 100 lbs Phosphoric acid per acre.	
5.	Superphosphate = 100 lbs Phosphoric acid per acre	
6.	Sulphate of Potash = 50 lbs. Potash per acre	
7.	Rape Cake = 100lbs. Nitrogen per acre. Castor Cake = 100lbs. Nitrogen per acre.		To be applied every fifth year.

Manurial Scheme for Pasture Experiments—contd.

No.	Details	REMARKS.
8.	Ammonium Sulphate = 20 lbs. Nitrogen per acre	} To be apphed every year.
9.	Nitrate of Soda = 20 lbs. Nitrogen per acre	
10.	Superphosphate = 25 lbs. Phosphoric acid per acre	
11.	Superphosphate = 25 lbs. Phosphoric acid per acre	
11.	Sulphate of Potash = 20 lbs. of Potash per acre	
12.	Superphosphate = 25 lbs. of Phosphoric acid per acre	
12.	Ammonium Sulphate = 20 lbs of Nitrogen per acre	
13.	Superphosphate = 25 lbs. of Phosphoric acid per acre	
13.	Ammonium Sulphate = 20 lbs Nitrogen per acre	
14.	Sulphate of Potash = 20 lbs. Potash per acre	
14.	Farm-yard Manure = 3 tons per acre	

The extent of even land available in the pasture land at Pusa is limited and the proposed experimental plots are, therefore, smaller than is desirable. The area in one block will be divided into 14 plots each of one-half acre. One-fourth of each plot will be fenced off and cut annually as hay, the remaining three-fourths will be grazed by cattle and simply kept under observation.

A detailed botanical examination of the character of the herbage of each plot will be undertaken.

E. SHEARER, M. A.,
Impersal Agriculturist.

APPENDIX C.

PROGRAMMES OF PROVINCIAL AND NATIVE STATES DEPARTMENTS
OF AGRICULTURE FOR 1908-09.

BENGAL.

1. There are at present five Agricultural Stations in this Province, *viz.*, Burdwan, Bankipore, Dumraon (Shahabad), Sabour (Bhagalpur), and Cuttack.

Particulars regarding their physical and climatic conditions are given in the statement below:—

Serial No	Name of station	SITUATION		Tract represented	Area in acres	Types of soil	D ^o when estab- lished	Height above sea- level.	Average rainfall in inches,	TEMPERA- TURE	
		North Latitude	East Longitude.							Maxi- mum.	Mini- mum.
1	Burdwan	23° 70'	88° 00'		31		1885	99	57 54	80°	70°
2	Dumraon (Shaha- bad).	25° 30'	84° 00'		30		1895	239	41 13	88°	68°
3	Bankypur	25° 27'	85° 14'		210		1906	183	44 54	89°	69°
4	Sabour (Bhagalpur)	25° 12'	87° 1'		324		1906	180	49 35	97°	68°
5	Cuttack	20° 29'	85° 54'		60		1904	80	60 35	91°	73°

In addition to the above, an area of about 210 acres has been acquired at Chinsurah in the district of Hooghly for an Agricultural Station which will be representative of the Deltaic tracts of this Province and enquiries are being made with a view to obtaining suitable sites for stations which will be representative of the laterite tracts of the Province and Chota Nagpur. The following farms are also maintained:—

- (a) The Purnea and Berhampur Jute Seed Farms.
- (b) The Chakradharpur Cotton Farm.
- (c) The Chaibassa Tasar Farm.

II. The programme of work for 1908-09 in the stations is as follows:—

(1) *Burdwan*.—The experiments now being carried on will be continued, *viz.*:—
Jute experiments:—

1. Manure.
2. Cutting at different stages.
3. Variety.
4. Spacing.
5. Drill *versus* Broadcast sowing.
6. Rotation experiment with paddy.
7. Rotation experiment with potatoes.

Paddy Experiments:—

A. Manure.

1. First series—Quantitative.
2. Second series—Qualitative.
3. Third series—Green manuring.

B. Variety.

C. Cultivation.

1. Thick and thin sowing (broadcast).
2. Spacing in transplanting.
3. Number of seedlings per hole in transplanting.

Potatoes:—

1. Manure experiments.
2. Variety experiment.

Selected varieties of Sugarcane, Jute and Paddy will be grown for seed distribution. Cassava will be tried.

- (2) *Bankipore*.—The laying out will be completed and the farm will be worked to get uniformity of conditions before commencing experiments. Sugarcane, paddy, gram, *juar* and vegetables will be grown for seed distribution.
- (3) *Dumraon* (Shahabad).—The sugarcane and mustard experiments will be continued, *viz* :—

Sugarcane :—

1. Manure experiment.
2. Variety experiment.
3. Planting experiment.
4. Rotation experiment.

Mustard :—1. Variety experiment. Selected varieties of Sugarcane, mustard and *arhar* will be grown for seed distribution.

- (4) *Sabour*. (Bhagalpur).—The College buildings will be pushed on. Laying out of the farm will be continued. Maize, *arhar* and *juar* will be grown for seed distribution.
- (5) *Cuttack*.—The experiments now being carried on will be continued, *viz* :—

Jute experiments :—

1. Manurial.
2. Cutting at different stages.
3. Variety.
4. Rotation with Aman paddy.
5. Rotation with Potatoes.

Paddy experiments :—

1. Manurial.
2. Varietal.
3. Methods of cultivation.
 - (a) Number of seedlings per hole in transplantation—1, 2, 4 and 8.
 - (b) Quantity of seed per acre in broadcasting—25, 30 and 40 seers (medium sized grain) per acre.
 - (c) Different ploughs—Cuttack, Burdwan, Sibpur, Meston and Hindustan.
4. Irrigation.
 - (a) General.
 - (b) Application of different quantities of water (3" and 6") every 15 days.

Potatoes :—

1. Manure.
2. Variety.

Groundnuts :—

1. Manure.
2. Variety.
3. Rotation experiment.

Sugarcane :—Variety.

Turmeric.

Selected varieties of jute, paddy, sugarcane, groundnut, turmeric and papayas will be grown for seed distribution.

Chinsurah.—The laying out of the farm will be commenced.

Purnea and Berhampore Jute Seed Farms.—These two seed farms will be continued.

Chakradharpur Cotton Farm.—Plant to plant selection of seed of the Buri variety of cotton for distribution purposes will be continued. A manure experiment will be commenced.

Chaubassa Tasar Silk Farm.—Distribution of one year acclimatised cocoons for seed purposes will be continued.

III.—GENERAL.

Well boring experiments will be undertaken. Cattle breeding at Sripur will be continued. Proposals for the improvement of sericulture have been submitted and it is hoped that work under this head will be undertaken.

UNITED PROVINCES OF AGRA AND OUDH.

I.—Section under the Deputy Director of Agriculture, including the agricultural stations at Cawnpore, Oras and Aligarh.

Cawnpore.—Only changes in detail have been made in the programme presented at last year's meeting of the Board. The investigations deal mainly with fundamental problems such as the effects of the continuous growth of crops on the same land with and without manure, the quantity and composition of drainage water, some of the chief existing rotations, the quantity of water required for various crops, and the loss of water in transit to the field. The remaining work is mainly selection applied to maize, poppy and cotton. The new investigations taken up include the trial of cotton-refuse as manure, methods of preserving potatoes and fruits, and the renewal of the seed-stock of potatoes in the hills.

At the Juhi outstation for the reclamation of non-alkaline barren land, practically the only experimental work in progress is the endeavour to reduce the cost of tree-planting by the use of an auger for drilling holes through the barren layer.

Oras.—The main objects of this farm are to study the question of tillage in Bundelkhand, both generally and in relation to the growth of *kans*, to make some use of the inferior soils, and to attempt to increase the diversification of crops.

Aligarh.—This station is intended mainly for the study of cotton. Indigenous and acclimatized varieties are grown, and it is the chief centre for the distribution of the latter kind among cultivators.

No new work has been undertaken at the alkali sub-station at Gursikran.

II.—Section under the Assistant Director of Agriculture, including the agricultural station at Partabgarh and the investigations in sugar-manufacture.

The Assistant Director is on special duty for the greater part of the year in connection with the organisation of sugar-factories following his methods of manufacture. The field work at Partabgarh is preliminary; areas that appear suitable for experiments have been cropped uniformly and the yield is being tested by harvesting in small compartments. Meanwhile, only a few preliminary experiments with sugar-cane are in progress. The station is the centre of seed distribution on credit. A small alkali outstation has been formed for trial of gypsum, and another for the prevention of ravining.

III.—Section under the Economic Botanist.

The Economic Botanist is engaged mainly in organising the biological side of the Agricultural College. His experiments with cotton have advanced and a preliminary note of the scientific results is in course of publication. Information concerning the agaves of the province is being collected.

IV.—Section under the Agricultural Chemist.

The Agricultural Chemist is engaged mainly in organising the chemical side of the Agricultural College. He is taking up preliminary experiments with a view to the study of the losses in sugar manufacture recommended by the Board at its last meeting.

V.—Well-section, under the Director.

This section is engaged in placing out borers where they are wanted; in investigating the form of percolation-wells in sand, and the improvement in rock-wells; and in classifying the various areas of the province according to the nature of their resources and their needs.

PUNJAB.

PROGRAMME OF WORK FOR THE CURRENT YEAR OF THE DEPUTY DIRECTOR OF AGRICULTURE, PUNJAB.

1. Investigation of the Reh question in collaboration with the Agricultural Chemist.

2. The introduction of harvesting machinery to the notice of cultivators.
3. Demonstrations of improved sugar-making methods.
4. Distribution of American cotton in the Jhelum and Chenab Colonies.
5. District trials of cottons (Egyptian cotton in South-West Punjab, American and Egyptian at Hissar).
6. Seed distribution generally.

PROPOSED NEW WORK.

7. Establishment of a second Experimental Farm.

Preliminary investigations with reference to :—

- (i) Diseases of gram in collaboration with the Economic Botanist, Punjab.
- (ii) The question of fodder scarcity particularly in the south and east of the Province, and the possibility of increasing the yield of crops by manures or otherwise on irrigated tracts in, and adjoining, famine areas.
- (iii) Improvement of tillage in backward districts.
- (iv) Study of crop rotations in special districts.

PROGRAMME OF WORK OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, FOR 1908-09.

1. Little progress having been made with the equipment of the Lyallpur College and the framing of the curriculum and prospectus, the bulk of this work will fall in the present year.

2. The laying out and equipment of the Agricultural Station for experimental seed-growing and recreational purposes will claim a good deal of attention.

3. At the Lyallpur Agricultural Station constant observations will be made on, and attention given to, the experiments already in progress. These have been somewhat modified during the last year.

- (a) The most noticeable advance has been the laying out, for comparative experiments, of the area tested last year. This area having been found, as was to be expected, uneven in quality, 12 acres were laid out, in the light of the information obtained by the testing, in plots which are expected to give consistent results. The experiments on this area include the comparison of :—

- (1) Varieties—principally of wheat and cotton.
- (2) "Cinereal" manuring.
- (3) Nitrogenous manuring—including the growth, removal and ploughing in, of leguminous crops.

- (b) In addition to these strictly comparative experiments, the area directly cultivated for seed-growing purposes will be used for testing one or two promising varieties, methods of cultivation, or manures on a relatively very large scale.

- (c) Preliminary observations on the effect of light and heavy waterings and surface cultivation on different crops and soils will be made, with a view to re-starting the irrigation experiment.

- (d) Other experiments include the trial of machinery—chiefly harvesting machinery, of new crops such as jute, of the effect of leguminous weeds in the wheat crop, and on the inoculation of land newly sown with leguminous crops.

- (e) The work of segregating varieties of crops, especially of cotton, by growing seed from single plants separately—as has been done by Mr. Howard with the Punjab wheats, was begun last year and has now been taken up by the Economic Botanist.

- (f) Various kinds of common fruit trees will be grown under observation.

PROPOSED WORK OF THE AGRICULTURAL CHEMIST, PUNJAB, FOR THE YEAR 1908-09.

The work can be divided into two branches—

1. Educational.
2. Chemical.

1. After the completion of the laboratories of the Punjab Agricultural College, a large portion of the Agricultural Chemist's time will be given to the preparation of the courses of study which he will have to supervise and this will include the training of educational assistants.

2. Chemical work.

This includes the various problems awaiting investigation and which have, as far as possible, been placed in order of importance :—

- (a) An investigation into the composition of the alkali lands of the Province with the object of effecting a cure.
- (b) In connection with the above problem, an investigation of the type and quantity of salts absorbed by plants.
- (c) An examination of the salt wells of the Southern Punjab.
- (d) An examination of the *sajji* industry (the manufacture of crude carbonate of soda from salt bushes).
- (e) Analysis of the river and canal silts of the Punjab.
- (f) The improvement of sugar manufacture.
- (g) An examination of special soils in connection with the disease hæmorrhagic septicæmia.
- (h) The most suitable conditions for retting the various fibres which can be grown in the Punjab.
- (i) An investigation into the reported deficiency of nitrogenous manure in the Hoshiarpur District.
- (j) General analytical work in connection with the experimental station.

In the meantime, before the laboratories are complete, it is proposed that the Agricultural Chemist should tour as much as possible in order to gain personal experience of the natural conditions of agriculture in the Province and of its problems in particular.

A certain amount of work is still to be done in connection with the equipment of the Chemical Department, and this will require the personal attention of the Chemist.

PROGRAMME OF WORK OF THE ECONOMIC BOTANIST, PUNJAB, FOR THE YEAR 1908.

1. Organisation of office.
2. Fitting out of Laboratories and Libraries, etc., for the Economic Botanist and students.
3. Collecting and getting knowledge of the Botanical literature of the Punjab.
4. Carrying on and extending the work of improvement of varieties of cotton and wheat already started at the Lyallpur Farm.
5. Making a survey of the indigenous cottons of the Punjab and North-West Frontier Province with a view to improving these crops by selection and hybridization.
6. Touring the Province to collect Herbarium Specimens of plants, to be familiar with the Flora and to become acquainted with the special agricultural conditions that obtain in the Punjab.
7. While touring, an attempt will be made to solve the problems put forward by the agriculturists of the districts.
8. Necessary attention will be paid to the Mycological and Entomological work of the Department if placed under the care of the Economic Botanist.

BOMBAY.

I.—AGRICULTURAL STATIONS IN CHARGE OF THE DEPUTY DIRECTOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION.		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maxi- mum.	Mini- mum.
1	Surat . . .	21° 12'	72° 52'	South Gujarat.	172	Black Cotton.	1896	About sea-level.	39	106°	51°
2	Nadiad . . .	22° 44'	73° 0'	North Gujarat.	44	Alluvial Loam.	1903	Do.	35	114°	43°
3	Dhárwār . . .	15° 27'	75° 6'	Karnatak.	136	Black Clay and Laterite	1904	2580	32	100°	50°
4	Dhulia . . .	21° 10'	75° 20'	North Deccan.	28	Medium black.	1905	844	22½	114°	36°
5	Muváha . . .	22° 50'	70° 18'	Panch Mahála	58	Part red part black.	1906	..	30	108°	44°

In addition, land has been acquired (66 acres) for a farm to be irrigated from the Gokák Canal (Belgaum District), but it is not yet started owing to want of men and funds.

2. *Continuous investigations* are being conducted on the manurial and cultural practices of the cultivators in the several districts of which the conditions on the above stations are typical. New methods and artificial manures are being tried in comparison.

3. *Selection of the following crops* is a part of the work of all stations on which they are grown, viz.:—Cotton, Jowár, Báji, Wheat, Tur, Til, Ground-nut.

4. *Foreign varieties* of these crops are being tried.

5. *Cotton breeding* is being extended.

6. *A Cotton survey* of the presidency is being continued and, where mixtures are grown, these are analysed.

7. *A survey of the cottons of the world* will shortly be published by the late Deputy Director (Mr. Fletcher).

8. *A wheat survey* has been initiated.

9. *Cotton wilt* is being investigated.

10. *Disease proof potatoes* are being sought for (Dhárwār).

11. *Tobacco cultivation and curing* are being investigated (Nadiad).

12. *The Spice gardens* of Kanara are being experimented on with regard to the question of leaf mould.

13. *Land Reclamation* is being attempted at Dumas near Surat.

14. *Irrigation* on several of the stations is a subject of experiment both as regards quantity of water to be applied and method of raising it.

15. *Insect Pests* are being investigated.

16. *European ploughs* are being largely distributed to cultivators at cost price.

17. *Cotton and Ground-nut seeds* are being distributed.

18. An experiment in the *manuring of pasture land* on similar lines to that about to be carried out at Pusa is being initiated.

II -- AGRICULTURAL STATIONS IN CHARGE OF THE SECOND DEPUTY DIRECTOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres.	Types of soil	Date when established.	Height over sea-level	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maxi- mum.	Mini- mum.
1	Mirpurkhas .	25° 32'	69° 2'	Sind.	54	Light coloured clay.	1904	Feet. 50	7	116°	42°
2	Daulatpur .	25° 27'	69° 1'	Do.	400	Alluvial sandy loam to clay loam.	1907	50	7	116°	42°

MIRPURKHAS STATION.

1. This station is a representative of perennially irrigated lands of Sind.
2. The objects of this station are:—

- (1) Head-quarters of Agricultural Department in Sind.
- (2) Centre for seed distribution, chiefly Egyptian Cotton seed and Berseem or Egyptian Clover for the Jamrao Canal colonists.
- (3) A centre for demonstration plots carried out in various districts in Sind on Zamindars' own fields.

On the Farm itself the main work consists of comparative tests of Egyptian and American cottons, varietal tests of wheat, bajri, jowar, pulses, etc.

An important endeavour is being made to introduce into Sind one of the common Egyptian rotations with its improved cultivation and implements. As ordinary Sind cultivation is still in such a backward state all work is as far as possible of a simple and practical nature.

DAULATPUR STATION.

This station is a representative of the worst classes of alkali or *kalar* lands in Sind.

2. The object of this station is to prove that these *kalar* lands can be profitably reclaimed and after reclamation cultivated at a good profit. The land will be given out to Sindhi *haris* on cultivation and the work done by these on a basis of share of crop. The whole station is to be run on strictly commercial lines and similar to the work being carried on by Land Reclamation Companies in Egypt. It is expected to be useful not only as a reclamation station but also as a means of prominently bringing to the notice of Zamindars the benefit of more careful and intensive cultivation. The land is favourably situated with regard to water-supply. The analysis shows some portions of the land to contain over 3 per cent. of total alkali and is said by neighbouring cultivators to be quite unfit for cultivation under ordinary methods.

III.—AGRICULTURAL STATIONS IN CHARGE OF THE PROFESSOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maximum.	Minimum.
1	Månjri (near Poona).	18° 32'	74° 2'	South Deccan.	62	Medium black and light murum	1894	1,850	16	106°	46°
2	Poona Agricultural College.	18° 30'	73° 50'	Do.	130	Light and Medium black.	1905	1,850	32	106°	41°
3	Poona (Kirkee) Dairy and Dairy Farm.	18° 30'	73° 50'	Do.	66	Medium black and light murum	1879	1,850	32	108°	42°
4	Lonávale . .	18° 45'	73° 27'	West Deccan	30	Light.	1904	2,030	186	.	..
5	Báramata . .	18° 8'	74° 37'	Do.	11	Light and heavy black.	1906	1,774	22	..	..

MÀNJRI STATION.

Månjri station is a Sugarcane Farm. A comprehensive series of experiments has been drawn up by a Committee composed of the officers of the Department.

Experiments to determine number of waterings, interval between them and the total quantity of water required for sugarcane continued; rotations suitable for the block system of irrigation, manural tests, including application of farm-yard manure and safflower cake, in varying proportions and at different stages of growth; farm-yard manure, safflower cake and sulphate of potash, farm-yard manure, safflower cake and ammonium sulphate, farm-yard manure, safflower cake and calcium nitrate and farm-yard manure, safflower cake and crude nitre.

In all cases, the quantity of manure is to be measured by bulk as well as in terms of its chemical constituents instead of solely in such terms as in previous experiments. The results of sugarcane tests will be recorded as recommended by the Board of Agriculture of 1907.

Cotton and jute under irrigation are to be tried.

Tests with wheat varieties to be continued.

Gram and Jowar fodders will be grown in rotation with sugarcane.

Light shallow soil area is utilized for growing cottons of the American type, pulses, oats and barley.

POONA AGRICULTURAL COLLEGE STATION.

College Farm is devoted for demonstration to agricultural students and for students' plots.

Experiments in dry farming will be arranged.

POONA DAIRY STATION.

It is proposed to convert the Poona Station into a Dairy Farm.

Dr. Butler has a series of experiments with ground-nut Tikka disease, and one with Tur wilt. These will be continued. The rest of the area will grow fodder for the Dairy.

Breeding experiments will be continued.

LONAVLA STATION.

Lonavla rice experiments are to be continued. A new area has been taken up. The principal line of work is to investigate the principles upon which the efficiency of *rab* depends, and to find a suitable substitute.

Some work in making a survey of the rice varieties has been begun.

BARAMATI STATION

At this station the results of experiments with sugarcane and irrigated cotton obtained at Mānjri will be demonstrated.

Rabi crops will be grown on lands flooded in the *kharij* season

IV.—AGRICULTURAL STATIONS IN CHARGE OF THE ECONOMIC BOTANIST.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE	
		North Latitude	East Longitude.							Maximum.	Minimum
1	Ganeshkhind gardens.	18° 30'	73° 50'	South Deccan.	80	Medium black and reddish alluvial deep loam.	1904	Feet. 1850	32	109°	45°
2	Bassein gardens	19° 20'	72° 51'	North Konkan	90	Sandy alluvial loam.	1906	About sea level	83	96°	64°

GANESHKHIND GARDENS.

1. A systematic collection of indigenous trees and shrubs to determine (among others) the following facts:—

- (i) The most satisfactory methods of reproduction, transplanting and treatment during growth.
- (ii) The periodical increment of growth.
- (iii) Periods of leafing, flowering, fruiting and ripening of seed.
- (iv) Age at maturity.
- (v) Special investigations regarding the quality of timber, yield of the other economic products, etc.

2. Experimental introduction of rubber, fibre, medicinal plants, etc.

3. Experimental tests on exotic plants on the same lines as (1) and (2).

4. Endeavours to increase and to improve the yield of fruit trees, indigenous and also exotic, if found suitable for the Deccan.

5. Botanical research, in special natural orders, the first three to be undertaken being Malvaceæ, Leguminosæ and Cucurbitaceæ.

6. To continue the cultivation of cottons for purposes of botanical classification, also of wheat, rice, millets and pulses.

7. To attempt the improvement of a selected number of our finest wild flowering plants so that they can be used as garden plants.

BASSEIN GARDENS.

Programme of work as in the Ganeshkhind Botanical Gardens with special reference to conditions in the Konkan. While the ground within the Fort is being cleaned, advantage is being taken to study the best local methods of agriculture.

MADRAS.

On the Government Agricultural Stations the following are the chief lines of work :-

(1) *Paddy* experiments in spacing are being carried out on the Samalkota and Palur Stations and on the Central Farm at Coimbatore. The object is to find out the best number of seedlings to plant, and the best distance apart, in different soils and conditions. In most parts of the Presidency five or more, up to twenty seedlings are planted in one bunch. Experiments are also being made as to the best time to lift seedlings from the seed-bed, and the seed-rate for seed-beds. Experiments will also be made in transferring superior varieties to districts where they are not known. *Green manuring* experiments will be continued on the Central Farm, Coimbatore, and on the Palur and Hagari Agricultural Stations.

(2) *Sugarcane*.—The testing of new varieties will be continued at Samalkota, and the best varieties will be distributed as before from the Samalkota and Palur Agricultural Stations. Mauritius sugarcanes have also been successfully grown on a small experimental plot at Taliparamba, in Malabar, where the cultivation of sugarcane is almost unknown. Manual experiments on sugarcane will be continued at Samalkota and Palur.

(3) *Fibres*.—Experiments with jute will be continued at Samalkota, Palur, Taliparamba and Coimbatore, and it is hoped to get some more experimental plots of jute grown in Tanjore and Malabar through the local Agricultural Associations. Mr. Finlow inspected these plots last year and reported that the defects noticed in the crops were mainly due to want of experience. A specimen of *Corchorus capsularis* having been found growing in a wild state in South Canara, it seems probable that jute could be successfully cultivated on the West Coast. Experiments on *Hibiscus cannabinus* will also be continued. The subject of Sunn-hemp for fibre and green-manuring is being specially investigated by the Acting Government Botanist and a bulletin will be published in the course of the year.

The Hindupur Agave Plantation will be continued and experiments will be carried out with the co-operation of the Indian Fibre Company.

(4) *Cotton*.—The extension of the area under pure Karunganni by the distribution of pure seed on a large scale and the introduction of the drill and bullock-hoe of the Ceded Districts will be the main lines of work in the Tinnevely District. On the Koilpatti, Bellary, Hagari and Nandyal farms the most promising plants of the indigenous cottons will be selected and the seed sown next season for observation. The hybrid cottons at Bellary and Koilpatti will be treated in the same way. At Hagari various methods of planting and spacing will be tried, and irrigation experiments continued on local and Egyptian cottons. The work at Nandyal chiefly consists of rotation experiments. The various types which at present are found in a very mixed condition in the District are being grown separately for comparison.

(5) *Groundnut* at the Palur Station. Cultivation, varietal, manurial and rotation experiments will be continued. Special attention will continue to be paid to the "surul" caterpillar pest. This crop has also been tried at Coimbatore, Attur, Koilpatti, Taliparamba, Hagari and Samalkota. It appears that groundnut can be successfully grown throughout a wider range of climates and soils than was hitherto supposed.

(6) *Indigo* is being tried as a rotation for cotton at Nandyal, and the Java Natal variety is being grown on a small scale at Palur.

(7) *General*.—Cultivation experiments are being tried on several crops with a view to improving the methods of the preparation of the land, the methods of sowing or planting crops, and their after-cultivation. The measures for the eradication of the palmyra fungus disease which are being carried out under the direction of the Imperial Mycologist, will be continued.

(8) *Botany*.—The Anamalai forests will be explored for economic products, and the Nilgiris will be surveyed for plants of systematic and economic importance. Similar work will be done in the hill tracts of the Kurnool District. Fodder plants are being collected from the chief grazing districts of the Presidency, and attempts made to render available for commerce the fibres of the *nendrom* plantain of Malabar, the hill plantain of Madura, the Amritapani and Chakkarakali plantains of

the Gódvári and Vizagapatam Districts, the pine-apples of the Simhachalam hills and the West Coast, and the *Agave vivipara* of South Canara.

Efforts will be made to introduce from the West Coast into Ganjam and Vizagapatam several varieties of edible tubers.

The process of extracting edible oil from the safflower which has already been demonstrated, will be again brought to the notice of the people in the Madura and Tinnevely Districts.

The cultivation of Sunn-hemp for fibre is being investigated in all parts of the presidency where it is grown.

(9) *Chemistry*.—The laboratories will be fitted up and prepared for the use of the students, and for carrying on the analytical work of the province. It is hoped that the following general investigations may be taken up later on:—

- (1) A systematic investigation of the tank and river silts of this presidency.
- (2) Experiments dealing with the ripening of sugarcane and the changes occurring in the juice during the period of growth.
- (3) The food requirements of plants cultivated in Southern India.

CENTRAL PROVINCES AND BERAR.

There are four Agricultural stations in these Provinces—Nagpur, Raipur, Hoshangabad and Akola. These serve a double purpose (1) as experimental stations, and (2) as central depôts from which selected seed, good bulls and improved agricultural machinery can be obtained. The Raipur station is situated in the rice tract, Akola in the cotton tract, and Hoshangabad in the wheat tract. The experiments at these stations are devised to solve problems relating to the staple crop or crops grown in the tracts in which they are situated and to introduce new ones. The crops experimented with at the Nagpur station are of a more varied type, as are also the crops of the surrounding country. This station, moreover, serves as a college farm on which the students of the Agricultural College get a practical knowledge of all the important crops grown in the provinces. At all the stations the programmes of experimental work have been revised in the light of past experience, so as to simplify the issues and improve the standard of work.

The experimental work on which the department will be engaged during the year will fall under the following heads.

2. The chief experiments with cotton are in progress at Akola under the supervision of Mr. Clouston, Deputy Director of the Southern Circle. The four

Cotton.

different varieties of cotton commonly grown under the name of *jari* or *kativlayti* will be grown separately, and the values of the outturns compared *inter se* and with other indigenous and exotic varieties suited to the conditions that obtain in the cotton tract. The rigid system of plant to plant selection already being followed with the view of improving the indigenous varieties and the exotics under trial gives promise of success, and will be continued. Other experiments deal with the spacing distances most suitable for cotton plants, the most profitable rotations with cotton, the advantages or otherwise of topping young plants to produce increased branching, of deep *versus* shallow ploughing for cotton, and the use of artificial and natural manures. The tests of nitrate of soda and sulphate of ammonia will be continued, and the former will be applied at different times so as to find the most economical method of application. These artificials will be tried with and without cattle dung. Many exotic cottons, previously under trial, have been abandoned because they proved quite unsuitable to the local conditions, but the acclimatized American cotton received from Bengal under the name of *buri* is very promising, and will be tested on a field scale. The results from hybridization have generally been disappointing, but a few selected hybrids will be tested on a larger scale. Other hybrids will be produced, and crosses made between plants of the same variety in order to endeavour to improve the vigour of growth.

3. A collection of all the wheats grown in the provinces has been made, together with information about the tracts in which they are grown and their local reputation. The varieties have been grown pure to type, and a preliminary

classification is now in progress. The main work of the Hoshangabad station, under the direction of Mr. Evans, Deputy Director of the Northern Circle, will be the production of a variety immune to rust and at the same time of good milling quality. The pure varieties and crosses now available will be tested still further for rust resistance. Questions relating to depth of tillage, suitable rotations, manuring and the like will also be investigated at the Hoshangabad station. A special study will also be made of the varieties of pigeon-pea (*Cajanus indicus*).

4. Experiments in rice cultivation are confined to the Raipur station under the supervision of Mr. Clouston. The four different methods of cultivation are compared, *viz.*, transplanting, broadcasting with and without subsequent cross-ploughing, *lehi* (sowing artificially germinated seed). Work will be started in the improvement of varieties by plant to plant selection of seed. As double cropping is likely to become important in rice land under regular irrigation, experiments will be designed with the view of extending the practice by introducing new after-crops and improving on the present method of cultivating the land for this crop. Experiments are also being conducted to ascertain what is the most economical quantity of water for rice in different classes of soil, and whether light waterings at frequent intervals are more economical for the less retentive soils than heavy waterings at longer intervals.

Rice.

5. The rotation experiments with *kharif* and *rabi* crops will be continued at all the stations. A study of the sorghums of the province will be started at the Nagpur station by Mr. Allen, and the improvement of the most desirable varieties by seed selection will be continued at Akola. Different varieties of sugarcane and groundnut will be tested on the Raipur farm in order to ascertain which varieties can be grown most profitably. Groundnut (*Arachis hypogaea*) promises to be a useful introduction into Chhattisgarh as a rotation crop. The experiments with jute have given promise of success both at Raipur and Nagpur, when it is sown under irrigation in April-May, and will now be tested on a field scale. The tests of Russian flax at Hoshangabad, which have hitherto given no definite results, will be continued. A beginning will be made in testing the best fodder grasses at Akola station.

Miscellaneous crop.

6. The various series of continuous experiments with locally obtainable manures and imported fertilizers, including the experiments started with calcium cyanamide and calcium nitrate, with and without irrigation, will be continued. Leguminous crops and weeds will be tried as a green manure for wheat on a larger scale than heretofore and in the cotton tract trials will be made to grow gram as well as some of the leguminous weeds found locally as a second crop after cotton; the second crop will be sown between the rows of cotton after the last weeding of that crop.

Manurial experiment.

7. The advantages of deep *versus* shallow cultivation for wheat and cotton will be compared. The use of Ransome's Turn Wrest plough for the eradication of *kans* (*Saccharum spontaneum*) will be demonstrated on one of the demonstration farms. New implements will be purchased and tried from time to time.

Tillage experiment.

8. The study of the wilt disease in tur and rust in wheat will be continued. The value of *bhendi* as a catch crop for cotton boll-worm will be tested. The Entomological Assistant will be free to devote all his attention to outdoor work in future, as another Assistant is being appointed to lecture in Entomology at the College. The Mycological Assistant will be mainly employed in the collection of material relating to the principal plant diseases in the province.

Plant diseases and insect pests.

9. The Agricultural College will continue its educational work under the supervision of the Principal, Mr. R. G. Allen. The curriculum has been revised on the lines of the standard syllabus framed by the Board of Agriculture. Now that the prospects in the Agricultural Department have been settled by the introduction of a graded service a larger and better class of students is attracted. The Principal has been placed in charge of the Nagpur Agricultural station, so that there is ample field for practical work by the students.

Agricultural education

The value of *bhendi* as a catch crop for cotton boll-worm will be tested. The Entomological Assistant will be free to devote all his attention to outdoor work in future, as another Assistant is being appointed to lecture in Entomology at the College. The Mycological Assistant will be mainly employed in the collection of material relating to the principal plant diseases in the province.

10. The Agricultural Chemist will mainly be employed in teaching at the College and in the general analytical work of the laboratory. He will take up the investigation of the composition of the wheats of the province, which will be done in conjunction with Mr. Evans' investigations on wheats. He will also continue his study of the soils of the Nagpur tract.

11. The demonstration work of the Department will fall under the following heads :—

Irrigated rice farms.—Several small farms will be worked by the Department in the more backward agricultural tracts of Chhattisgarh, recently provided with irrigation from Government reservoirs. The two main objects of these farms will be to introduce the system of transplanting rice and growing irrigated *rabi* staples, both as a single and double crop, so as to induce the cultivators to utilize to the best advantage the water now at their disposal. The opportunity will be taken to demonstrate better methods of cultivation, and to introduce new crops and manures that have proved successful on the Raipur Farm. The new crops to be grown on these demonstration farms are sugarcane, jute and ground-nuts; and the manures to be tried are urine, earth, nitrate of soda, sulphate of ammonia and saltpetre.

12. *Cotton seed farms.*—The existing farms having proved a success, four new seed farms will be started this year. They will be supplied with selected seed from the experiment station, the cultivation will be carried out on special lines for seed production, and the produce will be available for seed distribution.

13. *Manures.*—In addition to the tests of manures at the irrigated rice farms mentioned above, practical demonstration will be given of the Meagher system of sewage disposal at selected towns. Co-operative experiments with nitrate of soda and sulphate of ammonia as fertilizers for cotton will be carried out by members of the Agricultural Association in the cotton tract. Some have also agreed to adopt the method recommended by the Department for conserving cattle urine and to test it as a manure for *kharif* or irrigated *rabi* crops.

14. *Prevention of smut in juar.*—The method of treating juar seed with sulphate of copper to prevent smut will be demonstrated to cultivators at fixed centres in some of the sorghum-growing districts, where the method is not yet practised. These demonstrations will also be carried out at fairs. In some tracts, this method of seed treatment has become an established agricultural practice.

15. *Improved implements.*—The use of suitable new implements, such as the winnower, fodder-cutter, corn-sheller, Cawnpore pump and light iron sugarcane mill will be demonstrated at fairs. An Agricultural Assistant will be sent to the United Provinces to learn the Hadi process of sugar-making.

16. *Publications.*—The *Agricultural Gazette* published monthly gives the results of experimental work and such other information as is likely to be of some practical utility to its readers. Bulletins and leaflets will also be published as their want is felt.

17. *Agricultural Association.*—The meetings of the Agricultural Association are recognized means of disseminating useful knowledge and advice among the leading cultivators of these provinces. These meetings will be attended by one of the officers of the Department.

BURMA.

The Department now consists of a Director, two expert Agriculturists, an Agricultural Chemist and an Assistant Entomologist. The sanction of Government has been solicited to the entertainment of an Assistant Botanist.

2. The further organisation of the Subordinate Staff and the construction of the College and Farm buildings will continue during the year. Work will be in full swing on the Mandalay and Hmawbi Agricultural Stations. Proposals for the acquisition of a site for a dry zone farm at Meiktila have been submitted; but, for want of a trained staff, work will not begin there till the rains of 1909.

3. The details of work under the Principal of the College and the Deputy Director of Agriculture are given below. Amongst more general work the

Agricultural Survey will, it is hoped, be commenced by the Expert Staff. The Director proposes to devote a portion of next rains to a detailed study of one or more of the dry zone districts which are peculiarly liable to scarcity with a view to considering the possibility of introducing drought resisting crops or supplying local irrigation by means of wells. The development of the principles of co-operation in the purchase of seed and implements will also be considered. The Director also proposes to visit the Southern Shan States some time during the year.

4. *Agricultural Chemistry*.—A laboratory for the Agricultural Chemist is nearing completion. Mr. Warth will be engaged in training Junior Assistants and in the detailed work set forth below.

5. *Entomology*.—The Assistant Entomologist will continue his studies and collections of insects of economic value under the orders of the Principal of the College.

6. *Agricultural Education*.—It is hoped that it may be possible to complete the curriculum of the College during the year under report, as also to formulate courses for the training of Normal School Teachers, Inspectors of Land Records and Revenue Surveyors, Survey School Teachers and sons of cultivators. The training of men already appointed to the Department will be continued. It is hoped that it may be possible to start the full Diploma Course by next rains, temporary accommodation being found in a part of the Director's new office and in the Chemical Laboratory.

7. *Publications*.—The issue of cultivator's leaflets and of Bulletins will be continued as the necessity for them occurs.

II.—UNDER THE PRINCIPAL, COLLEGE OF AGRICULTURE.

MANDALAY AGRICULTURAL STATION.

1. *Cotton*.—A number of new varieties have been introduced and are being tested. The indigenous varieties will be selected, and endeavours to improve them by crossing with other varieties will be made. Other new varieties will, if possible, be introduced and experiments in cultivation and rotation will be commenced. Very little care is taken at present by the Burman cultivator in the growing of cotton.

2. *Paddy*.—Classification of varieties, already begun, to be continued. At present more than 250 varieties are being grown for this purpose. Experiments on watering, suggested by the Irrigation Department, will be commenced, and, if possible, rotation experiments with jute.

3. *Groundnut*.—Distribution of tested varieties and introduction of new ones. A test of all varieties grown in Burma.

4. *Jute*.—An attempt will be made to grow jute in rotation with paddy; and experiments on cultivation and the best time to sow will be made.

5. *Wheat and Barley*.—Classification of existing local varieties and introduction of new ones. Wheat-breeding may be initiated.

6. *Sugarcane*.—Trials of new varieties and methods of cultivation on the Mandalay Farm. Introduction of better methods of crushing and gur-making into the chief sugarcane districts.

7. *Jowari and Maize*.—Trials of new varieties, and selection of the indigenous varieties.

8. *Grasses*.—A continuation of the grass experiments now in progress, and the trials of other kinds, particularly the best known indigenous varieties. A continuation of the grass survey at present in progress.

9. *Rotations and Manures*.—Several rotation and manural experiments will be commenced. Green manuring and the value of bones and bat guano, now so largely exported, will be demonstrated, if possible.

10. *Implements*.—Suitable European and other implements are being introduced. Other simple and inexpensive implements are being made locally under the direction of the Principal of the College. Three of these have already been tried and proved satisfactory. This work will be continued.

11. A complete Agricultural Survey of the Province is about to be commenced, and will continue, whenever possible, throughout the year.

III—UNDER THE DEPUTY DIRECTOR OF AGRICULTURE.

(a) HMAWBI FARM.

The work on this farm will consist of—

1. *Laying-out operations.*—The experimental area will be divided by bunds into half acre fields, and these, if it be found possible or expedient, may be again subdivided for purposes of experiment. The whole farm is under water during the rains, hence bunds are a necessity, especially in manurial experiments. Such land as is not required for experiment will be sub-let to cultivators. Farm buildings will, it is hoped, be erected during the year.

2. *Experiments with paddy*—

(i) *Varietal Experiments.*—To compare botanically and for yield the varieties grown in the Pegu, Hanthawaddy, Tharrawaddy and Prome Districts.

(ii) *Cultivation Experiments.*—To ascertain the best method of transplanting, whether in ones, twos, threes, etc., also to discover the best time for transplanting and to compare and to contrast transplanting and broadcasting.

(iii) *Manurial Experiments.*—Experiment with different plants as green manures, sunn-hemp, cow-pea, etc., will be tried. The best time of application of farm-yard manure will be the subject of an experiment, and it is also proposed to try the effects of the ordinary artificial phosphates, potash, etc., on paddy soils. The manurial value of paddy husk will be investigated.

(iv) *Native Implements*—will be tested alongside of introduced ones and their relative merits ascertained.

3. *Experiments with Jute.*—These will have for their object to test the possibility of growing jute successfully on typical paddy soil and also to discover the proper times of sowing and cutting. A few Indian varieties will be experimented with.

4. *Experiment with sugarcane.*—This crop is grown on high lands of the delta only. The experiment will be to test the possibility of growing it on banks or on ordinary flat paddy land. Local varieties will be tried first.

5. *Grass Experiment.*—A portion of the farm will be laid under permanent pasture. This will be subsequently subjected to manurial treatment with a view to improvement. An attempt to grow English grasses may be tried on a small area.

(b) OTHER WORK.

1. *Agricultural Surveys.*—It is proposed to make a complete agricultural survey of the whole country so as to ascertain accurately the methods, conditions, resources and requirements of each district. A start will be made with the Hanthawaddy District in 1908.

2. *Demonstration of Implements.*—When the buildings are erected at Hmawbi, demonstration will be given of the use and advantage of hand thrashing machines, winnowers, choppers, etc.

This will also be done during the agricultural surveys mentioned above and cultivators, who desire such machines, will have them supplied at cost price.

3. *Winter cultivation experiments*—may be continued on areas which are so flooded in the rains that even paddy cannot be grown.

Such experiments are being tried this year at Yandoon and Hmawbi where a variety of crops have been tried.

4. *Insect and fungoid diseases*—will be noted and specimens collected and forwarded for examination and identification.

IV.—AGRICULTURAL CHEMISTRY.

1. *Examination of the Experimental Farm soils*—

(a) Determination of chemical composition of the soils.

(b) Determination of physical state of the soils.

(c) Examination of some properties of the soils.

2. *Examination of the saline matters present in some soils—*
 - (a) Determination of the composition of such saline matters.
 - (b) Determination of the relative quantities present at different times of year.
 - (c) Study of some site where alkali is accumulating.
3. *Examination of Agricultural products—*
 - (a) Sesamum and ground nut oils.
 - (b) Toddy palm juice.
4. *Investigations in connection with the utilisation of silt on the lines of Sir Edward Buck's Report will be instigated by the Agricultural Chemist in conjunction with the Agricultural Experts.*

EASTERN BENGAL AND ASSAM.

1. The programme of work for the ensuing year falls under the following heads:—

- I. Organisation of the Department.
- II. Experimental work at the Agricultural Stations.
- III. Promotion of sericulture.
- IV. Experimental work outside the Agricultural Stations.
- V. Demonstration of agricultural improvements and dissemination of agricultural information.
- VI. Special work of the Expert staff.
- VII. Organisation and work of the Provincial Veterinary Department.

I—ORGANISATION OF THE AGRICULTURAL DEPARTMENT.

2. The superior expert staff consists at present of an Assistant Director, a Fibre Expert and an Agricultural Chemist. An Economic Botanist is expected to join the Department a few months hence. A Bengali Sibpur graduate, who has recently returned to India after a course of agricultural study at Cornell University in America, has been appointed an Agricultural Supervisor. It is proposed to appoint two more Agricultural Supervisors as soon as men suitable for the posts become available. Three students were sent a year ago by the Local Government for special courses in agriculture at Poona and Pusa and more will follow during the current year. It is expected that some of them will ultimately qualify themselves for appointments in the Department.

3. The expert staff will be located at the Dacca Central Farm. A most pressing work is the construction of laboratories and buildings for the accommodation of these officers and their subordinate staff. The farmsteading has been completed and quarters for one expert and some of the subordinate staff are nearly ready. It is expected that by the end of the year all the residences of the superior staff and the greater part of the work on the laboratory building will have been completed.

II—EXPERIMENTAL WORK AT THE AGRICULTURAL STATIONS.

4. There are seven Experimental stations now in the Province, *viz.*—

- (i) The Dacca Central Farm.
- (ii) The Rajshahi Farm.
- (iii) The Rangpur Farm.
- (iv) The Burirhat Farm.
- (v) The Jorhat Farm.
- (vi) The Upper Shillong Farm and the Shillong Fruit Garden which are worked as a single concern.
- (vii) The Wahjain Tropical Plantation.

The Dacca Central Farm and the newly opened station at Burirhat are being laid out in suitable plots for experimental purposes; the work is expected to be completed in a few months, but some of the land will not be fit for experimental work for some two or three years.

Several of the farms remain to be provided with buildings which are being pushed on as fast as local resources permit.

The programmes of work of the several stations are briefly noted below.

5. *The Dacca Central Farm.*—No programme of work has yet been prepared for this farm. It is proposed to settle a programme after consulting the Imperial and Provincial Experts at Pusa. As a basis of discussion, the Assistant Director proposes the following experiments for inclusion in the programme :—

- (i) *Winter rice.*
 - (a) To grow varieties to study characters.
 - (b) To test, or rather to demonstrate the effect of green manuring with dhaincha (*Sesbama aculeata*) and sunn-hemp (*Crotolaria juncea*).
 - (c) To test the effect of bone meal with and without the addition of saltpetre.
- (ii) *New Crops* :—Ground-nut, flax and 3 varieties of cotton (*Buri*, Dharwar American and Spence's tree cotton).
- (iii) Fertilising an upland field by continuous green manuring for two or more years on the following plan :—

1st year—	<i>Bhador</i> —	Jute	ploughed in.
	—	<i>Rabi</i> —Sunn-hemp,	ditto.
2nd year	—	<i>Bhadoi</i> — <i>Dhaincha</i> (<i>Sesbania aculeata</i>) ploughed in.	
	—	<i>Rabi</i> —Oats fed off on the land.	

Two acres of land may be taken, of which one may be treated as above and the other cropped in the ordinary way.

Experiments in breeding rice, maize and cotton may be initiated after the Economic Botanist has joined the Department.

6. *The Rajshahi Farm.*—The programme of work will remain nearly the same as for the current year. The new crops tried will be potato, *malancha* (*Malachra capitata*) and groundnut. There will be trials of varieties of autumn and winter rice, sugarcane and wheat and manure experiments in winter rice, sugarcane and mulberry. The scheme of manuring for winter rice is to be as follows :—

- (i) To test bone meal—6 mds. per acre *versus* no manure.
- (ii) To test green manuring with *dhaincha* instead of cow-pea (which has been hitherto used, but found not to grow well on the clay soil) *versus* no manure.

For sugarcane the manure experiments will be—

- (i) Cowdung—150 mds. per acre *plus* castor cake 24 mds. per acre, to see if the use of the additional manure is profitable.
- (ii) Super—6 mds., *plus* saltpetre 2 mds. per acre *versus* castor cake 24 mds. per acre, to see if the use of oil cake can be profitably superseded by that of mineral manures.

It is proposed to decide the scheme for experiment in mulberry cultivation after discussion at Pusa.

It is proposed to abandon the seed selection experiment with winter rice at Rajshahi and to concentrate all selection and breeding experiments at the Dacca Farm under the control of the Economic Botanist.

A demonstration of sugar making with Mr. Hadi's apparatus has been made this year at Rajshahi and Bogra. It will probably be repeated next year at some other places in East Bengal.

Experiments in jute, sida and malancha will be under Mr. Finlow's direction. To meet the need of steeping water the existing tank is being considerably enlarged.

7. *The Rangpur Farm.*—A new station for tobacco research having been opened at Burrhat, a place 5 miles from the Rangpur civil station, it is proposed to make over the Rangpur station to the local Agricultural Association, to whom the land belongs, with effect from the 1st July 1908. The Association have not been able to decide on what lines the farm will be worked.

8. *The Burihat Farm.*—This station is to be mainly devoted to tobacco. As hitherto, the main object will be to produce tobacco suitable for the manufacture

of cigars and cigarettes. A large number of exotic and indigenous varieties of tobacco are being cultivated—the treatment of the crop as regards manuring, spacing, topping and suckering, as well as the subsequent operations of curing and spacing, being varied according as the leaf is intended to be used as cigar wrapper or filler or for the manufacture of cigarettes. A small area of Sumatra tobacco is grown under shade, following the practice which has largely come into vogue in the United States.

Besides these attempts at producing tobacco suited for expensive cigars and cigarettes, it is also intended to give special attention to the production of tobacco suitable for cheap cigarettes.

Besides tobacco there will be experiments with different varieties of ginger and potato, both being important crops in the Rangpur district.

Groundnut will be tried as a new crop.

9. *The Jorhat Farm.*—This farm is to be devoted mainly to the sugarcane crop. A programme of sugarcane experiments for the current year was decided in consultation with Dr. H. Mann in April 1907. It is proposed to follow the same programme with some slight modifications in the ensuing year. The programme includes—

- (i) An experiment to test the merits of a number of varieties of sugarcane. There will be some fourteen varieties under trial in the coming year, four among these being seedling varieties imported last year from Barbadoes. The experiment includes a continuous detailed study of the field characters of each variety during the growing season.
- (ii) An experiment to ascertain the most profitable amount of cattle manure and oil cake to apply; the manures tried being as follows:—
 - (a) 300 mds. of cowdung plus 20 mds. of rape cake per acre.
 - (b) 150 mds. of cowdung plus 10 mds. of rape cake per acre.
 - (c) 75 mds. of cowdung plus 5 mds. of rape cake per acre.
 - (d) 300 mds. of cowdung and no oil cake per acre.
 - (e) 150 mds. of cowdung and no oil cake per acre.

To these it is intended to add experiments with fish manure, green manure, cotton seed cake and whole cotton seed.

- (iii) An experiment in ratooning on the two plots planted with varieties in the current year. Most of the plots ratooned this year will also be maintained for a third year.
- (iv) A selection experiment consisting in selecting the 20 best cuttings of each variety picked out from the healthiest clumps of cane in the variety plots.

The attempt to free from disease certain varieties of cane which are extremely susceptible to red rot by carefully excluding every set that may show the least trace of reddening at the cut ends will be continued.

The programme of the farm will include the cultivation of groundnut as a new crop, of potatoes and of several exotic varieties of pineapple and of plantain, orange, lime, litchi and mango trees. It will also include demonstrations intended to bring home to the local raiyats the advantages of the 3-roller iron sugar mill and the shallow evaporating pan over the wooden mill and deep pans used by them.

The Upper Shillong Farm and the Shillong Fruit-Garden.—The programme will be as follows:—

- (i) *Potatoes.*—
 - (a) Trial of varieties.
 - (b) Experiments to test the merits of
 - (i) boxed against unboxed seed
 - (ii) whole against cut sets
 - (iii) large against medium sets.
 - (c) Trial of Bordeaux mixture as a fungicide. This may be said to have passed the experimental stage. Arrangements are being made to demonstrate the value of Bordeaux mixture in a number of raiyats' fields in the ensuing season.

(d) Manure Experiments :—

(i) Green manure with pulse crop *versus* no manure.

(ii) Rape cake—20 mds. per acre

versus

Super—6 mds.

Sulphate of Potash 3 mds.

both fields receiving 150 mds. of cow dung in addition.

} per acre,

(iii) *Introduction of European fruits and fruits of the semi-temperate climate.* These include apple, pear, cherry, plum, apricot, peach, grape, strawberry, gooseberry, raspberry, currant, fig, walnut, almond, loquat, tree tomato, cherimoyer and mountain papaya.

(iv) *Distribution of trees and seeds* of such new fruits and vegetables as have proved successful. These include pear, strawberry, fig, Spanish chestnut, rhubarb, asparagus, mulberry, varieties of potato, and a large fruited variety of squash.

(v) *Trial of new crops.*—Three varieties of American sweet potatoes, Jerusalem artichoke, mangel wurzel and groundnut.

(vi) *Breeding of maize.*—By cross-fertilising local with superior American varieties.

(vii) *Preservation of fodder in soils.*—As an object lesson to Khasia cultivators.

(viii) *Cattle-breeding.*—Efforts are being made to introduce a good milking strain of cattle and to improve the local Khasi breed by crossing it with a half English Patna bull. The farm will continue to distribute young bulls of its own breeding to cattle breeders in the District. The Superintendent of the Veterinary Department will constantly inspect and advise on the breeding operations.

(ix) *Sericulture.*—The cultivation of mulberry will be continued, as well as the experiment in the rearing of the univoltine silkworm, both from fresh imported seed and from seed locally produced. It has been proved that European silkworms can pass at least one year in Shillong without deterioration or increase of disease. It is now intended to ascertain whether the seed of the same worms gives equally good results in the third year. To introduce sericulture in the Khasi Hills, one Khasi boy has been sent with a Government stipend to the sericultural school at Rajshahi. He has bound himself to commence rearing silkworms on his return after completing the normal course of training at the school. Next year it is expected that two more Khasi boys will be sent for training.

11. *The Wahjain Tropical Plantation.*—The plantation will continue to be used as the trial ground for various species of tropical spices, drugs and fruits. These are as follows :—

A. *Spices*—

Cinnamon,
Lesser Cardamom,
Greater do.
Nutmeg,
Clove.

B. *Drugs*—

Coffee,
Cocoa,
Camphor.

C. *Fruits*—

Oranges and other citrus fruits,
Pineapple,
Papaya,
Grafted mango,
" litchi,
Sapota,
Banana,
Bread fruit,
Rambutan,
Soursop,
Cherimoyer.

D. Essential oils—

Lemon grass,
Tezpat (leaf of a species of Cinnamon).

The plantation is situated on the southern slopes of the Khasi Hills which are the home of the Sylhet orange. A very serious blight has appeared in the orange groves, which has already killed a vast number of trees, and is spreading fast. Dr. Butler was good enough to send one of his assistants, Mr. S. K. Basu, in May last to investigate the pest. His report has not yet been received, and no remedial measures have as yet been suggested. The blight is believed to be the work of a fungus which spreads underground from tree to tree. It has been observed that several species of citrus, though growing in close association with diseased orange trees are free from the blight. Experiment is being made to confirm this observation by planting a large number of citrus trees of different species in a badly diseased orange garden. If any of these species prove immune to the attack of the fungus, it will be possible to combat the blight by using them as stocks for grafting the orange on. Previous attempts at grafting orange on such stocks have however failed, and information is desired as to whether skilled grafters can be obtained from the Central Provinces or elsewhere to conduct further experiments.

III.—PROMOTION OF SERICULTURE

12. It has been decided that this province, while working in concert with Bengal in measures for the revival of the silk industry should have a separate staff for the purpose. This department is therefore taking over from the Bengal Silk Committee the charge of all sericultural operations in the districts of Eastern Bengal, including the two small pure-seed stations in Rajshahi. These it is intended to supplement shortly by two large rearing stations, one in Rajshahi and the other in Bogra, each controlled by a responsible officer of the grade of Sericultural Superintendent. One such officer after passing through a course in sericulture in Tokio University is now receiving special training in Indian methods under Mr. A. K. Ghose, Sericultural Superintendent of Bengal.

The sericultural school at Rajshahi will be continued on the lines already established last year. Twelve apprentices are received who must be sons of silk-rearers. After a year's training each apprentice who proves himself thoroughly competent is awarded a microscope together with a sum of Rs. 250 with which to build a model rearing house. It is expected that the number of students will be increased to twenty from January 1909, when probably six students will be received from Bengal, and two from the Khasi Hills.

IV.—EXPERIMENTAL WORK OUTSIDE THE AGRICULTURAL STATIONS.

13. The programme of work outside the Agricultural Stations will include helping Government Officers in making experiments in Government and wards' estates with advice as well as with seeds, manure, etc., and rendering similar assistance to private individuals wishing to try new crops, manures or implements. There are several private experimental farms in the Province which are being worked in co-operation with the department and will continue to receive its assistance.

14. An important branch of work, not directly connected with any Agricultural Station is the investigation of insect pests and the application of remedies wherever possible. The Department has in its employ an Entomological Collector who received his training under Mr. Lefroy at Fusa. It is proposed to issue a small handbook in the chief vernaculars of the province, of more important insect pests locally known for which practicable remedies can be recommended.

15. In some parts of the province the rearing of poultry and ducks and the sale of eggs are important industries. It is intended to make some experiments on the rearing of improved breeds and in the introduction of improved methods of preserving eggs. Some of these experiments will be made by officers of the department, others will be made by private persons and officers of other Departments with our advice and help. In all cases the experiments will be on a modest and tentative scale, until experience has shewn the lines on which larger operations can be undertaken with full expectation of ultimate benefit to the country.

16. The supervision of measures for the improvement of the hand-loom industry has received a large share of the attention of the officers of the department during the past year and it is probable that during the ensuing year this work will be largely developed.

17. During 1907 the department was charged with the duty of arranging for the planting of avenues in the new civil station of Dacca. It is probable that shortly the department will be directed to supervise the roadside arboricultural operations of the whole province.

V.—DEMONSTRATION OF AGRICULTURAL IMPROVEMENTS AND DISSEMINATION OF AGRICULTURAL INFORMATION.

18. The Department hopes to receive considerable assistance from its Honorary associates and correspondents in disseminating useful agricultural knowledge and in obtaining timely information of pests, blights and other calamities affecting crops, with a view to taking such steps as may be possible towards devising remedies. Some associates and correspondents have already been appointed, and it is proposed to extend the number as gentlemen qualified to do the work expected of them become available. An Honorary correspondent is expected to send regularly to the Department reports on all matters affecting crops and, in return, he is supplied with all information likely to be useful to the agriculturists of his neighbourhood. An Honorary Associate in addition to the duties of an Honorary correspondent is expected to make a comparative demonstration of an agricultural improvement which has been already proved by experiment.

19. The demonstrations to be taken up at present have been described in a bulletin (No. 16) issued by the Department. Materials for a bulletin on the cultivation of the potato, another on the cultivation of coffee in the Khasi Hills and a third on the use of Bordeaux mixture as a fungicide, particularly with reference to the potato disease, are being collected by the Assistant Director, and will be soon ready for publication.

20. Agricultural exhibitions which are an important means of spreading a knowledge of new crops and new agricultural practices will continue to receive assistance from the Department.

21. The compilation of agricultural statistics and the improvement of the present system of collecting figures for crop forecasts will require and receive considerable attention from the officers of the Department.

VI—SPECIAL WORK OF THE EXPERT STAFF.

22. Mr. Finlow will continue, in collaboration with the Reporter on Economic Products, the chemical and agricultural study of the various races of jute, having regard to quality as well as yield of fibre. The selection experiments with jute will be continued and, if possible, some cross fertilisation experiments will be made. Mr. Finlow will also be required to advise on measures for the extension of jute cultivation to parts of this province where, though the land is suitable, the crop is not at present grown. Mainly to assist in these measures he will maintain and distribute a sufficient supply of first class seed. He will also continue to visit other provinces where his services are required in connection with jute experiments.

23. During 1907 Mr. Finlow, in collaboration with Messrs. Cross and Bevan of London, commenced an investigation regarding the deterioration of damp baled jute. This will be continued and possibly completed during the year.

24. Further experiments will be made with flax cultivation and retting. The study of various fibre yielding plants indigenous to this province will be developed. It is hoped that a bulletin on the latter subject will be published during the year.

25. One of Mr. Meggitt's important duties will be to see that the construction and fitting up of the Central Laboratory at Dacca are brought to a speedy and satisfactory conclusion. Meantime from June next he expects to have the use of the old Dacca College laboratory.

26. The Local Government have asked that an enquiry should be taken up in regard to the value of the silt deposits on land annually inundated by rivers. One branch of this enquiry relates to the effect of embankments in depriving the fields of further supplies of silt. The details of the enquiry have not yet been settled. It is intended that this should be done after consultation with the Imperial Experts and officers of other provinces at Pusa. The enquiry when taken up will be in Mr. Meggitt's charge.

27. The Agricultural Chemist will also be required to continue the analytical work commenced this year in connection with sugarcane experiments. Many other analyses of soils, manures and plants will also have to be made.

VII—ORGANISATION AND WORK OF THE VETERINARY DEPARTMENT.

28. The Secretary of State having now sanctioned the formation of a Veterinary Department in this province, it is expected that great progress will be made during the year in veterinary work. At present there are under the Superintendent, one Inspector and 28 assistants. Within 4 or 5 months it is hoped that these numbers will be increased to 2 Inspectors and 48 assistants. The inspection and instruction of the new assistants will occupy most of Mr. Harris' time. He is also required by Government order to inspect and test all glanders and surra cases before any animal is destroyed under the Act.

29. An excellent site has been obtained for the Veterinary headquarters and laboratory between the new and old civil stations of Dacca. The construction of buildings will, it is hoped, be well in hand by the end of the year.

30. The special staff of inoculators under a qualified European Veterinary Surgeon will be maintained for a further period of one year in the Surma Valley where great progress has already been made in driving out the epidemic of rinderpest which had been working untold havoc among the cattle.

BARODA.

1. There are now four Farms—one Experimental and three Demonstration Farms in the State. The crops experimented with at the Baroda Model Farm are of a more varied type, as are also the crops of the surrounding country. This Farm, moreover, serves as a school farm on which the students of the Agricultural school get a general knowledge of all the important crops grown in the State. The three small Demonstration Farms are worked by the Department in the more backward Agricultural districts with the object of demonstrating better methods of cultivating certain crops, or of introducing new ones. The experimental work on which the Department will be engaged during the year 1908-09 will fall under the following heads :—

2. Manure experiments on Tobacco and Sugarcane were started last year with the intention of ascertaining whether any artificial manures can be economically successful so as to replace manures locally obtainable. For this, complete manure formulæ were made up for equal cost. This being the first year of the experiment, no results were deduced. The experiment will be continued.

3. Sowing of white Egyptian cotton at various dates was tried. That started in March gave 600 lbs per acre, while that sown in June gave only 240 lbs. The experiment will be continued.

Special experiment with brown Egyptian cotton without irrigation was tried in people's fields in various kinds of soil. The results show (1) that the best black soil of Gujrat is suitable for this crop; (2) that the heat of October—November forces this cotton to early maturity and the bolls thus formed attract boll-worms; and (3) that by removing tops and October flowers as they are found, good crops may be hoped for.

The trial will be continued now on a small scale under direct control of the Department in the best black cotton soil.

4. The seed of big Japanese groundnut which gave the best yield as an unirrigated crop has been given to the best cultivators and Travelling Instructors with printed leaflets of instructions. Efforts will be made to make this crop popular

- Cheese. 5. The Cheese-house which was under construction last year is now complete for making cheese and for utilizing Skim Milk.
- Cross breeding. 6. Cross breeding between English and Indian cattle will be tried.
- Seed Depôts. 7. The number of Seed Depôts for the selection and distribution of seeds of ordinary crops will be increased.
8. The insect diseases of tobacco, rapeseed, sesamum, gram, cotton, sugarcane were studied. Useful particulars about the cotton bollworms and Katra have been printed in Gujrati leaflets.
- Entomology.
9. The Mulberry plantation was extended at the Songhad Sericultural Farm to meet the growing demands of people for propagation. Six crops of silk worms were taken last year and forty students have received instruction in rearing and reeling. It is hoped that these students will take up the new industry, as special concessions are given.
- Sericulture
10. Revised course of studies in the School of Agriculture will be introduced from this year.
- Agricultural Education
11. Three more Experimental Farms will be opened before the end of this year for special experiments of cotton, poppy and sugarcane at Dabhoi, Sidhpur and Navsari, respectively.
- Experimental Farms
12. To induce the cultivators to make use of English implements, Turn Wrest Ploughs B.T. 2 are given on loan with skilled labour of the farm to well-to-do farmers. They tried these ploughs on their own lands and have promised to buy some ploughs.
- Introduction of English Ploughs
13. This year to economise water on irrigational crops, side-irrigation is tried on sugarcane, wheat, tobacco, English vegetables, potatoes, etc. The whole is still in experimental stage, but the present outlook of all the crops is very healthy, and it is expected to give a better yield.
- Side-irrigation.
14. It is proposed this year to inoculate the farm yard manure with Nitrogen-bacilli and to compare this manure with other artificial Nitrogen manures; if possible, the inoculated manure will be distributed to well-to-do farmers for trial.
- Inoculation of manures.

KASHMIR.

1. Experimental work at the Pratap Model Farm to be continued on the following points :—

1. Variety experiments with—

- (a) Wheat.
- (b) Oats.
- (c) Gram.
- (d) Peas.
- (e) Mustard.
- (f) Shali.
- (g) Cotton.
- (h) Maize and jvar in alternate plots.
- (i) Tobacco.
- (j) Potatoes.

The object of the variety experiments being to discover varieties suitable to the Kashmir Valley and superior to those commonly grown.

2. Russian Inseed (Riga) for fibre. Experiments were made with Riga to see if it could successfully be grown for fibre in Kashmir. The seed was obtained from the Department of Agriculture, Eastern Bengal. The sowing was delayed

over a fortnight owing to severe rains. The cultivation too was unsatisfactory owing to want of the proper implements. A sample of fibre, as grown, was sent to Messrs. Oglvy, Gillanders and Company, London, for favour of opinion, which is given as below :—

“Codilla, rough, strawy, mixed strength, value £13 to £14 per ton; owing to the irregularity of the sample, it is valued lower than it would be, if stored.

If the product was carefully stored, a varying proportion of ‘Line’ (which means fine quality) would be obtained, which at present is valued £20 to £30 per ton and ‘Codilla’ at a proportionate price.”

3. Manual experiments with—

- (a) Wheat.
- (b) Mustard.
- (c) Peas.
- (d) Paddy.
- (e) Oats.

The manures to be tried in each case are those which are easily procurable by the cultivators of the Valley. They are as follows :—

Horse dung; cattle dung; farm-yard manure; Dal soil; ashes of chinar leaves.

The Electric Department of Jammu and Kashmir State expects to produce nitrate of lime at a very cheap cost.

4. Green manuring *versus* Farm-yard manure.

- (a) Two plots. Wheat after urd-fodder ploughed in.
- (b) „ Wheat after moong-fodder ploughed in.
- (c) „ Wheat after hemp ploughed in.
- (d) „ Wheat after beans ploughed in.
- (e) „ Wheat after application of 100 maunds farm-yard manure.
- (f) „ Wheat without any manure.

The object is to see whether green manuring could quite as well and economically serve the purpose of farm-yard manure, which is very difficult to get sometimes at any price.

5. Norfolk rotation of Four Course System.

First year.—Wheat.

Second year.—Potatoes.

Third year.—Oats.

Fourth year.—Lucerne.

Fifth year.—Same as first year, and so on.

6. Two-year rotations :—

- (a) Two plots. Wheat and beans in alternate years
- (b) „ Wheat and juar do.
- (c) „ Wheat and peas do.
- (d) „ Wheat and urd do.
- (e) „ Wheat every year.
- (f) One plot. Wheat-mustard every year.
- (g) „ Wheat-gram every year.

7. Dofash rotations :—

- (a) Two plots. Wheat after urd-fodder removed.
- (b) „ Wheat after moong removed.
- (c) „ Wheat after hemp removed.
- (d) „ Wheat after beans removed.
- (e) „ Oats after urd removed.
- (f) „ Peas after juar removed.

Further work proposed to be done by the Agricultural Department of Kashmir State is —

- II. Organization of the Department.
- III. Trial of the following new crops :—Groundnut, juar, bajri, [finer paddy and lucerne.
- IV. Seed selection and distribution of ordinary crops.
- V. Trial of the Watt's and Meston ploughs and other agricultural implements likely to be more serviceable to the cultivators of the Kashmir Valley.
- VI. Cattle-breeding. Efforts will be made to improve local breeds of cattle by the distribution of stock from the farm.
- VII. Arrangements are being made for a seed farm.
- VIII. A Live Stock and Agricultural Show was held in Shrinagar on 18th and 19th October 1907 for the first time. It was fairly successful, and it is arranged that one should be held every year to encourage the cultivators and the zamindars of the Valley.
- IX. Introduction of European fruits and vegetables in the State gardens.

APPENDIX D.

PROPOSALS FOR THE EXPANSION OF THE DIFFERENT SECTIONS OF THE PROVINCIAL DEPARTMENTS OF AGRICULTURE.

The rates of pay fixed for the higher posts for Indian assistants at Pusa are not sufficient to attract and retain the best available men. It is equally certain that better rates of pay would attract better Indian assistants to the Agricultural Department of each Province, and would prevent them, after passing through the course in Agriculture, from eagerly seeking employment in other Departments as at present.

2. Until the best Indian assistants are employed for laboratory, class room and field work, it is uncertain that reliable original agricultural work will be done by them and probably ordinary routine work will also suffer.

3. Field and other practical experiments must always be largely supervised by Indian assistants. If this supervision is inadequate, the recorded results must be worse than useless.

4. The men we want should have been brought up on the land and should have obtained a good general education as also a technical education in some branch of the Department. The rates of pay for Indian assistants in the Agricultural Departments should be graded to rise as high as those in the Revenue Department.

5. I submit below a scheme to provide a sufficient native agricultural establishment for each Province. I hope it will be accepted by each Local Government without material alteration as the basis to which each Province can work up gradually. If Local Governments generally accept my proposals, we will have a strong case to put before the Secretary of State. The rates of pay and prospects should as far as possible be fairly uniform for all sections of the Department in each Province.

6. The work in each Province should be approximately as follows:—

- (a) Research and tuition in the College and in the field of the College Farm and to some extent in the districts.
- (b) The practical application in the field of research and experimental discoveries of proved value, the extension of improved varieties of crops, of improved methods of cultivation or other improvements from the experimental plots through demonstration areas to the cultivator's fields, the study of the variable and fixed natural conditions and their influence on agricultural possibilities and the collection of general agricultural facts.

7. For the work classed under (a) the following European staff was proposed by the Government of India to the Secretary of State:—(1) an all-round Agriculturist to be Principal of the College; (2) an Agricultural Chemist; (3) an Economic Botanist; (4) a Mycologist; (5) an Entomologist. The Principal of a Provincial College need not necessarily be an expert Agriculturist. Another expert on the staff might be a better man for the post. The Principal should reside at the College, but the other members of the staff will be able to tour to a considerable extent and all should be in continuous communication with the Deputy Directors of Agriculture, so that research work can be, as far as possible, based on practical information gathered in the field.

8. The Provincial posts of Mycologists and Entomologists have not been sanctioned by the Secretary of State. It is therefore necessary to get these sections of work done in each Province by the best Indian agency which is procurable.

9. Each European Expert, who at a Provincial College is a Professor of a particular subject, should have an Indian assistant thoroughly capable of teaching and also of guiding the laboratory work of the students.

10. In every Provincial College provision should be made for the teaching of Physics, Geology, Agricultural Mechanics, Surveying, Plan Drawing, Book-keeping and to some extent Veterinary Science in addition to the main subjects, viz., Agriculture, Chemistry, Botany and Mycology.

11. I summarize below the Indian establishment required at each Provincial College and Research Station :—

Principal and Agriculturist's Section.

1 Assistant Professor of Agriculture	250-10-500	
1 Farm Manager	200-5-250.	
1 Teacher of Physics, Agricultural Mechanics and, if necessary, Mensuration and Mathematics.	150-5-250.	
1 Teacher of Surveying, Plan Drawing and Farm Book-keeping.	100-5-150.	
1 Veterinary Assistant for teaching and also in charge of the District Dispensary.	100-5-150.	
2 Field Assistants	75-5-125.	each.

Agricultural Chemist's Section.

1 Assistant Professor of Chemistry and Geology	250-10-500.	
1 Laboratory Assistant and Demonstrator	150-5-250.	
2 Laboratory Assistants.	100-5-150.	each.
2 Ditto	75-5-125.	"

Economic Botanist's Section.

1 Assistant Professor of Botany	250-10-500.	
1 Laboratory Assistant and Demonstrator	150-5-250.	
2 Field Assistants	75-5-125.	each.

12. Since the Secretary of State has not sanctioned the appointment of European Mycologist and Entomologist for Provincial service, Dr. Butler and Mr. Lefroy have made proposals which provide the following Indian staff in each Province. Full explanations are given in Appendices to this note :—

Mycology.

1 Assistant Mycologist and Teacher (when necessary)	250-10-500.	
1 Laboratory Assistant and Demonstrator	150-5-250.	
2 Field Assistants	75-5-125.	each.
1 Fieldman	30-4-50.	
1 Collector and Mounter	10-2-30.	

Entomology.

1 Assistant Entomologist and Teacher (when necessary).	250-10-500.	
1 Laboratory Assistant and Teacher	150-5-250.	
3 Field Assistants	100-5-150.	each.
4 Ditto	75-5-125	"
2 Setters	30-4-50.	"
7 Fieldmen	10-2-30.	"
1 Laboratory keeper	10-2-20.	

13. The work of the Provincial Mycological and Entomological Assistants should be supervised by the Economic Botanist. Therefore efforts will be made to appoint to each Province an Economic Botanist of proved experience in original and practical work.

14. It should be recognized that it will take years to work up to an effective staff of Indian assistants, but definite rates of pay should be fixed at once to attract the right men. I consider that agricultural improvement in India depends largely upon the proper training of Indian assistants.

15. I strongly believe that the senior assistant of each European Expert of each Provincial College should be trained partly in England until Pusa can undertake this training. Each should be a graduate in Agriculture of an Indian College and be deputed to the Cambridge University for two years on a pay of Rs. 200 to take his degree in Agriculture and afterwards to specialize in his own particular subject. Experience has shown that selected students, who have graduated in Agriculture in India, have no difficulty in taking the Cambridge degree in Agriculture in a year and are then free to specialize in Economic Botany, Agricultural Chemistry or any other Agricultural subject in the other year. Each student should then have one year's further training at the Pusa Research Institute. The training

at Pusa will, by the time men are ready, be as good as that at Cambridge and directly suited to Indian workers. The other posts of my list down to those on pay Rs. 75-5-125 should be filled by graduates in Agriculture of an Indian College who should also in special subjects get a further special training at Pusa (for instance in Mycology or Entomology).

16. In (b) section of Provincial Agricultural work referred to in paragraph 7 of this note, the Deputy Director of Agriculture requires a sufficient number of Assistants as Farm Superintendents, Overseers and Fieldmen. The number should increase as work develops. I propose the following rates of pay :-

Superintendents of Experimental Stations and Seed Farms	200-5-250.
Overseers of Demonstration Areas	100-5-150.
Fieldmen	75-5-125.

In all cases these men should be chosen from the Agricultural graduates of Indian Colleges. A Fieldman may of course be gradually promoted to be a Superintendent.

17. It is unnecessary for me to discuss the range of work of Deputy Directors of Agriculture and of European Experts attached to Provincial Colleges and Research Stations. The work will be largely influenced by the originality and individuality of each man, but will be guided of course very materially in each Province by the consultation between the Experts and the Directors of Agriculture.

18. At Pusa full arrangements have been made for the illustration work of each section. Coloured and other illustrations can now be clearly reproduced in India and arrangements are being made so that coloured plates representing the life history of destructive insects will be supplied for leaflets or other publications to be issued by Provincial Agricultural Departments or by vernacular papers or otherwise at Rs. 30 per thousand and similar arrangements can be made in any other section.

J. MOLLISON,

Inspector General of Agriculture in India.

APPENDIX I.

A summary of some information obtained from the Imperial Mycologist regarding the expansion of his work in different Provinces.

The Secretary of State has not sanctioned a European Mycologist for each Province; therefore highly-trained Indians must do the work.

2. The need for Mycological enquiry regarding Indian crops is great. Rust causes immense loss to cereals and to linseed almost every year. Smut is also very prevalent in cereal crops and grasses. The palm disease in Madras has already caused loss amounting to 20 lakhs of rupees or more. The Betel Palm plague in Eastern Bengal is still more disastrous. Many other plant diseases affect the prosperity of agriculture in India. The cost of Dr. Butler's section would be met for many years by checking one of the major diseases which affect our agricultural crops.

3. He draws a distinction between the immediate results of the work of his section and of some other branches of agricultural science in India, because before his time there were no previous workers in India in Agricultural Mycology except Dr. Barclay and Dr. Cunningham; and because Mycology in relation to agricultural plant diseases is yet only a new science particularly in the tropics.

4. There is not a general treatise which deals with the fungus diseases of the tropical agricultural plants. Dr. Butler is preparing one and it is almost ready for the press. He has issued many clearly illustrated articles which deal with particulars of his work. Complex plant diseases are not necessarily the most difficult feature of Dr. Butler's work. He says there is often a stage in the life history of a plant parasite in which destructive measures are possible, and with full knowledge once gained a decision can easily be made upon the beneficial lines of work.

5. The first requirement for Mycological work in India is full provision for research. This, for the present, must be arranged for at Pusa. It is a very big undertaking, considering the agricultural area and the number of crop diseases which have to be dealt with. For research and general work at Pusa and throughout

India 3 European Mycologists and a full staff of Indian assistants will probably soon be employed.

6. The present Indian staff of the Mycological section at Pusa, excluding clerical and menial establishment, consists of—

	Rs.	
1 First Assistant	200-250	
2 Assistants	75-125,	each.
1 Fieldman	50-75	
2 Fieldmen	30-50,	each
1 Assistant (for Supernumerary Mycologist)	75-125,	
2 Assistants (trained for and employed by Provincial Departments).	100,	each.

7. Experience has proved that better rates of pay are required to attract and keep first class Indian assistants. Proposals have been made for such improved pay.

These proposals are—

	Rs.	
1 First Assistant and Teacher	300-600	
1 Second Assistant	250-300	
1 Third Assistant	200-250.	
3 Assistants	100-150,	each.
1 First Fieldman	50-75	
2 Fieldmen	30-50,	each
1 Assistant to Supernumerary Mycologist	75-125.	

8. The Indian staff above referred to is required for field and laboratory work connected with research and also for teaching students sent from Provinces.

9. The establishment at Pusa of a central reference collection and library in Mycology is receiving particular attention, as it is of the first importance that the Mycological workers in India should get fungus pests identified at or through Pusa and get other assistance there. The demand for information is keen from officers in the Forest and other Civil Departments and also from men in the Provincial Agricultural Departments.

10. The work of the Pusa staff will chiefly for some years refer to—

- Scientific research in plant diseases and their remedies and other problems such as the action of the fungi in the soil. It is from such enquiries that practical measures of treatment are chiefly expected.
- The study of the fungus flora of India and arrangements for a central reference collection which will aid Provincial Departments in the determination of their pests and in the study of life histories and in teaching students.
- The publication—
 - of the results of research work in specific diseases,
 - of descriptions with illustration of Indian fungus affecting agricultural crops,
 - of the results of remedial measures,
 - of popular articles in the Agricultural Journal of India or in leaflet form, the object of these being to indicate to educated landowners and agriculturists how the work of the section can be applied to practice in the field.
- The training of men for Provincial work.
- The co-ordination of work in the Provinces.
- The conduct of campaigns too large for the Provinces to deal with unaided.

11. The staff required in each Province should for the present be as follows :—

	Rs.	
1 Assistant Mycologist and Teacher (when necessary)	250-500	
1 Laboratory Assistant and Demonstrator	150-250	
2 Field Assistants	75-125,	each.
1 Fieldman	30-50.	
1 Moulder	10-30.	

12. The Senior Assistant in each Province should be a selected student of an Indian Agricultural College who is of the landholder class and who should be, if possible, a science graduate of an English University. The most satisfactory training possible would perhaps be that required for the Agricultural Diploma of Cambridge University, provided that the student devotes special attention to Mycology during the course.

13. The laboratory assistant required is the class of men who have been sent to Pusa by several Provinces for training, in the past two years. These men are graduates of Indian Universities who go through a course of about 18 months training at Pusa. When the Provincial Colleges are equipped, picked students from them with a considerable further training at Pusa will be available and should prove satisfactory. Men whose upbringing has been on the land should be sought.

14. The two field posts should be filled from the Agricultural Colleges in India, with some further training at Pusa.

15. The whole of this part of the proposals relating to the pay, selection and training of Provincial Assistants must be dependent, to some extent, on the special conditions and preferences of the Provinces concerned. It is impossible to lay down any hard-and-fast rules.

16. The duties of the Provincial Assistants should chiefly be connected with practical matters and should not particularly refer to original research. These Assistants should make enquiries in the field regarding any crop diseases, their seasonal prevalence, amount of the damage done, methods of checking adopted by cultivators, practicability of introducing other remedial measures and should adopt such measures on recognized lines, as far as possible, on the Government Farm and in cultivators' fields. They should collect specimens of the fungi of the Province which are harmful to agriculture and form teaching collections for the Provincial Agricultural College. Duplicate specimens should be supplied to Pusa to be identified.

17. In each Province the Assistant Mycologist and his Assistants should work under the Economic Botanist who alone will have sufficient knowledge to properly direct the work.

18. Since, for a part of the year, the presence of the two first assistants will not be essential at head-quarters, they should keep in close touch with field-work and carry out detailed enquiries into such serious diseases as are reported by the Field Assistants or otherwise. It is impossible to separate the field and laboratory branches of Mycological work. The two must be brought together by the frequent touring of the Assistant Mycologist and Laboratory Assistant. When large field work has to be taken up, as in a campaign against a specific disease, the field staff must be strengthened from the laboratory, and microscopic work in the field should form a prominent feature of such work when the full characters and life history of the disease are not thoroughly understood. All arrangements for the supply of spraying and steeping materials and the like should be made by the Assistant Mycologist.

19. The Field Assistants should be occupied in disseminating information, making enquiries, visiting villages to inculcate simple practices for checking or avoiding disease and such other purely field work. They must keep in constant communication with the laboratory for the identification of specimens and for other useful information. The fieldmen should chiefly carry out practical remedies requiring no special scientific knowledge.

20. The broad lines of work in each Province should be arranged in consultation between the Imperial Mycologist and the Provincial Botanist. Pusa should be kept in advisory touch with the Provincial Assistants so as to co-ordinate work and prevent overlapping. Monthly reports should be submitted by the Assistants, a copy being forwarded to the Imperial Mycologist for information and remarks.

21. As a specific instance of how this scheme of departmental organization should be applied in practice, Dr. Butler's description of the work at present being carried out by the Madras Department of Agriculture under the advice of the Imperial Department is given as Appendix II.

APPENDIX II.

The field campaign against the Palm Disease of the Godavari Delta.

The Godavari Palm Disease was first noticed by the people of the Delta about ten years ago. It was then confined to a few villages, but has extended steadily since, and in August 1905, when I visited the Delta to investigate, it occupied an area of about 900 square miles.

In the early years palmyra palms alone were attacked. Subsequently it spread to coconut and probably also to areca palms. These palms formed the chief feature of the Deltaic landscape, and in those localities where the disease has existed for several years, the sight of thousands of dead naked poles is extraordinarily impressive in indicating the severity of the disease.

The capital loss to the cultivators and landowners of the Delta is already somewhere between ten and twenty lakhs. This takes no account of the loss of excise revenue to Government amounting to Rs. 1-8-0 per dead tapped tree per annum. If once the disease reaches the large coconut-growing districts to the south, the loss will run into crores, unless the effective methods of checking are thoroughly carried out. In the Godavari Delta, palms form the most valuable economic asset of the people, furnishing them with an extraordinary number of every-day appliances, food, fuel, and the essential parts of their dwellings. In some villages 70 per cent. of the palms have been killed, and this loss will change the whole economic conditions of the Delta if not checked.

My investigations showed the disease to be due to a new form of fungus, belonging to an obscure group. I had fortunately been engaged in an extended study of this group for several years, and it was this fact that enabled me rapidly to work out some of the main features of its life history and to suggest practical measures for checking it. The information already available has been published in the *Agricultural Journal* for October 1906 and in *Memoir No. 5, Botanical Series*, of the Department. Further detailed study on the spot is necessary to elucidate all the conditions of attack, but should extend over six months or more to yield full information and it is impossible for me to leave my laboratory for so long a period.

The suggestions for treatment were adopted experimentally by the Madras Government and operations commenced in December 1906 at an estimated cost of Rs. 5,000. The perfect feasibility of these operations having been proved by three months' trial, their extension to the whole area has been recently jointly recommended by the Collector of Godavari, the Director of Agriculture, Madras, and myself and I understand that full measures for stamping out the disease are now assured. If these are thoroughly carried out I am confident that they will meet with entire success.

The parasite gains entrance to the leaf sheaths surrounding the apical bud of the palm. It penetrates these one after another, until the bud is reached and the tree dies. Two sorts of spore have been found, which germinate only under certain conditions. These convey the disease from tree to tree, but how is not certain. Infective material is only produced at certain stages. The activity of the parasite reaches its height about December. The facts ascertained would ordinarily have taken months of enquiry to work out, but for previous knowledge of all allied forms, gained chiefly by laboratory work, and this case indicates strikingly the value of research. Further useful knowledge of the specific action of the parasite on palm trees, the method of infection, the particular functions of the two spore forms, the conditions governing their production and germination, and the relations between host and parasite, await the strengthening of the Mycological staff sufficiently to depute a trained Mycologist for prolonged local investigation. It is a good example of the sudden appearance of a new disease, of which the coffee leaf disease in Ceylon, the potato disease and the vine mildew in Europe are well known cases,—requiring the application of knowledge gained by long continued research in checking.

The treatment was based on the facts that infection passes from tree to tree by the wind, birds or some unknown agency, but can only carry a short distance; that infective material is only produced in the inner layers of the bud and not very early

in the attack; that infection takes place through the outer leaf sheaths, and requires moisture and other seasonal conditions for its success; and that heating destroys the parasite in its entirety and Bordeaux mixture prevents the germination of the spores.

No local trained assistance was available. Three working parties were formed, each in charge of a Revenue Inspector. Village returns were obtained through the village officials. Each village in a certain area, reporting the existence of the disease was visited in turn. A local staff of palm climbers (toddy drawers) was recruited, the trees were marked and all diseased trees climbed and the tops cut. Neighbouring healthy trees were climbed for Bordeaux mixture treatment. One man could cut 15 trees or treat 35 in a day and the cost worked out at about 2 annas and 1 pie, per tree, respectively. An assistant from the Madras Government Botanist's staff was in supervising charge, but had no Mycological training and no field experience. No better provision was available.

The new proposals provide for the treatment of the whole affected area, taluq by taluq. The total cost is estimated at Rs. 30,000. Two Indian assistants will be lent from my establishment and two provided by the Government Botanist, Madras. Application has been made for a junior officer of the Civil Service (an Assistant Collector) to take charge of the operations, and this recommendation, strongly supported by the Collector and the Director of Agriculture, emphasises the need of sufficient European staff to deal with large campaigns of this nature, for the want of scientific training will seriously reduce the efficiency of the control. I shall have to give frequent visits to the scene of operations instead of being able to depute a trained European Mycologist to take charge of the work. Superior control has been found necessary, even though effected by a non-scientific officer, in order to check fraud for which there are many openings.

In the scheme proposed for extending Mycological sections in India the original investigation would have been entrusted to one of the superior staff at Pusa, who could have remained for as long as was necessary to work out the disease fully. He would be assisted by the local staff in field enquiries and could direct their work to elucidating many of the field conditions which it is of importance to note. We would have submitted our results to the Director of Agriculture, Madras, and planned the campaign in consultation with him. The field operations would have been carried out by the Provincial staff, strengthened if necessary, by one or two Assistants from Pusa and controlled in a large measure from Pusa. One of the European staff from Pusa would probably have to spend six or eight months in the Delta during the field operations or could visit it frequently, but this could be provided for out of the staff suggested, for it is but rarely that more than one large campaign of this nature will occur in any one year.

I think this case furnishes a strong argument in favour of the proposals for strengthening the central staff now submitted and shows, in its most favourable light, the particular directions in which trained Indian assistance and local knowledge will prove useful.

E. J. BUTLER,

Imperial Mycologist.

APPENDIX III.

WORK IN ENTOMOLOGY.

The assistance which Provincial Agricultural Departments can obtain from the Entomological Section at Pusa, can, to some extent, be estimated by the following information. The present Pusa trained staff for Entomology consists of:—

<i>European.</i>	<i>Rs.</i>
The Imperial Entomologist	750-50-1,000,
Second do (expected to join soon)	500-50-1,000
Supernumerary Entomologist	{ 400-30-450.
	{ 500-50-1,000

<i>Indian.</i>	Rs.	
1 Special Assistant	200- 5-250.	
1 Sericulture Assistant	100- 5-150.	
4 Assistants	75-10-125,	each.
1 Fieldman	50- 5-75.	
6 Fieldmen	30- 4-50,	each.
3 Setters	30- 4-50,	"
2 Laboratory keepers	10- 2-20,	"

2. In order to undertake original research and help the Provinces as far as possible in practical enquiries and work, the following Indian staff will probably soon be appointed :—

	Rs.	
1 Assistant	250-400.	
1 Do.	150-300.	
1 Do.	150-250.	
1 Assistant for Sericulture and Bees	150-400.	
6 Assistants	100-150,	each.
9 Fieldmen	30-75,	"
6 Setters	20-40,	"
2 Laboratory keepers	10-20,	"

3. Mr. Lefroy considers that at Pusa, where the work of each Assistant will be closely watched by himself and two other European Entomologists, he does not require men of exceptional educational qualifications. The Secretary of State has not sanctioned a European Entomologist for each Province. Therefore Mr. Lefroy would prefer to post to the Provinces men who have been partly trained in England. Such men may show special individuality or originality in their work and are, therefore, more suitable for the Provinces than for Pusa.

4. The investigation at Pusa should form a basis for the extensive work in each Province. Questions, such as the utilization of beneficial insects, the means of spreading parasites, the value of fungoid diseases of insects and the part played by birds in destroying insects, should be investigated at Pusa or by investigators from Pusa.

5. In the Pusa Insectory the life histories of injurious insects will be worked out in the greatest detail. All stages will be painted by trained artists. Insects destructive to crops and other insects will be collected, identified and preserved. In time a complete collection of the insects of the agricultural areas of India will thus be formed.

6. In collaboration with other experts on the Imperial staff insecticides and other methods of checking insects will continue to be investigated in the laboratories and in the fields of Pusa.

7. Pusa will provide instruction in Entomology, a long course for the Provincial Assistants and a short course for fieldmen.

8. When serious damage is being done by insects over wide areas, the Imperial Department must be in a position to give prompt assistance to the Provincial Departments or combine the work of two or more departments so as to secure the most efficient work. This has been found necessary recently as regards the migratory locust and boll-worm outbreaks.

9. Mr. Lefroy describes the entomological work which should be done in each Province as follows :—

- (a) Enquiry into the prevalence, behaviour and seasonal occurrence of injurious insects in the various tracts of the Province; into the injury caused to crops; the attitude of the cultivator towards these pests, the measures he adopts to check them and his willingness to adopt other remedial measures.
- (b) The examination in the field, as they occur, of all injurious and other insects.
- (c) The collection of specimens of injurious insects and the forwarding of those when necessary, for proper identification to Pusa.
- (d) Testing remedies on Farms and modifying these to suit local conditions.
- (e) Urging on the cultivators such simple remedies as have been found suitable, whenever losses in crops are noticeable.

- (f) Systematically spreading among the agricultural classes accurate information about insect life which injuriously or beneficially affects agriculture. This information should include the exhibition of collections by lantern slides in school rooms, fairs, etc., the publication of vernacular leaflets and village to village tours to demonstrate simple facts.

10. In reference to the Provincial establishment proposed under paragraph 12 of his general proposals, Mr. Lefroy advises that the work of the Assistant Entomologist should be executive, practical and chiefly in the field. He should not attempt systematic work that can be done at Pusa. He should direct and, as far as possible, control the work of the fieldmen. He should collect specimens of injurious and beneficial insects for Pusa and form at the Provincial College (a) the students' economic collection, (b) a reference collection of all economic insects of the Province, (c) a general collection of all insects of the Province.

11. The Laboratory Assistants' work should consist of—

- (a) Teaching entomology to students.
- (b) Care of the Collections.
- (c) Experimental and practical work on the College Farms and in the vicinity.

12. A field Assistant and a fieldman will be required for each Government farm and well-defined agricultural tract. The work of the field assistants will be to watch for the occurrence of a pest, to study it on the spot, to at once communicate the occurrence to the Assistant Entomologist and demonstrate practical remedies. In a serious outbreak all the fieldmen of the Province should be gathered in the affected areas. Ordinarily each field assistant should tour, talk to the people, instruct them, collect specimens of injurious insects, maintain on the Government Farm a small exhibit collection for demonstration and keep at hand such insecticides as may be ordinarily useful.

13. Mr. Lefroy explains that during the last two years Provincial Assistants have met in Conference at Pusa. This annual meeting is very useful and should be a definite feature in the year's work.

APPENDIX E.

POULTRY-FARMING IN INDIA

My Dear Sir,

May I call your kind attention to the following article which appeared in the *Indian Planters' Gazette* and beg your kind assistance in promoting the industry. I am sure the matter will commend itself to you, and thanking you in anticipation.

I am, dear Sir,

Yours faithfully,

H. E. ABBOTT.

POULTRY-FARMING IN INDIA.

It has been a great disappointment to us, and also an extreme regret, that in all the schemes for the agricultural regeneration of India, which have been mooted and considered since Lord Curzon established the Agricultural Bureau, the valuable adjunct of poultry-farming finds no place. Two annual meetings of delegates from all parts of the country have already been held at the Research Institute at Pusa, and in the first number of the *Agricultural Journal for India*, officially published the other day, Mr. F. G. Sly, the Officiating Inspector-General of Agriculture, has in a very interesting manner sketched the outlines of the general scheme for the expansion of the Imperial and Provincial Departments of Agriculture, which has become possible with increased expenditure justified by the stability of exchange and the prosperity of the finances of the country. He very rightly claims that the Department of Agriculture in India should occupy the first position in the administration of a country where the land revenue is such an important source of income, and where famine makes such appalling inroads on the national prosperity. But neither at the conclaves at Pusa nor in Mr. Sly's exposition has there been said a single word of the value of poultry-culture, which in one form or another has become a really valuable industry in Europe, America, and Australia, one in which much capital is invested, and the returns from which form a considerable item in national food and wealth. The neglect of so potential a source of revenue in India is to us little short of amazing, especially as the authorities cannot plead in excuse that their attention has not been drawn to the enormous field the country presents for the profitable pursuit of this essentially modern cult in economics. In the fall of 1900, the first year of the new century, Mr. H. E. Abbott, one of the oldest and most optimistic fowl fanciers in India, started the *Indian Fowl Fanciers' and Farmers' Journal* with the avowed intention of encouraging the breeding of poultry among the poorer classes of Europeans, Eurasians, and Native Christians to raise them from a slough of poverty and despondence into which they had been plunged by the tradition, we might almost say the fetish, of shiftless and improvident living. The journal was an immediate success and has since been steadily growing in popularity and influence. The enthusiastic Editor has kept pounding away on the value of poultry-farming to solve a large part of the problem of the Domiciled, a problem that has baffled the most astute of our legislators. He has supported his opinions by practical demonstration on his farm at Jaintpore. He is constantly importing from England the best breeds of utility poultry and loses no opportunity to prove the profitableness of such investment. Month after month the journal records the enormous advances made in the industry in Europe, America, and the Colonies, and with sturdy independence rebukes the Government for failing in a duty which is as plain as it should be compelling. We are told of successful individual effort in every part of the country, and then asked to say what we think of the supineness of an administration which allows such a certain and lucrative means of revenue to slip. We must repeat that the official indifference is simply amazing, and it makes one inclined to concede to Dr. Emil Reich, author of "Success Among Nations," the justice of his allegation that the English official is singularly inelastic and must be driven by a goad to meet new exigencies. Mr. Abbott's clever little paper has done very much during the past five years to educate its readers in poultry-keeping; it is a welcome guest in the

library of more than one Secretary to Government; and it proclaims the fiscal value of the hen with the clarion note of a chanticleer. Yet both Pusa and the Agricultural Bureau are deaf to the call, and would probably fall down in a scientific fit, if asked to contribute a portion of the annual grant of twenty lakhs of rupees to the promotion of poultry-farming in India on a large scale. Before going further it may be useful to draw the attention of Mr. Sly to the attitude of the English Board of Agriculture and Fisheries towards the industry. Last year it issued some very valuable hints to farmers on the feeding of Poultry which were prefaced by the following significant remarks:—"There is a widespread belief that poultry keeping can never be made a great industry in the United Kingdom, by reason of the large amount of labour entailed and the great cost of upkeep in the way of food. No idea can be more incorrect, though there is at present an unfortunate tendency in many quarters to look upon poultry-keeping as a sort of hobby, and moreover, there is a serious wastage in the matter of food and labour. So far as cost of keep is concerned, co-operation in buying will work wonders, while, as to the saving of labour, experience is all that is necessary." We would hardly put the case for India more trenchantly.

Poultry-farming has reached its highest development in the United States of America, owing to an inexhaustible market. The Americans consume much less butcher's meat than we English do, and poultry and eggs are rapidly replacing it as the national food. It would be well if the Anglo-Indian followed this excellent example. It would reconcile him to the fact that *moorghis* is ever a most important item in the dāk bungalow bill of fare, and, what is of more consequence, the demand thus created would result in the rearing of a better class of fowl for the table. From an excellent article on the subject of poultry-farming contributed by Lewis Wright, the author of "The New Book of Poultry", to the latest edition of the *Encyclopaedia Britannica*, we learn that the poultry industry in the United States is the most gigantic in the world, and probably the greatest pecuniary interest the country possesses. By the census of 1900, which tabulates returns from 5,096,252 out of the 5,739,657 farms in the States, the number of fowls over three months old on 1st June 1900 was returned as 233,598,085, with 6,599,367 turkeys, 5,676,863 geese, and 4,807,358 ducks, or 250,681,673 birds in all, valued at 85,794,966 dollars. This, however, would include very few of the chickens raised that year which would not have reached the age stated, and mainly represents breeding and laying stock, which thus average about 49 birds to every holding; it also of necessity omits many of the smaller city-lot raisers. The value of the poultry raised during the whole year 1899 is given as 136,891,877 dollars and of the eggs produced (1,293,819,186 dozen) at 144,286,186 dollars; a total year's product of over £56,000,000. Adding only a very moderate amount for city-lot and other small producers not making returns, it will be seen that the poultry industry in America exceeds in value either the wheat crop, or swine crop, or cotton crop, which probably comes next in value. Is not this enough to spur our Government to strenuous endeavour, especially when we find that both in Australia and Canada the authorities, stimulated by the example of the United States, make considerable efforts to encourage poultry? Were it not that we would greatly exceed the limits of a leading article, we would quote the Continental statistics to show the rapid advance and the increasing importance of the industry in France, Holland, Belgium, Germany, and even Russia, during the last decade of the nineteenth century.

Having written so much of the value of poultry-farming as a national asset, we may turn our attention to the immediate requirements of India. Anybody who has taken an interest in the subject and watched the signs of the times must be convinced that something will have to be done, and at once, if the *moorghis* is not to disappear entirely from our tables. The drain on indigenous poultry, always raised by the natives in the very haphazard sort of way, is enormous and the supply is slowly but surely giving out. Considering the extent of the country, the number of natives that go in for it is microscopic, and it is our experience that the denizens of the *paras* are becoming more and more discouraged. The necessity to save the industry from extinction is an imperative duty of the State, and we think of no better way than for the Government of India to issue to the local Governments a circular enjoining on them the duty of employing a portion of the provincial grant to assist native professional poultry-keepers, Poor Whites, and Christian Missions to obtain from England and elsewhere the best breeds of

utility poultry and thus start an industry the future of which is secure. Most of the railways in India are owned by the State and the operations of the few companies that remain are controlled by the Government. Nothing would, therefore, be easier than to send a recommendation, which would have force of an order, to the railway directorates to encourage and assist their poorer employes to rear poultry and thereby make a much-needed addition to their scanty wages. Safe and cheap transport by special poultry coop wagons on all Indian lines would be an important item in the general scheme, and it would present no difficulty to a sympathetic and determined Member for Commerce like the Honourable Mr. Hewett. Knowing what we do of the great shipping companies that draw much of their wealth from India, we entertain no apprehension that they would refuse to assist the great industrial experiment we are advocating, by carrying fowls from England at low freight and providing proper coops to ensure their being landed strong and healthy. In Mr. Sly's article in the *Agricultural Journal for India*, to which we have already referred, he says that it is contemplated to have an experimental farm for each important distinct agricultural tract in India. We contend that the equipment of every such farm will be incomplete unless provision is made for a poultry department. It is unnecessary to labour the argument, for, beside the value of eggs and fowls, there is the exceptional advantage of the best manure that can be procured. Having accepted the poultry adjuncts to experimental farms, the next step of the Government will be the appointment of an expert controller and inspector with a position and independence of action similar to that enjoyed by the Veterinary Inspector-General. But by far the most important action we expect from Government is the holding of shows at important centres. The development of poultry culture in England owes nearly everything to the great number of poultry exhibitions during the last ten years of the nineteenth century. It is difficult for us in India to realise that in the height of the season the *Field* had criticised as many as twenty shows in one week in Great Britain. We cannot hope to attain to any such enthusiasm in India for several generations to come; but it is useful to record the fact to show how incumbent it is on Government officials, in the mofussil especially, to organise frequent poultry exhibitions and encourage native rajahs and zamindars to help such of their ryots as are not prohibited by caste prejudices to take up poultry-breeding as an essential of their existence. If Government would provide such men and the Poor Whites, to whom we have so often referred, with eggs and young stock from the Government depôts, either gratis or at very nominal prices, the first great obstacle would be overcome and the industry would be launched on the fair way to success. Government aid in the way above indicated is imperative and it is also legitimate. We have in Lord Minto a Viceroy who is a great landlord at home and has done everything in his power to assist the prosperity of his tenants. He has come to us direct from Canada, where during his Viceroyalty the Government established several stations for official experiments in poultry culture. To him we can, therefore, appeal with a confidence we did not possess before he came among us to inculcate the lessons of his experience in the heads of the local Governments on whose initiative and support the success of any scheme of poultry-farming must necessarily depend. The planting districts of Behar, Assam, and the Wynnaad, the mission fields of Chota Nagpur and Southern India, the military garrison stations where the Eurasian descendants of British soldiers congregate and the innumerable railway towns scattered over the length and breadth of the country, are all ready to join at once and *con amore* in the Government experiment we advocate, and Lord Minto will confer a lasting benefit on the country if he will lead this host of willing workers into so rich a pasture, which for the present is unfortunately *incultum ac derelictum solum*.