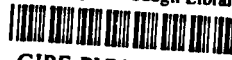


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Proceedings of the ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research

Held at New Delhi on the 19th, 20th, 21st, 23rd and 24th
February 1934.

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**AGENDA FOR THE MEETING OF THE ADVISORY BOARD OF THE
IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH HELD
AT NEW DELHI ON THE 19TH, 20TH, 21ST, 23RD AND 24TH
FEBRUARY 1934.**

1. Decisions of the Governing Body on the recommendations of the Advisory Board held in February and August 1933.

2. Appointment of Committees.

3. Recommendations of the Locust Committee at its fifth meeting held in January 1934. Proposals for continuance and future programme of work.

4. Application from the United Provinces Poultry Association for a grant of Rs. 42,130 (Rs. 2,500 non-recurring and Rs. 39,630 recurring) for a scheme to develop egg and poultry marketing on a co-operative basis.

5. Application from the Government of the Punjab for a grant of Rs. 1,73,970 spread over five years for a scheme for research on the water requirements of crops under canal irrigated conditions (revised scheme).

6. Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for investigations into the malting and brewing tests of Bihar barleys.

7. Scheme for the investigation of the Life-History, Bionomics and Development of Fresh Water Fishes of Bengal by Dr. H. K. Mookerjee of the Calcutta University at a cost of Rs. 7,870 spread over a period of three years.

8. Dacca University research scheme:—

(i) Request for sanction to an expenditure of Rs. 1,695 on account of apparatus, etc., required for the year 1934-35.

(ii) Request from the Dacca University for the extension of the term of the present scheme of research work (i) on the mechanical analysis of lateritic soils and (ii) on the nutrition of the rice plant.

9. Application from the Government of the United Provinces for a grant of Rs. 33,000 spread over a period of three years for undertaking experiments to investigate the possibilities of commercial utilisation of linseed fibre from straw after harvesting the seed.

10. The layout of Field Experiments—Proposal to refer to the Crops and Soils Wing of the Board of Agriculture in India.

11. Application from the Government of Assam for a grant of Rs. 47,972 spread over a period of 3 years for investigation into vaccination of cattle with goat-virus against rinderpest.

12. Application from the Government of the Central Provinces for a grant of Rs. 46,200 spread over a period of 4 years for a scheme of research work on pan cultivation.

13. Oilseed schemes:—

(a) Application from the Government of the Punjab for a net grant of Rs. 65,510 spread over a period of five years for ~~for~~ tional research on oilseed crops in the Punjab

- (b) Application from the Government of Bengal for a grant of Rs. 63,680 spread over a period of five years for research on the linseed crop by the Department of Agriculture, Bengal.
 - (c) Application from the Government of the Central Provinces for a grant of Rs. 61,400 spread over a period of five years for research work on oilseeds in the Central Provinces.
 - (d) (i) Application from the Government of the Punjab for a grant of Rs. 5,000 for one year for an inquiry into the economics of the village oil crushing industry in the Punjab.
 - (ii) Application from the Government of the United Provinces for a grant of Rs. 5,000 for one year for a census relating to the indigenous oil crushing industry and an inquiry into its economics.
14. Participation of India in the Xth World's Dairy Congress—Rome—Milan, April-May 1934.
 15. Proceedings of the Sixth Meeting of the Sugar Committee held in November 1933.
 16. Application from the Government of Madras for a grant of Rs. 45,000 spread over a period of five years for a scheme of research work on the chemistry of sugarcane.
 17. Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for a scheme of investigation on the possibilities of manufacturing Khandsari sugar by the single-pan method.
 18. Proposals for the initiation of future research into the insect pests of sugarcane.
 19. Scheme for an Imperial Sugar Research Institute.
 20. Scheme for research work on the developmental morphology and anatomy of sugarcane-sorghum hybrids and of the Indian sugarcane and wild saccharums costing Rs. 7,600 spread over a period of three years.—Application from Prof. Ekambaram of the Madras University.
 21. Participation of India in the Annual Congress of the Royal Institute of Public Health, Norwich, May 1934.
 22. Application from the International Institute of Agriculture, Rome, for a grant for the publication of the results of the World Agricultural Census.
 23. Progress reports on sugar schemes.
 - (i) Report on the scheme of research work on the Mosaic and other diseases of sugarcane for the period June 1932 to June 1933.
 - (ii) Report on the working of the Sugarcane research station in the Bombay-Deccan, Padegaon, for the period ending 30th June 1933.
 24. Application from the Government of Bombay for a grant of Rs. 56,795 spread over a period of five years for research for the study of the Deccan Wingless Grasshoppers.
 25. Report of the Editorial Committee.

26. Application from the Government of Madras for a grant of Rs. 37,580 (Rs. 2,630 non-recurring and Rs. 34,950 recurring) spread over a period of 10 years for sheep breeding research in Madras.

27. Report of Committee on Soil Science Schemes.

(i) Application from the Government of Bengal for a continuation grant of Rs. 18,800 spread over three years for research into properties of colloid soil constituents by Prof. J. N. Mukherjee of the Calcutta University.

(ii) Application from the Government of the Punjab for a grant of Rs. 13,120 spread over three years for a scheme to investigate the changes in the microflora of Kallar and alkaline soils during reclamation—by Dr. Jagjivan Singh, M.Sc., Ph.D.

(iii) Report on the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D., A.I.C., on the standardisation of physico-chemical "single-value" measurements most suitable for Indian soils.

28. (i) Annual report of Mr. Slater's goat breeding scheme for 1932-33.

(ii) Report of Mr. K. P. R. Kartha on milk production statistics.

29. Sann Hemp schemes.

(i) Application from the Government of Madras for a grant of Rs. 1,500 spread over three years for a scheme of experiments for the improvement of sann hemp fibre at the Agricultural Research Station, Samalkota.

(ii) Application from the Government of Bombay for a grant of Rs. 1,500 spread over three years for a scheme for research work on sann hemp in the Bombay Presidency.

(iii) Application from the Government of the Central Provinces for a grant of Rs. 20,060 spread over 5 years for a scheme of research work on sann hemp in the Central Provinces.

30. Annual reports on the working of the rice research schemes in Bengal and Burma for the year 1932-33.

31. Application from the Government of Bengal for a grant of Rs. 21,600 spread over five years for a scheme of research on the biochemical and physico-chemical properties of rice at the Dacca University.

32. Application from the Government of Bengal for a grant of Rs. 20,812 spread over three years for a scheme of research work on the Physiology of the rice plant by Dr. S. P. Agharkar.

33. Application from the Government of the Central Provinces for a grant of Rs. 10,088 spread over four years for research work on the "Gangai" pest of rice—entomological work under the scheme of rice research already sanctioned by the Council for the Central Provinces.

34. Report of the Sub-Committee on Fruit Schemes.

(i) Application from the Baluchistan Administration for a grant of Rs. 49,600 spread over a period of five years for a scheme for establishing a "Canning and Fruit Preserving Research Laboratory" at the Fruit Experiment Station, Quetta.

(ii) Application from the Government of the Central Provinces for a grant of Rs. 1,49,640 spread over a period of ten years for a scheme for research on the orange crop of the Central Provinces.

- (iii) Application from the Government of His Exalted Highness the Nizam for a grant of Rs. 74,300 spread over a period of five years for a fruit research scheme.
 - (iv) Application from the Government of the Punjab for a grant of Rs. 57,430 spread over a period of five years for a scheme of research on citrus stock and grape vines in the Punjab.
 - (v) Application from the Government of the Punjab for a grant of Rs. 35,052 spread over a period of three years for a scheme for a San Jose Scale survey in the Punjab.
35. (i) Annual report of the Agricultural meteorology branch of the Indian Meteorological Department, Poona, for the year ending the 21st August 1933.
- (ii) Annual report by Prof. P. K. Parija on the scheme of research work on Water Hyacinth in Bihar and Orissa.
- (iii) Report on the work done on the scheme of research on the effect of ions on the growth of plants by Dr. S. S. Bhatnagar during the period February 1931 to August 1933.
36. Provincial Schemes of Potato Research:—
- (A) Application from the Government of Bengal for a grant of Rs. 48,950 spread over five years for a scheme of potato research.
 - (B) Application from the Government of the United Provinces for a grant of Rs. 41,790 spread over five years for a scheme of potato research.
 - (C) Application from the Government of the Punjab for a grant of Rs. 37,760 spread over five years for a scheme of potato research.
 - (D) Application from the Government of Bihar and Orissa for a grant of Rs. 21,096 spread over three years for a scheme of potato research.
 - (E) Application from the Government of the Central Provinces for a grant of Rs. 15,246 spread over three years for a scheme of potato research.
 - (F) Application from the Government of Assam for a grant of Rs. 56,948 spread over five years for a scheme of potato research.
37. Question of the duration of appointment of members of sub-committees appointed by the Governing Body under Rule 30 of the Rules and Regulations of the Imperial Council of Agricultural Research.
38. Relation of the Provincial Governments and the Provincial Agricultural and Veterinary Departments to schemes financed by the Imperial Council of Agricultural Research and conducted in the provinces.
39. Proposed contribution by India of a sum of Rs. 14,500 during the period 1st October 1933 to the 1st March 1935, towards (i) the maintenance of the laboratory for collecting, breeding and despatching beneficial parasites at Farnham House, Farnham Royal, and (ii) the investigations into the control of insects and moulds injurious to stored products at Slough.

PROCEEDINGS OF THE NINTH MEETING OF THE ADVISORY
BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL
RESEFARCH HELD AT NEW DELHI ON MONDAY, THE 19TH
FEBRUARY 1934.

The following were present:—

1. Diwan Bahadur Sir T. VIJAYARAGHAVACHARYA, K.B.E., *Chairman.*
2. Mr. R. G. ALLAN.
3. Rao Bahadur D. ANANDA RAO GARU.
4. Mr. B. K. BADAMI.
5. Dr. W. BURNS.
6. Mr. B. C. BURT.
7. Mr. P. H. CARPENTER.
8. Mr. G. K. DEVADHAR.
9. Dr. T. EKAMBARAM.
10. Mr. E. S. FARBROTHER.
11. Professor J. C. GHOSH.
12. Mr. W. J. JENKINS.
13. Mr. P. J. KERR.
14. Dr. V. N. LIKHITE.
15. Mr. K. McLEAN.
16. Dr. W. McRAE.
17. Mr. A. N. MUSTAFA.
18. Dr. NAZIR AHMAD.
19. Dr. S. S. NEHRU.
20. Khan Bahadur SHEIKH NIAZ MUHAMMAD.
21. Mr. NIZAMUDDIN HYDER.
22. Colonel A. OLVER.
23. Mr. T. F. QUIRKE.
24. Mr. J. H. RITCHIE.
25. Mr. C. V. SANE.
26. Mr. G. P. SEN.
27. Mr. D. R. SETHI.
28. Mr. H. R. STEWART.
29. Major R. F. STIRLING.
30. Mr. G. T. TAIT.
31. Mr. W. TAYLOR.

Rai Sahib Malik CHARAN DAS, *Secretary.*

The following attended as visitors:—

1. Dr. S. P. AGHARKAR.
2. Dr. J. K. BASU.
3. Mr. E. J. BRUEN.
4. Dr. P. S. HUDSON.
5. Dr. S. N. JAFRI.
6. Dr. P. J. KRISHNA.
7. Mr. S. K. MITRA.
8. Professor J. N. MUKHERJEE.
9. Mr. NURUL ISLAM.
10. Professor P. K. PARIJA.
11. Dr. M. A. SAMPATHKUMARAN.
12. Dr. K. C. SEN.
13. Mr. M. VAIDYANATHAN.
14. Rao Bahadur B. VISHWANATH

2. The meeting lasted from 11 A.M. to 1-10 P.M. and adjourned till 11 A.M. on the 20th February 1934 to allow the Standing Cattle Breeding Committee and the Soil Science Committee to meet in the afternoon.

3. In opening the meeting the Vice-Chairman welcomed the members and thanked them for the trouble they had taken to come and attend the meeting. He added a special word of welcome to Dr. P. S. Hudson and expressed his appreciation of Dr. Hudson's readiness to serve on the Sub-Committees of the Council.

4. *Decisions of the Governing Body on the recommendations of the Advisory Board held in February and August 1933 (Subject No. 1 of the Agenda, Appendix I).*

NOTED.—In reply to Mr. Devadhar's question the Chairman said that no difference was intended to be made by the use of two separate phrases in the Note I such as "sanctioned" and "approved" and that they were identical.

5. *Appointment of Committees (Subject No. 2 of the Agenda, Appendix II).*

The proposed composition of the Committees was agreed to with the following additions:

Rice Committee—

- Dr. V. N. Likhite, Deputy Director of Agriculture, Baroda State, Baroda.
- Dr. S. P. Agharkar, Ghosh. Professor of Botany, Calcutta University.
- Dr. M. A. Sampathkumaran, Professor of Botany, Central College, Bangalore.

Agricultural Progress Reports Committee—

- Dr. V. N. Likhite, Deputy Director of Agriculture, Baroda State, Baroda.
- Professor J. N. Mukherjee, Calcutta University.
- Mr. C. V. Sane, Director of Agriculture, Baroda State, Baroda.

Potato Schemes Committee—

Dr. V. N. Likhite, Deputy Director of Agriculture, Baroda State,
Baroda.

6. *Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for investigations into the malting and brewing tests of Bihar barley (Subject No. 6 of the Agenda, Appendix III).*

In introducing the subject the Chairman explained that owing to its urgency the scheme was first considered by the Governing Body and sanctioned by it subject to its approval by the Advisory Board at its present meeting. Mr. Sethi said that it was a part of a co-ordinated scheme including the United Provinces, the Punjab and Bihar and Orissa which had already been approved by the Advisory Board. The Bihar and Orissa scheme differs from the other schemes in one slight respect only, viz., that it is proposed to send duplicate samples from Karachi in addition to the despatch of samples from Calcutta which is the natural port for shipping of the produce of Bihar and Orissa as the malting and brewing qualities of barley are affected by the length of the sea voyage and other causes. The scheme was supported by Messrs. Allan and Stewart and approved by the Advisory Board.

7. *Scheme for the investigation of the life-history, bionomics and development of fresh water fishes of Bengal by Dr. H. K. Mookerjee of the Calcutta University at a cost of Rs. 7,870 spread over a period of three years (Subject No. 7 of the Agenda, Appendix IV).*

Mr. K. McLean introduced the scheme and said that it would be of benefit to the rural population. Colonel Olver emphasised the importance of fishing industry to rural population and said that it was a modest scheme. Dr. Burns said that in view of the present financial stringency the Council should not sanction schemes of this character particularly as one fisheries scheme had already been sanctioned for Madras. He also criticised the scheme on the ground that the work done in a small laboratory in the University would not apply to actual conditions. Dr. Agharkar, in reply to Dr. Burns criticisms, said that the tank described in the scheme was really a *jhil* 300 feet long and not a small tank. The scheme had the advantage of being close to the laboratory and in a place where there was a commercial demand for fish. All facilities would be provided by the University which was also willing to make a contribution towards the expenditure on the scheme. In his opinion the proposal represented the cheapest lines on which the scheme could be worked and he supported the scheme. Mr. Burt enquired as to what information on carp-breeding in Bengal was lacking and what research work had been done by Dr. Mukherjee on fishes, as only an assistant was proposed. Success would mainly depend on Dr. Mukherjee's qualifications for this particular research. Mr. Stewart said that some work on carp culture had been done in the Punjab and enquired whether Dr. Mukherjee was in touch with the work done in other provinces. Mr. McLean and Dr. Agharkar answered that a good deal of work had been done by the Fisheries Department in Bengal before it was closed down on account of financial stringency but it had mainly laid the foundations of work and the practical applications remained. Dr. Mukherjee had specialised in the embryology of fishes and was very suitable for the proposed work;

Dr. Mukherjee was also in touch with work in other provinces. Dr. Ghosh, in supporting the scheme, said that carp were found in open streams only and that it was proposed to introduce breeding of carps in big tanks. Mr. Carpenter opposed the view of Dr. Burus and said that the question of the finances of the Council was not a matter for the Advisory Board and that, in his opinion, the Board when considering schemes need not consider that aspect. The Chairman agreed with Mr. Carpenter and said that the question of finances was one for the Governing Body and that the Advisory Board should deal with all the schemes on their merits. In reply to questions he reminded members that a supplementary grant of five lakhs was made to the Council in March 1933 in lieu of the suspended grant for 1932-33 and informed them that subject to the vote of the Legislative Assembly, the Standing Finance Committee had approved of a supplementary grant of five lakhs for 1933-34 also. Of the latter amount, a sum of rupees one lakh would be earmarked for the appointment of a Marketing Officer and his staff and Rs. 4 lakhs for general research. Finally the scheme was recommended for sanction. At this stage Mr. Devadhar raised the general question as to what the Council was doing to bring home the results of successful experiments to the cultivators. The Chairman explained that the Council had been in existence for only 4½ years and that the results of researches were not yet ripe for propaganda. Besides, the work of popularising, the results achieved was essentially the concern of Local Governments but if in any particular case special action was called for to secure adequate dissemination of information the Council could consider the matter further.

8. *Dacca University research scheme*:—*Request for sanction to an expenditure of Rs. 1,695 on account of apparatus, etc., required for the year 1934-35 [Subject No. 8 (i) of the Agenda, Appendix V].*

Mr. McLean explained that the scheme to which the request related was sanctioned on the recommendation of the Advisory Board in 1929 on the condition that each year's requirements for apparatus, etc., should be submitted for prior sanction. The present request was for apparatus required during 1934-35. The Advisory Board approved of the proposal.

9. *Dacca University research scheme*:—(ii) *Request from the Dacca University for the extension of the term of the present scheme of research work (i) on the mechanical analysis of lateritic soils, and (ii) on the nutrition of the rice plant [Subject No. 8 (ii) of the Agenda, Appendix VI].*

The Advisory Board approved of the proposals contained in paragraph 2 of the Secretary's note on the subject.

10. *Application from the Government of the United Provinces for a grant of Rs. 33,000 spread over a period of three years for undertaking experiments to investigate the possibilities of commercial utilisation of linseed fibre from straw after harvesting the seed (Subject No. 9 of the Agenda, Appendix VII).*

Mr. Allan introduced the scheme and said that hitherto work on a small scale had been going on for some time but it was now proposed to start work on a large scale. Mr. Burt explained that the scheme arose out of a suggestion made in the course of discussion in the Indian Oil Crushing Industry Committee, the object being to make linseed production more profitable. There was every possibility that the short linseed fibre would be valuable as the raw material for the new type of 'cottonised'

fibre. Mr. McLean said that the Fibre Expert to the Government of Bengal had a mass of information on the subject and suggested that, in the event of the scheme being sanctioned, he may be consulted. Mr. Allan had no objection to this and the scheme was carried.

1. *The layout of Field Experiment—Proposal to refer to the Crops and soils Wing of the Board of Agriculture in India (Subject No. 10 of the Agenda, Appendix VIII).*

Mr. Burt, in introducing the subject, said that the Fertilizers Committee would shortly consider the results of manurial experiments made in India in the past which had been collated and analysed by the Statistician to the Council but it was already obvious that there was very great need for better-planned field experiments. This confirmed the conclusion reached by the Board last summer. In his opinion the next step was to secure an adequate discussion of the subject by the agricultural officers who were actually doing field experiments in the provinces. It was therefore proposed to consider the matter at the next meeting of the crops and Soils Wing of the Board of Agriculture and Animal Husbandry and in the meanwhile it was suggested that the Directors of Agriculture of provinces and States be requested to secure notes and papers from those of their staffs who were interested in the subject. Mr. Carpenter agreed with this view and proposed that a note should be prepared by the Secretariat of the Council which would give a lead. He also enquired why the matter should be considered only by the crops and soils wing and suggested that as it affected animal husbandry side also it should be discussed at both the wings of the Board of Agriculture and Animal Husbandry. Particular points of importance were the methods of covariance and the calculation of missing plot yields. Dr. Burns supported Mr. Carpenter's proposal and suggested a series of notes from the Council on such points as:—

- (a) Statistical significance.
- (b) Size of plots and replications.
- (c) Presentation of results, with a short bibliography.

Dr. Hudson emphasized the importance of the subject and the extreme value of having field experiments throughout India organised on a uniform plan for all India. The Imperial Council of Agricultural Research, he said, was in a fortunate position if it could do this for the whole country. He also suggested that a booklet on the subject might be prepared and that the Council might establish touch with Statisticians in England and other countries especially as there was now a move towards uniformity in field experiments throughout the Empire. Mr. Vaidyanathan emphasized the need for securing higher standards of lay out for experiments in the Provinces and for the need for using the correct mathematical formulæ for the interpretation of the results. He also stressed the need for the publication of a booklet giving the relevant mathematical formulæ applicable to different type of field experiments. He promised to get into contact with the Statisticians in other countries on which Dr. Hudson spoke. Ultimately the proposal was carried with the modifications proposed by Mr. Carpenter. At the suggestion of Dr. Ghosh it was also decided that Professor Mahalanobis should be invited to attend the meeting of the Board of Agriculture and Animal Husbandry when this subject

comes before the Board. It was further agreed that the publication of a manual giving relevant mathematical formulæ should be prepared as proposed in the Secretary's note. †

12. *Application from the Government of Assam for a grant of Rs. 47,973 spread over a period of 3 years for investigation into vaccination of cattle with goat-virus against rinderpest (Subject No. 11 of the Agenda, Appendices IX and IX-A).* †

Mr. G. P. Sen introduced the scheme. Mr. Stewart suggested that the scheme be referred in the first instance to a Committee of the Advisory Board. After Col. Olver and Messrs. Kerr and Stirling had spoken the suggestion regarding the appointment of a committee to consider the scheme was approved; the selection of the personnel of the committee was left to the Chairman. †

13. *Application from the Government of the Central Provinces for a grant of Rs. 46,200 spread over a period of 4 years for a scheme of research work on pan cultivation (Subject No. 12 of the Agenda, Appendix X).*

Mr. Ritchie introduced the scheme. Dr. Burns and Rao Bahadur Ananda Rao said that some work on pan cultivation and diseases had been done in Bombay and Madras respectively. Dr. McRue described the work done at the Pusa Research Institute on pan diseases in Bengal and Bihar and mentioned the three principal diseases which were prevalent in the monsoon, winter and summer respectively. He stressed the need for having a pan garden under the investigator's own control. Mr. Burt suggested that this subject be referred to a committee of the Advisory Board, the personnel to be selected by the Chairman as usual. This suggestion was approved and it was decided that the committee should meet before or on the occasion of the next Advisory Board meeting and should submit its report at that meeting. Meanwhile, information in regard to the work already done should be furnished to the Council's secretariat.

14. Oilseed schemes:—

(a) *Application from the Government of the Punjab for a net grant of Rs. 65,510 spread over a period of five years for additional research on oilseed crops in the Punjab (Appendix XI).*

(b) *Application from the Government of Bengal for a grant of Rs. 63,680 spread over a period of five years for research on the linseed crop by the Department of Agriculture, Bengal (Appendix XII).*

(c) *Application from the Government of the Central Provinces for a grant of Rs. 61,400 spread over a period of five years for research work on oilseeds in the Central Provinces (Appendix XIII).*

(d) (i) *Application from the Government of the Punjab for a grant of Rs. 5,000 for one year for an inquiry into the economics of the village oil crushing industry in the Punjab (Appendix XIV).*

(ii) *Application from the Government of the United Provinces for a grant of Rs. 5,000 for one year for a census relating to the indigenous oil crushing industry and an inquiry into its economics (Appendix XIV) (Subject No. 13 of the Agenda, Appendices XI and XIV).*

Mr. Devadhar at this stage enquired if the Council had received any application for a grant from any provincial Government or any of the Indian States that have joined the Council as regular members for any investigation in regard to the improvement of the copra or coconut oil and

investigation into the present position of the coconut industry all along the West Coast and the killing competition of the Ceylon coconut and its products from which the Ryot is reported to be suffering terribly. The Chairman informed Mr. Devadhar that the whole question of coconut and its products was under close investigation and the report of Dr. Patel—an officer who was appointed last year by the Council specially to conduct that enquiry would soon be out and when it is submitted to the Council then it would afford an opportunity to the Council to consider that question along with other oil seeds, regarding the condition of the position of the coconut industry on the West Coast.

Mr. Stewart said that all the schemes included under this item should first be considered by the Indian Oil Crushing Industry Committee. This was agreed to by the Board. |

15- *Participation of India in the Xth World's Dairy Congress, Rome-Milan, April-May 1934 (Subject No. 14 of the Agenda, Appendix XV).*

Colonel Olver said that this Congress was an important one and that it was desirable that India should be represented at it. He said that Dr. Henson, Professor of Dairying in the Allahabad Agricultural Institute, would be on leave in England at the time of the Congress and that he would be prepared to attend the Congress as a representative of India if his expenses between London and Rome were met by the Council. Mr. Allan supported the nomination of Dr. Henson. Mr. Bruen enquired whether Dr. Henson was preparing himself for representing India at the Congress and whether he was in touch with this work. Colonel Olver replied to both the queries in the affirmative. Mr. Sethi suggested that the name of Mr. McLean, Deputy Director of Agriculture, Bihar and Orissa, might also be considered as he would be on leave at the time. This was agreed to and the proposal was carried. Mr. Devadhar suggested that, if possible, not on racial grounds but on moral and economic grounds, one of the delegates should be an Indian. The Chairman said that he would see if that was possible. |

16. *Application from the Government of Madras for a grant of Rs. 45,000 spread over a period of five years for a scheme of research work on the chemistry of sugar-cane (Subject No. 16 of the Agenda, Appendix XVI).*

Rao Bahadur Ananda Rao introduced the scheme. Rao Bahadur Viswanath emphasized the need for a careful and detailed study of the chemistry of sugar-cane and anatomy of sugar-cane. Unless these two subjects were taken up it would not be possible to make the cultivator realise the benefit of the development of the industry. Mr. Carpenter enquired as to what was being done in regard to the question of leave and pension contributions. In reply the Chairman said that the general question was under consideration and that whatever decision was finally arrived at would apply to the present case as well. Dr. Burns wanted to know whether the Sugar Committee considered if this scheme or a part of it could be made part of the work of the Crop Physiological Section of the Padegaon Sugarcane Research Station. Mr. Burt observed that there was scope for work at more than one station on the conditions governing the elaboration of sugar in the cane. In view of the introduction of hybrid canes with wild saccharum parents and row of the sugar cane sorghum hybrids it was important to know more about the non-sugars in the juice of those hybrids. In his opinion no time should

be lost in carrying out this latter piece of work and he supported the scheme. The scheme was then approved by the Board on the understanding that the question of leave and pension contributions be disposed of in consultation with the Madras Government.

17. *Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for a scheme of investigation on the possibilities of manufacturing Khandasari sugar by the single-pan method (Subject No. 17 of the Agenda, Appendix XVII).*

Mr. Sethi, in introducing the scheme, drew attention to the fact that the scheme had become all the more important in view of the recent earthquake which had rendered the question of the disposal of sugar-cane a matter of very urgent necessity. *Khandasaris* were non-existent in Bihar till recently and it was necessary that they should be in a position to make use of the single-pan method as far as possible. Mr. Sethi therefore requested that the sanction of the Governing Body to the scheme, if approved by the Advisory Board, be obtained by circulation. Mr. Devadhar desired that the present opportunity should be taken to express the Council's sympathy with the people in Bihar and he wished to move a resolution on the subject. Here Mr. Sethi wished to have an opportunity to explain the present situation in his province. The Chairman said that Mr. Sethi might do this the first thing next morning and that the resolution which Mr. Devadhar desired to move might also be properly moved then. After Mr. Burt had supported the scheme it was recommended for sanction. |

18. *Scheme for research work on the developmental morphology and anatomy of sugar-cane sorghum hybrids and of the Indian sugar-cane and wild saccharums costing Rs. 7,600 spread over a period of three years—Application from Professor Ekambaram of the Madras University (Subject No. 20 of the Agenda, Appendices XVIII and XVIII-A).*

Professor Ekambaram explained the scheme which was approved.

19. *Participation of India in the Annual Congress of the Royal Institute of Public Health, Norwich, May 1934 (Subject No. 21 of the Agenda, Appendix XIX).* |

Here Mr. Devadhar enquired if any reports of this Congress were available for the use of members and the Chairman informed Mr. Devadhar that they were in the office and could be made available for inspection. |

The Board recommended that Mr. F. Ware, Director, Imperial Institute of Veterinary Research, Muktesar, and Lieutenant-Colonel S. S. Sokhie, I.M.S., Director, Haffkine Institute, Bombay, should be deputed to represent India at this Congress. |

20. *Application from the International Institute of Agriculture, Rome, for a grant for the publication of the results of the World Agricultural Census (Subject No. 22 of the Agenda, Appendix XX).*

Mr. Burt explained the circumstances leading to the proposal which was approved. |

21. *Progress reports on sugar schemes:—(i) Report on the scheme of research work on the Mosaic and other diseases of sugar-cane for the period June 1932 to June 1933 (Subject No. 23 (i) of the Agenda, Appendix XXI).* |

The report was adopted.

22. *Progress reports on sugar schemes:—(ii) Report on the working of the sugar-cane research station in the Bombay-Deccan, Padegaon, for the period ending 30th June 1933 (Subject No. 23 (ii) of the Agenda, Appendix XXII).* †

Mr. Sethi pointed out that this progress report was not considered by the Sugar Committee at its last meeting held at Coimbatore and suggested that it should be placed before the Committee at its next meeting. This was agreed to.

23. The meeting then adjourned till 11 o'clock on Tuesday, the 20th February 1934.

NEW DELHI;
The 19th February, 1934.

CHARAN DAS,
Secretary.

PROCEEDINGS OF THE NINTH MEETING OF THE ADVISORY BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH HELD AT NEW DELHI ON TUESDAY, THE 20TH FEBRUARY 1934.

The following were present:—

1. Diwan Bahadur Sir T. VIJAYARAGHAVACHARYA, K.B.E., *Chairman.*
2. Mr. MOHD. AZHAR ALI.
3. Mr. R. G. ALLAN.
4. Rao Bahadur D. ANANDA RAO GARU.
5. Mr. B. K. BADAMI.
6. Dr. W. BURNS.
7. Mr. B. C. BURT.
8. Mr. P. H. CARPENTER.
9. Mr. G. K. DEVADHAR.
10. Dr. T. EKAMBARAM.
11. Mr. E. S. FARBROTHER.
12. Professor J. C. GHOSH.
13. Dr. L. K. HYDER.
14. Mr. W. J. JENKINS.
15. Mr. P. J. KERR.
16. Dr. V. N. LIKHITE.
17. Mr. K. McLEAN.
18. Dr. W. McRAE.
19. Mr. S. K. MITRA.
20. Mr. A. M. MUSTAFA.
21. Dr. NAZIR AHMAD.
22. Dr. S. S. NEHRU.
23. Khan Bahadur SHEIKH NIAZ MUHAMMAD.
24. Mr. NIZAMUDDIN HYDER.
25. Colonel A. OLVER.
26. Mr. T. F. QUIRKE.
27. Major P. B. RILEY.
28. Mr. J. H. RITCHIE.
29. Mr. C. V. SANE.
30. Mr. G. P. SEN.
31. Mr. D. R. SETHI.
32. Mr. H. R. STEWART.
33. Major R. F. STIRLING.
34. Mr. G. T. TAIT.
35. Mr. W. TAYLOR.

Rai Sahib MALIK CHARAN DAS, *Secretary*

The following attended as visitors :—

1. Dr. S. P. AGHARKAR.
2. Dr. J. K. BASU.
3. Mr. E. J. BRUEN.
4. Dr. P. S. HUDSON.
5. Dr. S. N. JAFRI.
6. Dr. P. J. KRISHNA.
7. Professor J. N. MUKHERJEE.
8. Mr. NURUL ISLAM. |
9. Professor P. K. PARIJA. |
10. Dr. M. A. SAMPATHKUMARAN.
11. Dr. K. C. SEN. |
12. Mr. M. VAIDYANATHAN.
13. Rao Bahadur B. Viswanath.

2. The meeting lasted from 11 A.M. to 1-25 P.M. and adjourned till 11 A.M. on the 21st February 1934 to allow the Rice Research Committee and the Animal Nutrition Committee to meet in the afternoon.

3. Before proceeding with the business of the meeting, the Chairman asked for the opinion of the Board regarding a suggestion made to him that the names of Dr. P. S. Hudson and Dr. S. S. Nehru should be added to the Fruits Committee appointed by the Board. The Board approved of the suggestion. |

4. The Chairman then announced that as promised yesterday he would now call upon Mr. Sethi to give the Board an account of the conditions prevailing in Bihar after the earthquake. Mr. Carpenter said that it would be interesting to have an account of the Pusa Institute also and suggested that after Mr. Sethi had spoken Dr. McRae should be invited to let us know what had happened at Pusa. The Chairman agreed. Mr. Sethi was then called upon to make a statement. |

5. Mr. Sethi, in giving a brief description of the earthquake which occurred on the 15th January 1934 at 2-15 P.M., said that it was now apparent that the epicentre of the earthquake was somewhere in the foothills of the Himalayas. North Bihar and adjacent to those hills and that was why that province felt a heavy shock. The districts of Champaran, Muzaffarpore and Darbhanga were the most affected districts and a part of the province which was once called to be the garden of India was now in ruins. He had visited these areas and at first nothing else was visible but sheets of water and mud. It was extremely difficult to convey any idea of the damage done in Bihar either by photographs or by cinematographs. It had to be seen to be realised. The country was now honey-combed with long fissures, varying in width from 6 inches to 16 feet and depths up to 52 feet had been actually measured without reaching the bottom. At a very conservative estimate Bihar had lost property in land worth about 40 crores of rupees. Out of 25 sugar factories in North Bihar, seven had gone involving a loss of about 1½ crores. The reconstruction of these seven factories was now a problem to be dealt with immediately as about 60,000 acres of sugar-cane crop were standing. Had these factories been in working order they would have crushed 150 lakhs of

maunds of cane which meant to the cultivator 50 lakhs of rupees. The first and foremost problem before the Department of Agriculture now was the disposal of sugar-cane. Their difficulties were further increased as there were no bullock crushers and no boiling pans available in that part of the country. The Local Government took prompt measures and sanctioned 2½ lakhs of rupees for the purpose and they had been able either on purchase or hire to obtain 3,500 bullock crushers and 3,500 boiling pans. Some factories in their own province had also come to their help by agreeing to crush 40 to 45 lakhs of maunds of cane over and above their requirements. It was in that connection that he had come to Delhi to see the authorities of the Railway Board to get transport facilities. The Bihar Central Relief Committee had also sent Rs. 25,000 for distribution to purchase some bullock crushers and boiling pans. They now had the problem of disposal of this 150 lakhs maunds of cane fairly well in hand. There was a much bigger problem that remained to be tackled with and that was the reclamation of a thousand square miles of the country. The Government had lost in buildings about Rs. 8 crores, the people had lost lands and buildings worth 40 to 50 crores and they had lost sugar factories valued at 1½ crores and other crops valued very conservatively at 50 lakhs of rupees. Continuing Mr. Sethi said that all officials and non-officials had faced the situation in a manner that will arouse the admiration of every body. All that was possible for the Government to do was done and is being done. The people of Bihar were now absolutely ruined. The speaker concluded with an appeal for help and said that unless the Central Government had come to their help they would have remained ruined for ever; their best lands had been destroyed, their towns had been wiped out, their sugar industry had been partially paralysed. Mr. Sethi expressed his gratitude to the members of the Board for giving him an opportunity of acquainting them with the conditions now prevailing in Bihar and also a glimpse of the work that the local Government were doing for the relief of the people. The speaker also hoped that the Imperial Council of Agricultural Research would give them a word of encouragement. |

6. Dr. McRae then described in detail the damage done to the Imperial Institute of Agricultural Research, Pusa. He said that the Public Works Department had seen the Institute and declared that the present site was not suitable for rebuilding. They were however fortunate in not having lost a great deal of valuable apparatus though naturally much glass ware and chemicals had been destroyed. Several bungalows were seriously damaged and there were many cracks in the staff quarters, ten per cent. of which had been rendered uninhabitable. The Engineer had estimated a loss of 1½ lakhs on outside buildings alone, *i.e.*, apart from the Phipps Laboratory. The farm land was practically unaffected and the Botanical Section was almost untouched except for a few cracks in the laboratory. Out of 50 wells, three were all right: in all the rest there was sand. |

7. Mr. G. K. Devadhar was then asked to speak in connection with the help to be given by the Council about which he had spoken on the previous day. Mr. Devadhar then moved a resolution appreciating the work of the Local Government, Government of India and non-officials, etc. After some other members had spoken it was decided that the question be postponed till the 21st February in order that the wording of the resolution might be carefully considered. |

8. *Application from the Government of Bombay for a grant of Rs. 56,795 spread over a period of five years for research for the study of the Deccan Wingless Grasshoppers (Subject No. 24 of the Agenda, Appendix XXIII).*

Dr. Burns introduced the scheme and explained how the "Deccan Wingless Grasshoppers" had spread and the various points connected with the scheme. Mr. Burt said that there were certain features in common between this scheme and the work on which the Council's special locust staff was working. He thought that the scheme might first be examined by the Council's Locust Research Entomologist so as to see how far the two problems were similar. He added that possibly this scheme could be linked up with the Council's research scheme.

Speaking in support of Dr. Burns, Mr. Devadhar took the opportunity of drawing the attention of the Council to a very important observation made by Mr. T. N. Jhaveri, Assistant Professor of Entomology, Poona, in para. No. 2 of his letter, dated the 6th of November 1933 on this subject to the Director of Agriculture of Bombay Presidency to the effect that "the item of the control propaganda has been altogether deleted from the scheme as funds for propaganda work are not allotted. Ultimately it was decided that the scheme be first examined by the Locust Research Committee of the Council.

9. *Application from the Government of Madras for a grant of Rs. 37,580 (Rs. 2,630 non-recurring and Rs. 34,950 recurring) spread over a period of ten years for sheep breeding research in Madras (Subject No. 26 of the Agenda, Appendix XXIV).*

Rao Bahadur Ananda Rao introduced the scheme. Mr. Kerr said that one sheep breeding research scheme was already working and enquired whether there would be any overlapping. Colonel Olver referred to the provision in the scheme on account of the cost of 40 Bellary ewes and enquired whether that was the total number proposed to be purchased or whether it was in addition to the stock already available. To this Mr. Ananda Rao replied that it was in addition to 61 ewes already there. Colonel Olver then said that this number was sufficient for purposes of the scheme as the sheep breeding schemes committee which had considered the previous scheme was of the opinion that 100 was the minimum number for the purpose. He added that in his opinion we should not wait for the results of the other scheme and that this scheme should be approved in addition to the other scheme already working. He thought that the type of sheep in Madras was different from the other types. The object of the scheme was two-fold, *viz.*, the improvement of local breeds by selection and by cross breeding with Bikaner Breed. In the end he suggested that before the scheme was approved by the Board it should be considered by the Sheep Breeding Schemes Committee on the occasion of the next Advisory Board Meeting. The suggestion was approved by the Board. |

Proceedings of the Sixth Meeting of the Sugar Committee held in November 1933 (Subject No. 15 of the Agenda, Appendix XXV).

Several questions on points of detail were answered. The Proceedings were approved. |

10. *Proposals for the initiation of future research into the insect pests of sugar-cane (Subject No. 18 of the Agenda, Appendix XXVI).*

Mr. Burt introduced the scheme and explained that a scheme for research work at Pusa on Sugar-cane insect pest including the carriers of mosaic was considered by Sugar Committee and the Advisory Board soon after the formation of the Council. That scheme was not approved by the Board but at the last discussion it was recommended that a committee of Entomologists be appointed to deal with the question and to draft a scheme of research. A Committee of Entomologists was accordingly appointed by the Chairman of the Advisory Board and the Committee met in August 1933 and their scheme was considered and approved by the Sugar Committee at its meeting held in November 1933. The Board was now asked to endorse the Committee's proposals which amounted to the appointment of an all-India Sugar-cane Research Entomologist with staffs in the provinces of Bengal, Bihar, Bombay, United Provinces, Punjab, Madras and Mysore; the idea being that the work in the provinces should be co-ordinated and directed by the all-India senior sugarcane research entomologist who would be responsible for the framing of the programme in the first four provinces, the direction of the work and collation and interpretation of the results obtained in these provinces. He added that if the Board agreed the Provincial Governments concerned would be asked to submit schemes on the lines of the report of the Sub-Committee. Mr. Mitra suggested that Assam should also be added to the provinces from which schemes were to be invited as the sugarcane borer was considerably damaging sugarcane in Assam. Mr. Burt explained that Assam was in fact included in the recommendations of the Sub-Committee but as stated at the end of paragraph 7 of the Sub-Committee's report the requirements of Assam were not mentioned because the Committee had no information before them. Mr. Ritchie suggested that the Central Provinces should also be included. Dr. Ghosh here raised a point that for the senior sugarcane research entomologist a twenty years scale of 1,000—50—2,000 p. m. had been provided in the Committee's report. He enquired whether it was intended to engage the officer on a twenty years' basis, and if so it should be considered carefully whether it was necessary. The Chairman explained that a twenty years scale was not intended but the idea of putting that scale was to recruit an officer and fix his pay according to his experience and qualifications within that scale.

Dr. Ghosh also raised the point whether co-operation from the Entomologists employed under Universities would be sought in carrying out the scheme. Mr. Burt pointed out that this point was taken up at the meeting of the Board in January 1932 and it was then decided that this large problem could not be dealt with in that manner. Dr. Agharkar pointed out that there were good Entomologists employed under Universities and that their co-operation would be forthcoming. Mr. Burt said that he had personally raised that point in the special Committee but the Entomologists present did not consider that the problem could be tackled in that manner. In reply to an enquiry Mr. Carpenter was informed that the scheme, if sanctioned, would be financed from the sugar grant. Mr. Carpenter said that he agreed in the idea to have the scheme carried out on an all-India basis but he disagreed in regard to the proposed allocation of schemes on the basis of provinces. He was inclined to think that the headquarters staff would probably be sufficient

and that for the present the provincial part which was costly might be omitted. Dr. Agharkar agreed with Mr. Carpenter and said that the central part might be started first and if and when it was found necessary the provincial part might be introduced possibly at less cost. Dr. McRae referred to the urgency of the problem and favoured simultaneous starting of the two parts; the original scheme was submitted by Pusa as long ago as 1929. Mr. Burt said that the damage from the insect pests of sugarcane was inconceivable necessitating the starting of work urgently. As regards Mr. Carpenter's remark, Mr. Burt was of the view that in addition to the central officer there must be staff working in the provinces. Ultimately it was decided that the central part of the scheme should be started first. As regards its extension into the provinces it was decided that the scheme would be worked by the central officer under the control and direction of the Imperial Council of Agricultural Research and that of a suitable committee, i.e., either the main sugar committee or a sub-committee appointed by it and that if and when it was found necessary the extension of the scheme into the provinces would be decided by that sub-committee in consultation with the central officer. It was agreed that approval of the scheme did not imply approval of the financial details for which a separate estimate should be drawn up.

11. *Application from the United Provinces Poultry Association for a grant of Rs. 42,130 (Rs. 2,500 non-recurring and Rs. 39,630 recurring) for a scheme to develop egg and poultry marketing on a co-operative basis (Subject No. 4 of the Agenda, Appendices XXVII and XXVII-A).*

It was decided to refer the scheme for consideration to the Poultry Committee to which the name of Mr. G. K. Devadhar was added.

12. *Application from the Government of the Punjab for a grant of Rs. 1,73,970 spread over five years for a scheme for research on the water requirements of crops under canal irrigated conditions (revised scheme). (Subject No. 5 of the Agenda, Appendix XXVIII).*

Mr. Stewart, in introducing the scheme, said that the Board was familiar with the subject as a scheme had been accepted by it in January 1932 but rejected by the Governing Body in October 1932. The reason for rejection on the last occasion was that it was an expensive scheme costing about Rs. 4,00,000. In order to meet the objection on the score of expense the old scheme had now been revised into the present one, the cost of which is estimated at Rs. 1,73,970 spread over a period of five years. Towards this cost the Local Government proposed to credit to the Council annually a sum equal to the income derived from the land. This was estimated at Rs. 22,500 for the entire period of the scheme. In addition the Local Government proposed to provide funds to the extent of Rs. 4,000 for the repair of existing quarters and for the erection of such buildings as might be required and to undertake the repairs and upkeep of these buildings at an estimated cost of Rs. 300 per annum. The Local Government was also providing free of cost the necessary facilities in land, buildings, laboratories and for the part time services of the senior staff. Rao Bahadur Ananda Rao while supporting the scheme enquired whether the Provincial Officer on Rs. 300 per month provided for in the scheme would be considered senior enough to control the officers in charge of physiological and soil work and what the need for the soil physiologist was when the programme did not indicate any physiological work. Mr. Stewart explained that the

extra Assistant Director would be subordinate to the Deputy Director of Agriculture who would control the scheme. Mr. Jenkins was of the opinion that the work proposed in the scheme would be of very great help to Sind, and offered to supply the results of the Sakrand experiments to the staff at Lyallpur. Mr. Carpenter said that the lay-out of experiments in connection with the scheme would be a very complicated matter. As it was very important to see that the results were capable of realisation and suggested that the Statistician to the Imperial Council of Agricultural Research be associated with the lay-out of the experiments. Dr. Agharkar suggested that the scheme was an irrigation scheme and thought that the supply of water which was proposed to be paid for at the rate of Rs. 600 per annum should be free. He also expressed the view that provision on account of seed and manures, etc., provided in the scheme should be met by the Punjab Government. Mr. Stewart, in reply referred to the Punjab Government's contribution which has already been mentioned above. As regards the free supply of irrigation water, he said that the Irrigation Department is a commercial Department and that whenever the Agricultural Department required water in the past for any scheme financed by the Indian Central Cotton Committee or the Imperial Council of Agricultural Research the Irrigation Department asked for payment. In the circumstances he felt it would be useless to ask that Department to supply water free. He agreed to the Statistician to the Council being associated with the lay-out of the field experiments. The scheme was then carried with the rider regarding the association of the Statistician with the lay-out of the field experiments. }

13. The meeting then adjourned till 11 o'clock on Wednesday, the 21st February, 1934. }

NEW DELHI; }

The 20th February, 1934.

CHARAN DAS,
Secretary.

PROCEEDINGS OF THE NINTH MEETING OF THE ADVISORY
BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL
RESEARCH, HELD AT NEW DELHI, ON WEDNESDAY, THE
21ST FEBRUARY 1934.

The following were present:—

1. Diwan Bahadur Sir T. VIJAYARAGHAVACHARYA, K.B.E., *Chairman*.
2. Mr. R. G. ALLAN.
3. Rao Bahadur D. ANANDA RAO GARU.
4. Mr. B. K. BADAMI.
5. Dr. W. BURNS.
6. Mr. B. C. BURT.
7. Mr. P. H. CARPENTER.
8. Mr. G. K. DEVADHAR.
9. Dr. T. EKAMBARAM.
10. Mr. E. S. FARBROTHER.
11. Professor J. C. GHOSH.
12. Mr. W. J. JENKINS.
13. Mr. P. J. KERR.
14. Dr. V. N. LIKHITE.
15. Mr. K. McLEAN.
16. Dr. W. MCKRAE.
17. Mr. S. K. MITRA.
18. Mr. A. M. MUSTAFA.
19. Dr. NAZIR AHMAD.
20. Dr. S. S. NEHRU.
21. Khan Bahadur SHEIKH NIAZ MUHAMMAD.
22. Mr. NIZAMUDDIN HYDER.
23. Colonel A. OLIVER.
24. Mr. T. F. QUIRKE.
25. Major P. B. RILEY.
26. Mr. J. H. RITCHIE.
27. Mr. C. V. SANE.
28. Mr. G. P. SEN.
29. Mr. H. R. STEWART.
30. Major R. F. STIRLING.
31. Mr. G. T. TAIT.
32. Mr. W. TAYLOR.

Rai Sahib Malik Charan Das, *Secretary*.

The following attended as visitors:—

1. Dr. S. P. AGHARKAR.
2. Dr. J. K. BASU.
3. Mr. E. J. BRUEN.
4. Dr. P. S. HUDSON.
5. Dr. S. N. JAFRI.
6. Dr. P. J. KRISHNA.
7. Dr. P. E. LANDER.
8. Professor J. N. MUKHERJEE.
9. Mr. NURUL ISLAM.
10. Professor P. K. PARLJA.
11. Dr. M. A. SAMPATHKUMARAN.
12. Dr. K. C. SEN.
13. Mr. M. VAIDYANATHAN.
14. Rao Bahadur B. VISWANATH.

2. The meeting lasted from 11 a.m. till 1-20 p.m. and adjourned till 11 a.m. on the 23rd February 1934 to enable the following committees to meet in the meantime:—

1. Fruit Research Committee at 2-45 p.m. on 21st February, 1934.
2. Poultry Scheme Committee at 2-30 p.m. on 21st February, 1934.
3. Rice Research Scheme Committee at 11 a.m. on 22nd February, 1934.
4. Potato Research Schemes Committee at 11-30 a.m. on 22nd February, 1934.
5. Progress Reports Committee at 2-45 p.m. on 22nd February, 1934.

3. The Chairman announced that as decided yesterday Mr. Devadhar's resolution in regard to conditions in Bihar would be taken up. He added that a suitable resolution had been drafted which embodied the suggestions made on the previous day and asked Mr. Devadhar to move the same formally. Mr. Devadhar then moved the following resolution:—

"That this Board desires to express its deep and intense sympathy with the agriculturists of Bihar in their present distress resulting from the recent earthquake. It wishes to assure the Bihar and Orissa Agricultural and Veterinary Departments of its hearty support in the great task of rural reconstruction so far as this lies within the purview of the Council, and especially in the carrying out of any schemes of research and experiment connected with the restoration of the normal agricultural life of the Province."

Mr. Burt seconded the resolution which was carried unanimously.

4. *Scheme for an Imperial Sugar Research Institute (Subject No. 19 of the Agenda, Appendix XXIX).*

Mr. Burt, in introducing this subject, explained that at its meeting held in March 1933 the Sugar Committee approved of the general lines of a proposal for the establishment of a Sugar Research Institute and recommended the appointment of a sub-committee to examine the details. A sub-committee was accordingly appointed which submitted a report which was considered by the Sugar Committee in November 1933. Mr. Burt went on to say that the scheme as recommended by the sub-committee consisted of two alternative proposals, namely, (1) that the Sugar Institute should be located at the Harcourt Butler Technological Institute, Cawnpore, if suitable arrangements could be made for the direct control of the sugar work and (2) for the setting up of an entirely new all-India research and teaching institute without making use of any existing institution. The cost of these schemes respectively over a period of five years was estimated at about 14 lakhs for the first and about 31 lakhs for the second alternative scheme. The Sugar Committee had recommended the first alternative provided that satisfactory arrangements could be made with the United Provinces Government. The Sugar Committee had also recommended that the Sugar Institute should be provided with an adequate area of land at least 250 acres for the growing of cane for testing and experimental purposes. Mr. Burt added that if the Advisory Board endorsed the recommendations of the Sugar Committee, negotiations would be opened with the United Provinces Government regarding the conversion of the Sugar Department of the Harcourt Butler Technological Institute to an all-India Sugar Research Institute. He formally moved that the report of the committee be adopted. The motion was seconded by Dr. McRae. Professor Ghosh invited attention to Table II in Annexure I to the notes circulated on the subject entitled "Staff for the Institute and Sugar School as recommended by the Indian Sugar Committee, 1920," and table V entitled 'Recurring expenditure for running the Imperial Sugarcane Research Station at Harcourt Butler Technological Institute, Cawnpore', and said that after comparing the two tables he found that there were certain new posts to be created which were not recommended by the Sugar Committee of 1920. He referred to the post of one Professor of Sugar Technology and enquired why in addition to the post of Sugar Technologist that was necessary. Similarly, the post of Assistant Manufacturing Chemist provided now seemed to be a new post. Mr. Burt replied that the Sugar Technologist who would also be the Director would have a large amount of work to do outside the Institute and would not be able to perform the duties of Professor of Sugar Technology. Similarly, in regard to the other post he said that the matter had been carefully considered by the Committee in the light of recent experience and the staff recommended was considered absolutely essential. Mr. Jenkins enquired whether the question of sugar factories contributing towards the cost of the scheme was considered. Mr. Burt replied in the affirmative and said that the representatives of factories at the meeting of the Sugar Committee had expressed the readiness of the industry to contribute in some suitable manner. If and when the scheme is sanctioned this point would require further consideration. Mr. Devadhar wanted to know if the claims of Coimbatore were fully considered in view of the location of the Sugarcane breeding centre. Mr. Carpenter referred to the recommendation of the Sugar Committee that the Imperial Sugarcane Breeding Station, Coimbatore, should be

made a part of the proposed Sugar Research Institute and said that as the work of the Coimbatore station was connected entirely with cane breeding the Sugar Technologist who would under this scheme be the Director of the Sugar Research Institute would not be suitable to control the work of the Coimbatore Station. While, therefore, he agreed to the Coimbatore Station being brought directly under the control of the Imperial Council of Agricultural Research with Sugar Committee as its executive committee, it should not be under the Director of the Sugar Research Institute. The second point raised by him was whether there was sufficient cane area in the vicinity of Cawnpore to ensure that adequate quantity and kind of cane required for experimental purposes at the proposed Institute would be forthcoming from growers. He himself doubted this and said that in any case it would be unsatisfactory and that the Institute should have at least 500 acres of sugar land for the purpose. He further enquired whether Cawnpore was considered the best place for locating the Institute. Mr. Burt, in answer to Mr. Carpenter, said that the scheme itself made no reference to the Coimbatore cane breeding station being controlled by the Director of the proposed Institute. The essential proposal was the establishment of an institute for sugar technology. The Committee were satisfied that Cawnpore was the best centre for the Institute. He agreed that a sufficient area of land for the growing of cane for experimental purposes was required. Dr. Agharkar here raised the question of the relations of the Institute with the Universities and was told by the Chairman that the question need not be considered at this stage but would be borne in mind if and when an Institute was established. The Chairman then summarising the discussion stated the various points that required decision of the Board, *viz.*—

- (1) Does the Board want an Institute of the kind proposed?
- (2) If so, where should it be located?
- (3) Does the Board want the Institute to be an entirely technological institute or whether the Imperial Sugarcane Station at Coimbatore should also form part of it? and
- (4) Details of staff.

In regard to the first point, it was decided unanimously that the proposed Institute was necessary. With reference to the second point it was explained by the Chairman that the Sugar Committee had recommended three places in the order of preference, *viz.*, Cawnpore Lucknow and Meerut. The advantage of locating the Institute at Cawnpore was that, in the event of satisfactory arrangements being made with the United Provinces Government for taking over the Sugar Department of the Harcourt Butler Technological Institute, the buildings required for the Institute would be available. If, however, satisfactory arrangements with the Local Government could not be made then the matter could be submitted to the Board for re-consideration. After Mr. Burt had explained that the Committee considered that Cawnpore was in any case the best place from a technological point of view the Board decided in favour of it, subject to difficulties, if any, that may arise being reported to the Board in due course.

In connection with the third point the Board was asked whether, in the event of the scheme being sanctioned, the Coimbatore Station should be transferred to the Imperial Council of Agricultural Research or not. Dr. McRae was of the view that a Technologist is not expected to have and does not have a knowledge of questions connected with the botany and breeding of sugarcane and the Director of the proposed Institute was therefore not a suitable person to control the Coimbatore Station. At present the Vice-Chairman is Agricultural Adviser to the Govt. of India and his advice is freely asked for on many points of policy and administration, besides, the Director and the Sugarcane Expert are both members of the Sugar Committee while the former is also a member of the Advisory Board. The liaison between the Imperial Institute of Agricultural Research, particularly the cane-breeding Section, is thus as close as possible and advisable. In his opinion neither the Sugar Committee nor the Imperial Council of Agricultural Research as at present constituted is a suitable body to administer the cane-breeding section of the Imperial Institute of Agricultural Research and to change from the present administrative control to that suggested would be a detrimental step. Mr. Carpenter explained that he had made no suggestion for a Technologist controlling the Coimbatore Station. His idea was that the station should be controlled by the Sugar Committee under the direction of the Imperial Council. He added that at present the Director of Pusa controlled the activities at Coimbatore and as he was a member of the Sugar Committee he along with the Agricultural Expert would continue to exercise adequate control over it. The Department of Education, Health and Lands, which was in charge of the Station now, had many other things to think of and had probably not much time to think of scientific departments. On the other hand, the transfer of the station to the Council would secure a careful and primary consideration to it on the part of the Council. According to him this body was much more suitable for control of scientific departments. The question as to whether the Coimbatore cane breeding station should be transferred to the Council's control was then put to vote and lost by a majority of 9 against 7. The next question put to the Board was whether it preferred alternative scheme (1) or (2). The first alternative was approved. The Chairman then invited comments on the details of staff proposed by the Sugar Committee. Professor Ghosh referred to table V entitled 'Recurring expenditure for running the Imperial Sugar Research Institute at the Harcourt Butler Technological Institute, Cawnpore, and pointed out that while the scale of pay proposed for the Assistant Manufacturing Chemist was Rs. 600—50—800 that proposed for the Physical Chemist was only Rs. 400—20—600. He thought that officers holding these posts were likely to have the same qualifications and that the rates of pay and status should be the same. Mr. Burt said that this question had been very carefully considered because the Committee was anxious to keep down the cost of the scheme to the minimum, and the proposed rates of pay were considered adequate. Professor Ghosh stressed the point that the work of both the officers would be equally important and that therefore their status and pay should be the same. In the end, it was decided that the status and salary scale of the two officers should be equalised, but not necessarily the initial salaries. The financial position of the scheme was then approved subject to any detailed modifications which may be found necessary later. Professor Ghosh then

referred to item 4 (page 250 encl. 1 to Annexure I) to the note circulated to the Board which required *inter alia* that the Assistant Manufacturing Chemist to be recruited for the Institute should have at least five years experience of manufacturing cane sugar in India. In his opinion, what was required was an officer having superior mental equipment and not necessarily actual experience of manufacturing work which could be acquired in a short time. Mr. Burt said that the Committee certainly intended that an officer of adequate scientific training and outlook should be secured. As he was intended to succeed the head of the division after not too long a period he should also have manufacturing experience in India. The Sub-Committee's proposal was then approved. The main report of the sub-committee was then adopted by the Board, subject to the resolutions and decisions recorded above.

5. Sann-Hemp schemes.

- (i) Application from the Government of Madras for a grant of Rs. 1,500 spread over three years for a scheme of experiments for the improvement of sann hemp fibre at the Agricultural Research Station, Samalkota.
- (ii) Application from the Government of Bombay for a grant of Rs. 1,500 spread over three years for a scheme for research work on sann hemp in the Bombay Presidency.
- (iii) Application from the Government of the Central Provinces for a grant of Rs. 20,060 spread over 5 years for a scheme of research work on sann hemp in the Central Provinces.
(Subject No. 29 of the Agenda Appendix XXX.)

Mr. Burt in introducing the subject, explained that the schemes were the outcome of the discussion by the Board of Mr. T. S. Sabnis' report on the Hemp Marketing in India. He proposed that before the Board considered the schemes, they might be referred to an *ad hoc* Committee to be appointed by the Chairman to meet at or before the next meeting of the Advisory Board. In supporting the three applications for grants from the Governments of Bombay, Madras and the Central Provinces and the letter of Mr. V. V. Gadgil from Bombay on this subject, Mr. Devadhar desired to emphasise the need for systematic efforts for organizing co-operative societies of non-credit type made by these Governments as the production of this crop and its marketing concern chiefly the small cultivators in these provinces. The proposal was carried. Mr. McLean proposed to submit the Bengal proposal by about the middle of May.

6. Question of the duration of appointment of members of sub-committees appointed by the Governing Body under Rule 30 of the Rules and Regulations of the Imperial Council of Agricultural Research. (Subject No. 37 of the Agenda, Appendix XXXI.)

Mr. Burt explained that so far Committees appointed by the Advisory Board had been *ad hoc* Committees appointed to examine particular schemes and had been dissolved after finishing their work and the question of limiting the duration of appointment of members thereof did not arise. But the standing committees appointed under Rule 30 of the Rules and Regulations were continuous committees and the members thereof once appointed continued as such indefinitely because there was no provision for limiting the duration of membership. He considered it

advisable to limit the term of office of members in order firstly to prevent the committees from becoming too large on account of the addition of new members which became necessary as time went on and also to remove such members as were appointed for committees for particular reasons which no longer existed. In the event of the Board agreeing to the period of membership being limited, it had to consider whether this should be done by an amendment of the Rules and Regulations of the Council or by approaching the Governing Body with a request to do so under the powers vested in it under rule 30. Mr. Burt formally proposed that the Governing Body be asked by resolution to fix the period of membership to three years. Mr. Allan seconded the proposal. Mr. McLean proposed an amendment to the effect that the period of two years should be fixed. Messrs. Carpenter and Olver supported the amendment which Messrs. Burt and Allan accepted. The amended proposal was then carried.

7. Relation of the Provincial Governments and the Provincial Agricultural and Veterinary Departments to schemes financed by the Imperial Council of Agricultural Research and conducted in the provinces. (Subject No. 38 of the Agenda, Appendix No. XXXII.)

Dr. Burns introduced the subject. In the course of discussion in which several members joined it was made clear that no objection would ever be raised to the Provincial Directors of Agriculture and Veterinary Departments making un-official friendly visits to the work done on the Council's schemes other than those conducted under the control of the Provincial Agricultural or Veterinary Departments themselves. Even with regard to such schemes as Dr. Burns had in view Mr. Devadhar saw no objection defining the relation of the Director of Agriculture of the Province by granting him a kind of a statutory position as he was the representative of the Provincial Government here and also was a member of this Council. In Mr. Devadhar's opinion it was justifiable on the ground that when the reports or results of such non-official schemes in different provinces would come up before the Council the Director of Agriculture was naturally the person who would be expected to supply to the Council full information. Mr. Devadhar, therefore, further suggested that the reports of such non-official schemes in provinces might be called by the Council through the Director of Agriculture on its behalf. It was not considered desirable however to introduce a formal rule that the Directors were officially in charge of those schemes or to provide for formal inspections. It was further stated that any suggestions made by the Directors would receive due consideration. Messrs. Stewart and McLean stated that so far as their own provinces were concerned, very cordial relations existed between themselves and the professors of Universities who were carrying out Council's schemes. In view of this Dr. Burns said that no further action need be taken on the subject.

8. Proposed contribution by India of a sum of Rs. 14,500 during the period 1st October 1933 to the 1st March 1935, towards (i) the maintenance of the laboratory for collecting, breeding and despatching beneficial parasites at Farnham House, Farnham Royal, and (ii) the investigations into the control of insects and moulds injurious to stored products at Slough. (Subject No. 39 of the Agenda, Appendix XXXIII.)

Mr. Bart explained the proposal and formally moved for the grant asked for. The motion was seconded by Dr. McRae. In this connection

Mr. Devadhar wanted from Mr. Burt information regarding the following points (1) Was the share of India in proportion to her wealth as compared with the wealth of other countries, (2) what were the benefits that would accrue to India, (3) what would be the relation of this Council with the bodies to which grants are to be made, and (4) in what sense was the term 'co-operative' occurring in so many places in this note used? Was it in its specific sense of the economic movement or simply joint action? In reply to the last point the Chairman said that it was not used in the economic sense, but other sense. Mr. Burt supplied other information. After a question of detail asked by Mr. Carpenter had been answered, the proposal was carried unanimously.

9. With reference to the recommendations of the Advisory Board on 19th February 1934, that the application from the Government of Assam for a grant of Rs. 47,972 spread over a period of three years for investigation into vaccination of cattle with goat-virus against rinderpest (Subject No. 11 of the Agenda, Appendix IX) be referred to an *ad hoc* committee, the Chairman announced the appointment of the Committee composed as follows:—

Vice-Chairman, Imperial Council of Agricultural Research,
Chairman.

Animal Husbandry Expert, Imperial Council of Agricultural
Research.

Mr. P. J. KERR.

Mr. T. F. QUIRKE.

Mr. W. TAYLOR.

Major STIRLING.

Mr. G. P. SEN.

Rai Sahib Malik Charan Das, Secretary.

This Committee, will meet at 2-30 p.m., on Thursday, the 22nd February 1934.

10. The meeting then adjourned till 11 o'clock on Friday, the 23rd February 1934.

CHARAN DAS,
Secretary.

NEW DELHI;
The 21st February 1934.

PROCEEDINGS OF THE NINTH MEETING OF THE ADVISORY
 BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL
 RESEARCH HELD AT NEW DELHI ON FRIDAY, THE 23RD
 FEBRUARY 1934.

The following were present:—

1. Diwan Bahadur Sir T. VJAYARAGHAVACHARYA, K.B.E.,
Chairman.
2. Mr. Mohd. AZHAR ALI.
3. Mr. R. G. ALLAN.
4. Rao Bahadur D. ANANDA RAO GARU.
5. Mr. B. K. BADAMI.
6. Rao Bahadur BHIMBHAI R. NAIK.
7. Dr. W. BURNS.
8. Mr. B. C. BURT.
9. Mr. P. H. CARPENTER.
10. Mr. G. K. DEVADHAR.
11. Dr. T. EKAMBARAM.
12. Mr. E. S. FARBROTHER.
13. Professor J. C. GHOSH.
14. Mr. W. J. JENKINS.
15. Dr. V. N. LIKHITE.
16. Mr. K. McLEAN.
17. Dr. W. McRAE.
18. Mr. S. K. MITRA.
19. Mr. A. M. MUSTAFA.
20. Dr. NAZIR AHMAD.
21. Dr. S. S. NEHRU.
22. Khan Bahadur SHEIKH NIAZ MUHAMMAD.
23. Mr. NIZAMUDDIN HYDER.
24. Colonel A. OLVER.
25. Mr. T. F. QUIRKE.
26. Major P. B. RILEY.
27. Mr. J. H. RITCHIE.
28. Mr. C. V. SANE.
29. Mr. G. P. SEN.
30. Mr. H. R. STEWART.
31. Major R. F. STIRLING.
32. Mr. G. T. TAIT.
33. Mr. W. TAYLOR.

Rai Sahib Malik Charan Das, Secretary.

The following attended as visitors:—

1. Dr. S. P. AGHARKAR.
2. Dr. J. K. BASU.
3. Mr. E. J. BRUEN.
4. Dr. P. S. HUDSON.
5. Dr. S. N. JAFRI.
6. Dr. P. J. KRISHNA.
7. Dr. P. E. LANDER.
8. Professor J. N. MUKHERJEE.
9. Mr. NURUL ISLAM.
10. Professor P. K. PARIJA.
11. Dr. M. A. SAMPATHKUMARAN.
12. Dr. K. C. SEN.
13. Mr. M. VAIDYANATHAN.
14. Rao Bahadur B. VISWANATH.

2. The meeting lasted from 11 A.M. till 1-15 P.M. and adjourned till 11 A.M. on the 24th February 1934.

3. *Recommendations of the Locust Committee at its fifth meeting held in January 1934. Proposals for continuance and future programme of work (Subject No. 3 of the Agenda, Appendix XXXIV).*

Mr. Burt introduced the scheme and explained the work done on the subject of locust research during the year 1933-34. He then referred to the various recommendations made by the Locust Committee at its meeting held in January last for continuance of the work during the year 1934-35. The Committee expressed the opinion that the locust laboratory at Pasni must continue until the next appearance of migratory locusts so that the whole cycle between two visitations could be studied. For this reason the Committee had recommended the construction of a building for the laboratory as well as Kachha-pucca buildings for the staff costing in all about Rs. 6,000. He then formally moved for the adoption of the report. Dr. Agharkar seconding the proposal said that results of great value had been obtained and that, in his opinion, the work should be continued. He suggested, however, that for relative humidity and temperature absolute maxima and absolute minima should be recorded. The Chairman in putting the proposals to vote said that the report on the work done during the last year was considered very carefully at the last meeting of the Committee: he explained the financial details of the proposals. The report was then adopted.

4. *Report of the Sub-Committee on Fruit Schemes.—(i) Application from the Baluchistan Administration for a grant of Rs. 49,600 spread over a period of five years for a scheme for establishing a "Canning and Fruit Preserving Research Laboratory" at the Fruit Experiment Station, Quetta (Subject No. 34(i) of the Agenda, Appendices XXXV and XXXV-A).*

Mr. Mustafa introduced the scheme and moved the adoption of the recommendation of the Fruit Committee on the Baluchistan Scheme. He

said that the scheme would be very helpful to the prosperity of Baluchistan. Dr. McRae supported the scheme, from personal knowledge of the variety and quality of the fruit grown at Quetta. Mr. Mitra said that there were many fruits in the country of which a surplus existed. The proposal under consideration was a step towards meeting this problem and he supported the proposal. The scheme was carried as recommended by the Committee.

Mr. Allan mentioned that the Committee had suggested that a plain canning station in Bihar would be of help to Bihar and of value to the rest of India. The Chairman said that this would be noted in the proceedings.

5. *Application from the Government of the Central Provinces for a grant of Rs. 1,49,640 spread over a period of ten years for a scheme for research on the orange crop of the Central Provinces (Subject No. 34 (ii) of the Agenda, Appendices XXXV and XXXV-B).*

Mr. Ritchie introduced the scheme and moved the adoption of the report of the Committee on this scheme. Mr. Devadhar wanted to know whether the research on the orange crop in the Central Provinces would be useful for the improvement of another valuable fruit called "Mosambi" in Bombay which is getting popular day by day owing to its vitamin values. Mr. Jenkins supported the scheme which was then approved with the modifications proposed by the Committee.

6. *Application from the Government of His Exalted Highness the Nizam for a grant of Rs. 74,300 spread over a period of five years for a fruit research scheme (Subject No. 34(iii) of the Agenda, Appendices XXXV and XXXV-C).*

This scheme had also been examined by the Fruit Committee which recommended that the present scheme should be withdrawn and that a scheme of work for research on those fruits for which Hyderabad was especially suitable and which were not already covered by research schemes might be put forward. The Director of Agriculture, Hyderabad, agreed to this and to re-examine the scheme in the light of the Committee's suggestions. This was approved by the Board.

7. *Application from the Government of the Punjab for a grant of Rs. 57,430 spread over a period of five years for a scheme of research on citrus stock and grape vines in the Punjab [Subject No. 34(iv) of the Agenda, Appendices XXXV and XXXV-D.]*

The Board took up the consideration of this scheme together with the recommendations of the Fruit Committee thereon. Mr. Stewart introduced the scheme and said that the first part was complementary to the Central Provinces scheme of research work on the "Santra" type of orange as it would deal mainly with the Malta type although other citrus fruits would be included. He said that this Department planted a large variety of fruits on their various farms all over the Punjab and carried out experiments with the object of finding out which can be grown most successfully. It had been clearly established that citrus fruits are the best under average conditions. He added that they had also obtained the concession of quarter parcel rate for trial consignments of fruit from the North Western Railway in an endeavour to find new

markets for Punjab maltas and other fruits and were in communication with the Railway Board in regard to similar concessions on other Railways.

The Chairman referred to the recommendation of the Fruit Committee that, both in regard to this scheme and the Central Provinces research scheme on "Santra" oranges, a full technical programme of work should be submitted for consideration and discussion as soon as financial sanction had been communicated. The scheme was then approved as recommended by the Committee.

8. *Application from the Government of the Punjab for a grant of Rs. 35,052 spread over a period of three years for a scheme for a San Jose Scale survey in the Punjab [Subject No. 34(v) of the Agenda, Appendices XXXV and XXXV-E.]*

Mr. Stewart in introducing the scheme explained that, as far as is known at present, the San Jose Scale exists in the Kulu Valley and Simla Hills. The Punjab Department of Agriculture had been undertaking spraying as a control for the last five years these measures had been particularly successful. He referred to the Kashmir State having recently introduced quarantine regulations in the hope of bringing the pest under control in their fruit growing areas and thought that before similar regulations could be considered in the Punjab, it was essential to ascertain definitely how far the pest had spread in the Province. He added that the Fruit Committee, which had examined the scheme, had recommended it for sanction for a period of two years instead of three years as proposed in the scheme and requested sanction to the scheme with the modification suggested by the Committee. Mr. Jenkins suggested that the staff proposed for the Punjab scheme might also undertake survey in the fruit growing area in Sind. The area under fruit in Sind was about 4,000 acres. Mr. Stewart agreed that it would be economical to use this experienced staff but he could not say whether it could be done within the two years now proposed for the scheme in the Punjab alone. He said that whilst there may be only 4,000 acres under fruit in Sind or under the type of fruit on which this pest was known that area may be scattered over very wide areas. Mr. Jenkins said that that was not the case. Mr. Devadhar wanted to support Mr. Jenkin's suggestion if it would not interfere with the working of the original Punjab scheme and also if it did not involve much larger expenditure loss of time as those two provinces were so close to each other. The Chairman in putting the scheme to a vote stated that sanction might be accorded subject to the understanding that Sind would be included if this could be done without additional expense. If a further grant were needed the matter would be brought up again. This was agreed to and the scheme was approved with the modification proposed in the Fruit Committee's report.

9. *Report of the Editorial Committee (Subject No. 25 of the Agenda, Appendix XXXVI).*

Mr. Burt and Colonel Olver explained in detail the various recommendations made by the Editorial Committee. Mr. Devadhar referred to the proposals made by the Committee for the supply of free copies of the Council's Journals to important publishers in agricultural and veterinary books in India and abroad and suggested that the Council might also supply its publications free to several interested institutions and organisations in India that conducted magazines or periodicals in the vernacular languages so as to bring the valuable knowledge within the reach of

the intelligent but poor cultivators scattered all over the country. It was explained in reply that copies were being supplied to all the important institutions in India and that requests for copies, whether from private individuals or institutions, were always dealt with sympathetically. At Dr. Ghosh's request Mr. Burt explained the procedure followed by the Editorial Committee of the Council for the examination of papers received for publication. A paper on receipt was seen first by the appropriate Expert to the Council and then, referred to one or more specialist referees. If found suitable it was straightway accepted for publication. If any serious criticisms were made on the paper a second referee was consulted. The comments of the referee were communicated to the author without disclosing the name of the referee. Dr. Ghosh thought it essential that when a paper was adversely criticised by a specialist referee it should be examined by another suitable referee and if necessary and if the author so desired such paper might be referred to a specialist outside India. Professor Mukherjee supported Dr. Ghosh. Mr. Burt explained that papers were already being referred to more than one referee; whenever necessary he agreed that in some cases a paper might be referred to a referee outside India. The Chairman added that in some cases papers had even gone to three referees.

10. On the question of improving the illustrations in the Council's publications Professor Mukherjee thought that there was considerable scope for improvement and mentioned three good block making firms in Calcutta, *viz.*, the Art Press, the Baptist Mission Press and the Statesman Press, where good work was being done. Mr. Tait drew attention to the fact that poor quality of the blocks might sometime be due to the poor quality of paper and the ink used and he thought that this point might also be kept in mind.

11. Dr. Burns considered that the recommendations of the Editorial Committee made in items 9 and 10 of the note circulated on the subject were very desirable. Colonel Olver said that he had come across several instances in which on account of the policy that publications of one Government or Department must be had on payment by other Governments and Departments, several officers of local Governments were not able to get the Council's publications. Mr. Burt said that to try and remedy this drawback the Council had started a scheme of free interchange of agricultural and veterinary publications the object of which was to provide a sufficient number of the Council, publications to all the Agricultural and Veterinary departments in India in exchange for the supply of a certain number of the latter's publications to the Council and also to the other participants in the scheme. While the scheme of exchange of publications between the Council and the Local Governments, etc., had been accepted by all the parties it was a matter for regret that some of the Local Governments did not fully participate in the larger exchange scheme. He appealed to the heads of the Agricultural and Veterinary departments who were present to use their influence in order to see that the scheme, which was a very valuable one, was made a success. In the end, the report of the Editorial Committee was adopted by the Board with an expression of appreciation of the help rendered to the Council by all the referees in an honorary capacity.

12. Mr. Devadhar at this stage with the permission of the Chairman and in continuation of what he said on the first day in connection with the discussion of the scheme for additional research on oilseed crops in

various provinces, raised a question in regard to the condition of the coconut oil industry and suggested that in order to improve and develop it an organisation might be created on the lines of the Indian Central Cotton Committee as suggested to him by the Travancore Chamber of Commerce at Allepy in his capacity as President of the Travancore Co-operative Enquiry Committee in their letter to him dated the 9th of February 1934 embodying therein a draft of a resolution to that effect to be moved by him in this Council. Here Mr. Devadhar with the Chairman's permission read this letter and in addition, he referred to the fact that a special officer had been appointed by the Imperial Council of Agricultural Research to enquire into this matter who was now engaged on the problem and enquired whether the suggestion for the creation of an organisation made by him should be taken up now or whether it would be better to wait till the report of the special officer was out. The Chairman said that it would be well to wait till the work of the special officer was completed and his report had been received and considered.

13. *Report of Committee on Soil Science Schemes—(i) Application from the Government of Bengal for a continuation grant of Rs. 18,800 spread over three years for research into properties of colloid soil constituents by Professor J. N. Mukherjee of the Calcutta University [Subject No. 27(i) of the Agenda, Appendices XXXVII and XXXVII-A].*

Professor Mukherjee introduced the scheme which had been examined by the Standing Soil Science Committee and commended it for approval subject to the modifications made therein by the Committee. Dr. Nazir Ahmad referred to Dr. Bhatnagar's scheme on the effect of ions on plant growth which was already in progress and enquired whether the present scheme would in any way amount to duplication of work. Dr. Nehru was of the opinion that the two schemes were complementary to each other. Professor Mukherjee explained that his scheme did not aim at any results on plant growth. He would when carrying out the present scheme, confine work to the soil side and would not touch the botanical side at all. Mr. Carpenter said that the work which Professor Mukherjee proposed to do was purely chemical and not directly agricultural; it was work for the benefit of agriculturists but the work would be of great value to agricultural research workers in the various branches of soil science and thus to the agriculturists. The report (Appendix XXXVII) of the Soil Science Committee relating to the scheme was then adopted.

14. *Report of Committee on Soil Science Schemes, (ii) Application from the Government of the Punjab for a grant of Rs. 13,120 spread over three years for a scheme to investigate the changes in the microflora of Kallar and alkaline soils during reclamation by Dr. Jagjivan Singh, M.Sc., Ph.D. [Subject No. 27(ii) of the Agenda, Appendices XXXVII and XXXVII-B].*

Mr. Stewart introduced the scheme. Mr. Jenkins enquired whether the Microbiologist proposed under the scheme would also investigate the reclamation of alkali land in Sind and advise Sind as to what should be done. Dr. Lander said that he presumed that the officer would be able to visit research stations in Sind and co-operate with workers there. Mr. Carpenter said that this was not a reclamation scheme but aimed at studying the problem in order to find out the various factors connected with it. As such he thought that the results of the Punjab will also be useful to Sind. Mr. Jenkins, on the other hand, thought that there was no question of the Punjab results applying to Sind where actual

work would be required as Sind methods of reclamation were different. Rao Bahadur Viswanath thought that there should be no difficulty in securing samples from Sind for examination. In the end it was agreed that the conditions in the two provinces were different and that one officer would not be able to do work for both the provinces. Mr. Allan thought that the best thing would be to await the results of the Punjab scheme and then consider what should be done for Sind. The Chairman put the following two proposals to the vote:—

- (i) That the Committee's report regarding the Punjab Scheme be adopted, and
- (ii) That Mr. Jenkins be asked to submit a separate scheme for similar work in Sind.

Both proposals were carried.

15. *Report of Committee on Soil Science Schemes (iii) Report on the investigations carried out by Dr. A. N. Puri, M.Sc. Ph.D., A.I.C., on the standardisation of Physico-chemical "single value" measurements most suitable for Indian soils [Subject No. 27(iii) of the Agenda, Appendices XXXVII and XXXVII-C].*

The Board adopted the report of the Soil Science Committee.

16. At this stage, Mr. Burt introduced the following two subjects which had been dealt with by the Soil Science Committee at its meeting held on the 20th February 1934 but which were not on the agenda of the Advisory Board:—

- (i) Third International Congress of Soil Science to be held in England in May 1935.
- (ii) Proposed establishment in India of a National Section of the International Society of Soil Science. In regard to (i) Mr. Burt explained that the Imperial Council had received a special request from the President elect of the Congress, Sir John Russell, F.R.S., Director of the Rothamsted Experimental Station, that the Indian Delegation to the Congress should be as strong and representative as possible and that at least one official delegate should be arranged. He went on to say that steps had already been taken to circularise Provincial Agricultural Departments and the Universities offering to secure facilities for any soil science workers and similar officers who were likely to be in England in 1935 and who might wish to attend the Congress in order that they be given the status of official delegates. The Committee approved of the steps that had already been taken by the Council's secretariat to bring the Congress to the notice of the Provincial Agricultural Departments and Universities and considered it extremely important that there should be a strong Indian delegation at this Congress. The Committee also endorsed the proposal that the Imperial Council of Agricultural Research should meet the expenses of one member who would be the Leader of the Indian Delegation to the Congress and recommended that this representative should, if possible, be the President of the Indian National Section of the International Society of Soil

Science which was now being formed.

moved the adoption of the Committee's report.

The motion was seconded by Professor Mukherjee, ^{officially} carried.

Mr. Burt also moved the adoption of the recommendation of the Committee in regard to the establishment of a National Section of the International Society of Soil Science. In doing so he explained that as recommended at the last meeting of the Advisory Board of the Council, this subject was discussed at the Indian Science Congress held at Bombay in January 1934 and that the Soil Science Committee had endorsed the view that the Indian Section of Soil Science should essentially be an un-official organization. The Committee also considered the draft scheme and bye-laws (not printed) to be generally appropriate. Professor Mukherjee seconded the motion which was then carried.

The meeting then adjourned till 11 A.M. on Saturday, the 24th February 1934.

CHARAN DAS,

Secretary.

NEW DELHI;

The 23rd February 1934.

PROCEEDINGS OF THE NINTH MEETING OF THE ADVISORY
BOARD OF THE IMPERIAL COUNCIL OF AGRICULTURAL
RESEARCH HELD AT NEW DELHI ON SATURDAY, THE
24TH FEBRUARY 1934.

The following were present:—

1. Diwan Bahadur Sir T. VIJAYARAGHAVACHARYA, K.B.E., *Chairman*.
 2. Mr. R. G. ALLAN.
 3. Rao Bahadur D. ANANDA RAO GARU.
 4. Mr. B. K. BADAMI.
 5. Rao Bahadur BHIMBHAI R. NAIK.
 6. Dr. W. BURNS.
 7. Mr. B. C. BURT.
 8. Mr. P. H. CARPENTER.
 9. Mr. G. K. DEVADHAR.
 10. Dr. T. EKAMBARAM.
 11. Mr. E. S. FARBROTHER.
 12. Professor J. C. GHOSH.
 13. Dr. V. N. LIKHITE.
 14. Mr. K. McLEAN.
 15. Dr. W. McRAE.
 16. Mr. S. K. MITRA.
 17. Dr. NAZIR AHMAD.
 18. Dr. S. S. NEHRU.
 19. Khan Bahadur Sheikh NIAZ MUHAMMAD.
 20. Mr. NIZAMUDDIN HYDER.
 21. Col. A. OLVER.
 22. Mr. T. F. QUIRKE.
 23. Major P. B. RILEY.
 24. Mr. C. V. SANE.
 25. Mr. G. P. SEN.
 26. Mr. H. R. STEWART.
 27. Major R. F. STIRLING.
 28. Mr. W. TAYLOR.
- Raj Sahib Malik CHARAN DAS, *Secretary*.

The following attended as visitors:—

1. Dr. S. P. AGHARKAR.
2. Dr. P. S. HUDSON.
3. Dr. S. N. JAFRI.
4. Dr. P. J. KRISHNA.
5. Dr. P. E. LANDER.
6. Professor J. N. MUKHERJEE.
7. Mr. NURUL ISLAM.
8. Professor P. K. PARIJA.
9. Mr. M. VAIDYANATHAN.
10. Rao Bahadur B. VISWANATH.

2. The meeting lasted from 11 A.M. till 1-30 P.M. when it dispersed having completed all the items on the Agenda.

3. *Application from the Government of Assam for a grant of Rs. 47,972 spread over a period of three years for investigation into vaccination of cattle with goat-virus against rinderpest. (Subject No. 11 of the Agenda Appendices IX and IX-A).*

Colonel Olver introduced the scheme (Appendix IX-A) and the report of the Committee (Appendix IX) which had examined it. In doing so he said that the work involved in this scheme was highly technical and that the feeling of the Committee was that valuable information of more than local importance could be obtained from some of the items included in the scheme and that the work could be carried out by a small extra staff working immediately under the Disease Investigation Officer. Even so it would require careful expert supervision and the Committee considered that the scheme should not in any case be started until an experienced and fully qualified veterinary surgeon was available to direct and control the work of the Veterinary Investigation Officer and the staff employed on this work. Mr. G. P. Sen said that he had already started the proposed work to some extent and that he did not agree with the last portion of the Committee's report. He would therefore amend that portion. Mr. Mitra said that he did not understand the need for a veterinary surgeon. Assam had in Mr. G. P. Sen, Superintendent, Civil Veterinary Department, a person who had done work of superintendent for six years and who was quite competent to supervise the work of the scheme. Mr. Mitra emphasised this in view of Mr. Sen's qualifications and of 28 years experience of veterinary work, this scheme should be placed under him, otherwise it would mean a reflection on his capabilities, with which the Assam Government were not likely to agree. In the course of discussion it was made clear that the Committee did not intend to cast any reflection on Mr. Sen's capabilities, but what they had in mind was that Mr. Sen was due to retire sometime in July 1935 and that his services would therefore not be available for supervising this scheme throughout its entire period of three years. In regard to the Veterinary Investigation Officer employed in Assam, it was thought that while he was a thoroughly qualified man he did not possess long experience of such work. In view of this the Committee feared that owing to financial difficulties, the Government of Assam might on Mr. Sen's retirement make some arrangement for carrying on the work of the Superintendent, Civil Veterinary Department, by combining it with some other post.

That is what the Committee had in mind. The Chairman suggested that the best way out of the difficulty seemed to him to be to inform the Assam Government of the recommendation of the Committee and say that while making the recommendation contained in the Committee's report no reflection on Mr. Sen's capacity to supervise it was intended, the Committee was not sure that after Mr. Sen's retirement a thoroughly efficient man would be available. The Assam Government might then be told that before the scheme was sanctioned the Council would like to be informed of the arrangements that would be made by the Local Government after Mr. Sen's retirement. There was a general discussion in which several members joined. In the end it was agreed at the suggestion of the Chairman that the scheme be approved on the understanding that the Vice-Chairman of the Council would satisfy himself that suitable arrangement can be made for the proper supervision of the work throughout. It was also agreed that in communicating the report of the Sub-Committee on the scheme to the Assam Government, the Local Government should be informed of the reason for the recommendation contained in the report of the Sub-Committee.

4. *Annual Report of Mr. Slater's goat breeding scheme for 1932-33.*
[Subject No. 28(i) of the Agenda, Appendices XXXVIII and XXXVIII-A.]

Col. Olver introduced Mr. Slater's report on the goat breeding scheme for the year 1932-33 and explained the two points mentioned in the Sub-Committee's Report. He stated that as a result of the publication of this report enquiries had been received from prominent goat breeders in America who were very much impressed by the results obtained from some of the best of Mr. Slater's goats. Professor Mukherjee said that now-a-days there was a great demand for goat flesh, but its flavour was sometimes disagreeable, and he enquired whether anything could be done to remove this defect. Col. Olver said that the point was worth consideration and that it would be borne in mind. The report of the Committee was then adopted.

5. *Report of Mr. K. P. R. Kartha on milk production statistics.*
[Subject No. 28(ii) on the Agenda, Appendix XXXIX.]

The Chairman explained that the Board had decided to refer the report to the Dairying Committee which will meet in March and submit its report to the Advisory Board at its next meeting. The report of Mr. Kartha was meanwhile submitted merely for information. The Board noted and passed on to the next item.

6. *Annual reports on the working of rice research schemes in Bengal and Burma for the year 1932-33.* (Subject No. 30 of the Agenda, Appendices XL and XL-A.)

Mr. Burt introduced the report of the Rice Research Schemes Committee (Appendix XL) in so far as it concerned the Annual Reports (Appendix XL-A) on the work of the rice schemes in Bengal and Burma for the year 1932-33. He particularly mentioned the recommendation made by the Committee that for all schemes of this nature (and not only for rice schemes) it was desirable that in future as soon as financial sanction to a scheme has been communicated a full technical programme of work should be drawn up and submitted to the Council. The programme should then be brought before a suitable sub-committee whenever possible and in any case should be examined by the staff of the Council. Mr. Burt explained that the first year's reports on schemes inevitably come

before the Advisory Board when the second year's work is well on, with the result that whatever suggestions are made by the Board can only affect the third year of the scheme. The recommendation of the Committee referred to above would enable the suggestions in regard to detailed programmes to be carried from the very beginning of the schemes. Another point to which he specifically drew attention was the recommendation of the Committee that in order that a more definite method of reporting the results of field experiments might be adopted, the Statistician to the Council should prepare a draft form of report and circulate it. This would apply not only to these two schemes, but also to all similar schemes. Mr. Burt said that the Committee attached great importance to these points and then formally moved for the adoption of the Report. Dr. Burns seconded the motion. Mr. Carpenter suggested that in regard to the first recommendation to which reference was made by Mr. Burt, namely, that "it is desirable that a full technical programme of work should be drawn up and submitted to the Council as soon as possible after financial sanction has been given to the scheme" that the word "essential" should be substituted for the word "desirable". In other words, he said that the Board should pass a resolution to the effect that it is essential that a full technical programme of work should be drawn up and submitted to the Council as soon as possible after financial sanction had been given to the scheme. Professor Mukherjee seconded the motion. Dr. McRae was of the opinion that there might be difficulty if this recommendation which referred originally to field experiments were made now general. In the case of laboratory work where the exploration of the unknown was to be undertaken it was not so easy to draw up a detailed programme in advance though a plan of the method proposed for the investigation was always prepared beforehand and would be available. Professor Ekambaram said that a working plan could be given without going into too much detail. Professor Ghosh was of the opinion that a forecast of the lines of work was necessary, but some changes might be found necessary later on and he hoped that the Council would permit suitable changes being made if and when found necessary. The Chairman said that the Council would not interfere with any changes that were found necessary. Mr. Carpenter explained that the question in the Committee arose in connection with the lay out of agricultural experiments and the Committee wanted to be sure that experiments were laid out satisfactorily so that the future work was done on proper lines. In his opinion the Committee's recommendation was in the interests of the scientific officers carrying out schemes as well as of the Council. In the end the report of the Committee was adopted subject to the modification suggested by Mr. Carpenter.

7. Application from the Government of Bengal for a grant of Rs. 21,600 spread over five years for a scheme of research on the biochemical and physico-chemical properties of rice at the Dacca University. [Subject No. 31 of the Agenda, Appendices XL-B and XL-B (i).]

Mr. Burt introduced the report, Appendix XL-B (i) of the Rice Research Schemes Committee so far as it related to this scheme, and referred to the Committee's recommendation that this scheme together with the pending scheme from Madras and the scheme already sanctioned for work at the Indian Institute of Science, Bangalore, should be sent to General Sir Robert McCarrison with a note of the Committee's recommendation inviting his opinion and advice. He also mentioned that the

Committee had agreed that before writing to Sir Robert McCarrison, an enquiry should be made from Provincial Agricultural Chemists as to the work which had been carried out and was actually in progress at the present moment and a summary of this should also be sent. Lt.-Col. A. J. H. Russell had kindly offered to assist in the preparation of the draft to Sir Robert McCarrison. He added that on receipt of General McCarrison's reply the whole question should again be examined by the Committee and submitted to the Board at its next meeting. The Committee's report was adopted.

8. *Application from the Government of Bengal for a grant of Rs. 20,812 spread over five years for a scheme of research work on the physiology of the rice plant by Dr. S. P. Agharkar. (Subject No. 32 of the Agenda, Appendices XL and XL-C.)*

Mr. Burt explained that Professor Agharkar who had submitted the scheme had agreed to the suggestion of the Committee that the scheme should be withdrawn for reconsideration. The Committee's recommendation was approved by the Board.

9. *Application from the Government of the Central Provinces for a grant of Rs. 10,088 spread over four years for research work on the "Gangai" pest of rice-entomological work under the scheme of rice research already sanctioned by the Council for the Central Provinces. (Subject No. 33 of the Agenda, Appendices XL and XL-D.)*

Mr. Burt moved the adoption of the Committee's report on the subject. Rao Bahadur Bhim Bhai Naik seconded the motion which was adopted.

10. *Annual Report of the Agricultural Meteorology Branch of the Indian Meteorological Department, Poona, for the year ending the 21st August 1933. [Subject No. 35(i) of the Agenda, Appendix XLI-A.]*

Mr. Burt introduced the Committee's Report (Appendix XLI) on the subject and moved for its adoption. Dr. Nazir Ahmed seconded. Professor Agharkar raised a point that no records appeared to have been kept about light, as he thought that both quality and intensity of light were of importance for plant growth. He suggested therefore that if possible information on this subject might be recorded in future. Mr. Burt thought that this was more a problem for a University Physical Laboratory. Professor Ekambaram said that information regarding the intensity and quality of light was not of great value to agricultural crops. Mr. Carpenter agreed with Professor Agharkar regarding the necessity of recording the intensity and quality of light when work was being done on any particular crop, such as tea; these had a great effect on the development of plants. He added, however that this did not apply in the present case, because work was not being done, on any particular crop. The report of the Committee was then adopted.

11. *Final report by Professor P. K. Parija on the scheme of research work on Water Hyacinth in Bihar and Orissa. [Subject No. 35(ii) of the Agenda, Appendix XLI-B.]*

Mr. Burt introduced the scheme and formally moved the adoption of the Committee's report (Appendix XLI) on the subject. Professor Mukherjee seconded the motion. Dr. Agharkar in supporting the motion said that he would like to raise one or two points. He said that he

had tried in Calcutta during April and May to grow water hyacinth, but had failed. He however found that after the monsoon had set in water-hyacinth grew. Mr. Parija explained that his experience was quite different and that he could grow water hyacinths throughout the year, but he would look into the points mentioned by Professor Agharkar. Professor Agharkar also drew attention to the desirability of compiling a handbook of all the available information on water hyacinth to which Professor Parija had referred in his report. Professor Agharkar attached great importance to its compilation at an early date. Professor Parija said that for the compilation of the hand-book he needed a good library and for this purpose he intended to go to Pusa shortly, if Dr. McRae could give him the necessary facilities. Dr. McRae replied that he would be able to do so in about a month when the Library was removed from the Phipps' Laboratory to Bungalow No. 5. Dr. Mitra enquired whether any other chemical than copper sulphate was used by him in connection with this scheme to which Professor Parija replied in the negative. The report was then adopted.

12. *Report on the work done on the scheme of research on the effect of ions on the growth of plants by Dr. S. S. Bhatnagar during the period February 1931 to August 1933.* [Subject No. 35(iii) of the Agenda, Appendix XLI-C.]

Mr. Burt explained the recommendations (Appendix XLI) of the Committee which had examined the report and formally moved its adoption. Professor Mukherjee seconded the motion which was carried.

13. *Provincial schemes of potato research:—*

- (A) *Application from the Government of Bengal for a grant of Rs. 48,950 spread over five years for a scheme of potato research.*
- (B) *Application from the Government of the United Provinces for grant of Rs. 41,790 spread over five years for a scheme of potato research.*
- (C) *Application from the Government of the Punjab for a grant of Rs. 37,760 spread over five years for a scheme of potato research.*
- (D) *Application from the Government of Bihar and Orissa for a grant of Rs. 21,096 spread over three years for a scheme of potato research.*
- (E) *Application from the Government of the Central Provinces for a grant of Rs. 15,246 spread over three years for a scheme of potato research.*
- (F) *Application from the Government of Assam for a grant of Rs. 56,943 spread over five years for a scheme of potato research.* [Subject Nos. 36(A) to F, Appendix XLII-A.]

Mr. Burt in introducing the report (Appendix XLII) suggested that, as one Committee had examined all the schemes (Appendix XLII-A) together, it would be as well for the Board to consider them at the same time. He then explained the recommendations made by the Committee in regard to these schemes and formerly moved the adoption of the Committee's report. Dr. Hudson seconded the motion and particularly referred to the desirability of establishing a Central Research Institute

for Potato in India and also commended the recommendation of the Committee in regard to the sending of an expedition to South and Central America. In this connection Dr. Hudson referred to the scientific expedition sent by the Russian Soviet Government in 1925 to South and Central America which brought back a large number of specimens of new species of cultivated potato as well as wild potatoes and commended the suggestion that India might also send an expedition there. Dr. Nehru said that as far as he knew the Russian Institute would be very willing to supply the necessary information to any Institute in India in regard to this matter. Dr. Hudson said that while the Russian institutes would be willing to supply sets and seeds of the older type of potato, they would not be likely to supply any of the new varieties which they had found at any rate at present. Dr. Nehru was however of the opinion that Soviet Russia would be quite willing to exchange Indian exhibits for Russian varieties. The Report was then adopted.

Dr. Hudson explained that, even so, one could not possibly expect to get all the new material which the expedition had brought back and that it was very likely that some of the forms of most value to India but not so useful to Russia were not now maintained in Russia even if they had been collected.

14. *Application from the United Provinces Poultry Association for a grant of Rs. 42,130 (Rs. 2,500 non-recurring and Rs. 39,630 recurring) for a scheme to develop egg and poultry marketing on a co-operative basis. (Subject No. 4 of the agenda, Appendices XXVII and XXVII-A.)*

Col. Olver introduced the scheme (Appendix XXVII-A) and the report (Appendix XXVII) of the Committee which had examined it together with the note of dissent by Mr. Nurul Islam. Col. Olver explained that the Committee felt that the scheme was costly and would not provide what was most required for the development of the industry *viz.*:—An expert marketing officer capable of advising and assisting provincial organisations and facilities for developing the marketing of eggs and poultry products all over India, particularly in the big consuming centres. The Committee felt that the scheme as submitted by the United Provinces Poultry Association would not provide for this important matter. They recommended that for the all-India work an egg marketing officer should work under the Imperial Council of Agricultural Research and that the Animal Husbandry Expert should put up a separate scheme for this work. As regards the rest of the work proposed the Committee were of the opinion that a great deal of precise information was required but to carry out the necessary investigations, modification of the scheme put up by the United Provinces Poultry Association would be necessary. The Committee therefore suggested that the Association should be requested to submit a modified scheme in which details should be given of the accommodation and facilities which would be available and required for carrying on such work. He then moved the adoption of the majority report. The motion was seconded by Mr. Quirk. Mr. Nurul Islam speaking on his note of dissent said that the point regarding the costliness of the scheme was that the Committee considered that provision for Travelling Allowance would be insufficient. He did not attach any importance to this inasmuch as the provision could be increased. As regards the appointment of an egg marketing officer on all-India basis he was of the opinion that work could be started only where there were material and facilities available. In the United Provinces and

such material and facilities were available and he did not think the Committee was justified in asking the Imperial Council of Agricultural Research to spend more money on the appointment of a highly paid egg marketing officer. He added that the services of the staff proposed in the scheme could be utilised by other provinces if need be. He added that he had no objection to the scheme as submitted being directed by the Imperial Council of Agricultural Research and went on to say that marketing was the principal idea of the present scheme and that without it not much would be left of it. In the end he asked the Board to pass the scheme as prepared by the United Provinces Poultry Association. Mr. Quirke in supporting Col. Olver's motion said that in his opinion, the marketing of egg should be directed by the Council, while the other matters connected with the poultry production referred to in the Committee's report should be dealt with by the United Provinces Poultry Association. Mr. Allan said that while he supported the idea of appointing an all-India officer for marketing purposes, he was of the opinion that the present scheme would help the agriculturists and favoured it to be sanctioned. "Dr. Burns referred to the Bengal Scheme on Poultry Diseases (passed by the Advisory Board, and sanctioned by the Governing Body) and to the Bombay Scheme for Poultry Breeding (which the Advisory Board sanctioned on terms he could not accept) and asked why the Advisory Board should sanction Rs. 40,000, on a scheme that was not true research, and dealt with marketing—a subject that could be much better handled by the marketing officer, when appointed". He wanted many more such societies to be started to enable the poor cultivators to reap the full benefit from the introduction of one of the most productive of cottage industries in the country to-day. Mr. Devadhar said that the scheme was a valuable aid to rural reconstruction. He was interested in it from the co-operative point of view as it was mentioned in the scheme that there were six co-operative societies concerned with egg and poultry production. It was not clear, however, whether the association was registered under the Co-operative Societies Act. He was informed that it was not so registered. He therefore favoured the recommendations made by the Committee. He did not want any associations or organisations started with a view to help, charge any commission on sales as is done by some organisations working in the field of Rural Reconstruction. In this connection Dr. Nehru referred to the report of Mr. T. Murari, Superintendent, Live-stock Research Station, Hosur, Madras, who was deputed by the Imperial Council of Agricultural Research to attend the Fifth World Poultry Congress in September 1933, in which he had suggested that the lesson to be learnt from the Congress was that it was time that India had a full time poultry officer for studying the available breeds and evolving useful types required for Indian conditions. He said that rabbits and pigeons should not be neglected. Dr. Nehru was of the view that it was necessary to accelerate the growth of birds on modern lines. In the end he supported the appointment of a marketing and research officer on an all-India basis. Mr. Carpenter said that he understood that the Council intended to appoint shortly a marketing expert for the development of agricultural produce in India and that for this purpose the Government of India were likely to make a grant of one lakh of rupees per annum for a period of three years. In his opinion the Marketing officer and the marketing branch of the Council will consider the question of marketing of eggs also, and it would not be right for the Board at this

stage to definitely commit themselves as to how the marketing of eggs should be dealt with. He however supported the Committee's report. After Mr. Nurul Islam had replied the Committee's report was adopted.

15. The Chairman announced that all the items on the agenda had been finished, but that before the Board came to a close he would like to refer to one or two matters. He said that Dr. McRae, Director, Imperial Institute of Agricultural Research, Pusa, was due to retire sometime before the Board would meet next and he would like to say a word of appreciation of the various services which Dr. McRae had rendered to Government and to the Imperial Council of Agricultural Research. At the time the Council was formed Dr. McRae was not the Director of Pusa and so was not a member of the Board, but he was appointed as a member of the very first committee formed by the Council, namely, the Sugar Committee, and in that capacity and later as Director, Pusa, and as a member of the Advisory Board his services to the Council had been very valuable. Moreover, the Chairman had worked in close touch with him when Dr. McRae acted as Agricultural Expert to the Council for six months or so in 1932 and found him unflinching in good humour, courtesy, loyalty and ability; on his own behalf and that of the Board he wished him, on his impending retirement from service and departure from this country, *bon voyage* and long life and prosperity in his retirement. The Chairman then thanked all the visitors for the trouble they had taken in coming to attend this meeting of the Board and helped it in its deliberations. He particularly thanked Dr. Hudson, Deputy Director, Imperial Bureau of Plant Genetics (Crops other than Herbage) for the valuable help he had given to the Board and to the Potato Research Schemes Committee and he expressed his thanks to all members for the courtesy and kindness shown to him.

Dr. McRae expressed his grateful thanks for the kind words that had been said about him and requested that whenever any of the members happened to go to the United Kingdom he would be glad if they could pay a visit to his home in Edinburgh. Dr. Hudson expressed his deep indebtedness to the Chairman and the other members of the Board for the unflinching courtesy received by him during his sojourn in Delhi and said that he exceedingly enjoyed his visit. At the instance of Mr. Devadhar the Board passed a vote of thanks to the Chairman in appreciation of the able and tactful manner in which he conducted the proceedings of the meetings.

The meeting then came to a close.

CHARAN DAS,
Secretary.

New Delhi;
The 26th February 1934.

APPENDIX I.

NOTE DATED THE 7TH FEBRUARY 1934, BY SECRETARY ON SUBJECT NO. I.—DECISIONS OF THE GOVERNING BODY ON THE RECOMMENDATIONS OF THE ADVISORY BOARD MADE AT THE LATTER'S MEETINGS HELD IN FEBRUARY AND AUGUST 1933.

1. Proposal for a grant of Rs. 7,000 for continuing the Tractor Work conducted by the Burma Shell Oil Storage and distributing Company of India during the 1933-34 season.

Sanctioned.

2. Proposal for the appointment of a permanent Standing Committee for the examination of all schemes on soil problems submitted to the Advisory Board of the Imperial Council of Agricultural Research.

Approved.

3. Scheme for statistical studies relating to Agricultural work in India (Rs. 40,000 spread over 5 years) of Professor P. C. Mahalanobis, Presidency College, Calcutta.

Sanctioned.

4. (a) Proposal for an extension of the work done on Investigation on the relations of Physico-chemical factors to the fertility of soils from December 1933 to the end of June 1934 (Rs. 2,420) by Dr. S. S. Bhatnagar.

(b) Proposal for a further extension of the research work done on the effect of ions on the growth of plants by Dr. S. S. Bhatnagar from the 1st January 1934 to the 31st December 1934—Rs. 900.

Sanctioned.

5. Application from the Government of Burma for a grant of Rs. 11,200 spread over a period of three years for a scheme of research into Parasite to control the betel pest of sugarcane in Burma.

Sanctioned.

6. Application from the Government of the North-West Frontier Province for a grant of Rs. 64,250 spread over a period of 5 years for a scheme for sugarcane research in the North-West Frontier Province.

Sanctioned.

7. Proposed enquiry into the production of *khandari* sugar in the United Provinces and the Punjab.

Sanctioned.

8. Application from the Government of the Central Provinces for a grant of Rs. 46,700 spread over a period of 3 years in connection with a scheme for further investigation into vaccination of cattle against Rinderpest.

Sanctioned.

9. Scheme for conducting research in warble flies at the Muktesar Institute at a cost of Rs. 32,400 spread over a period of 5 years.

Sanctioned.

10. Application from the Government of Bengal for a grant of Rs. 65,579 spread over a period of seven years for research into diseases of poultry in Bengal.

The scheme was sanctioned for a period of 5 years.

11. Application from the Government of Mysore for a grant of Rs. 20,400 spread over a period of three years for investigation into Johne's disease among animals.

Sanctioned.

12. Application from the Coorg Administration for a grant of Rs. 1,11,430 spread over a period of five years for research work into the selection of the most suitable breed or breeds of Indian Cattle for Coorg.

The recommendation of the Advisory Board that the scheme should be rejected was accepted.

13. Application from Dr. G. S. Thapar, Reader in Zoology, Lucknow University, for a grant of Rs. 25,460 spread over a period of five years for an enquiry into the *ascariasis* of cattle sheep and goats in the United Provinces.

Approved.

14. Application from the Government of Bombay for a grant of Rs. 85,122 spread over a period of ten years for research in sheep breeding.

Sanctioned.

15. Application from the Government of Bombay for a grant of Rs. 82,821 spread over a period of ten years for Researches on goat breeding in the Bombay Presidency.

The recommendation of the Advisory Board was not accepted and the scheme was rejected.

16. Establishment of an All-India Bureau of Animal Husbandry.

Sanctioned.

17. Application from the Government of the Punjab for a non-recurring grant of Rs. 22,300 in connection with a scheme for the installation of wheat milling and baking laboratory at Lyallpur.

Sanctioned.

18. Application from the Director of Agriculture, Bombay Presidency, for a grant of Rs. 2,000 for holding an all-India mango show in Bombay.

The recommendation of the Advisory Board was accepted by the Governing Body and the scheme was rejected.

19. Application from the Government of Bombay for a grant of Rs. 48,916 spread over a period of two years for a tractor Ploughing Scheme for the eradication of Hariali in deep black cotton Soils.

The application was postponed till the next meeting of the Governing Body.

20. (a) Application from the Government of the United Provinces for a grant of Rs. 4,650 spread over three years for investigations into the malting and brewing tests of improved barley.

(b) Application from the Government of the Punjab for a grant of Rs. 4,800 spread over three years for an investigation into the malting and brewing qualities of improved Punjab barleys.

(c) Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for investigations into the malting and brewing qualities of Bihar barleys.

The Governing Body approved the recommendations of the Advisory Board in regard to (a) and (b) and also sanctioned the Bihar and Orissa scheme (c) subject to its approval by the Advisory Board at its present meeting.

21. Application from the Government of the United Provinces for a grant of Rs. 38,565 spread over a period of three years for research on sunn hemp.

Sanctioned.

22. Application from the Government of North-West Frontier Province for a grant of Rs. 44,940 spread over a period of three years for an Entomological Survey Scheme in the North-West Frontier Province—Report of the Committee appointed to examine the scheme.

Sanctioned.

23. Application from the Government of Madras for a grant of Rs. 63,632 spread over a period of five years for a scheme for research on rural pisciculture—Report of the Committee appointed to examine the scheme.

Sanctioned.

24. Application from the Government of Assam for a grant of Rs. 68,174 spread over a period of five years for investigation into fruit cultivation in Assam—Grant recommended Rs. 37,424

Sanctioned.

25. Application from the Director, Zoological Survey of India, for a grant of Rs. 1,500 for one year for carrying out investigations on the plant galls of India by Mr. M. S. Mani.

The recommendation of the Advisory Board was accepted by the Governing Body and the scheme rejected.

26. Application from the Government of Bihar and Orissa for a grant of Rs. 78,680 spread over a period of five years for a scheme of research on the economics of irrigation from tube wells.

Sanctioned.

27. Scheme for the investigation and cultivation of medicinal plants in the Punjab at a cost not exceeding Rs. 70,470 spread over a period of five years.

Application from the Government of the United Provinces for a grant of Rs. 1,01,970 (Rs. 14,200 non-recurring and Rs. 87,770 recurring) spread over 5 years for investigation into indigenous drug plants of the United Provinces and their effective expansion as agricultural crops.

The recommendation of the Advisory Board was accepted and the schemes were rejected.

28. Application from the Government of Madras for a grant of Rs. 75,000 spread over a period of five years for a scheme of research on oil-seeds in the Madras Presidency.

Approved.

29. Application from the Government of the United Provinces for financial assistance to the Oil Technological Section of the Harcourt Butler Technological Institute, Cawnpore.

The Governing Body did not accept the recommendations of the Advisory Board but sanctioned financial assistance to the extent of Rs. 30,000 for one year 1934-35.

30. Proposed extension of the scheme of investigations of the "wither tip" of citrus trees by Dr. H. C. Chaudhuri for a period of four months with effect from the 1st June 1934.

Sanctioned.

31. Application from the Government of Bombay for a scheme of poultry breeding research in Western India at a cost of Rs. 52,995 spread over 5 years.

Sanctioned as recommended by the Advisory Board.

32. Scheme by Dr. P. E. Lander for determining the feeding values of certain food grains, oil seeds and oil cakes for working bullocks and dairy cattle.

Sanctioned.

33. Application from the Government of Assam for a grant of Rs. 69,788 spread over a period of 5 years for a scheme of cattle nutrition.

Sanctioned.

34. Six schemes forwarded by the Director, Imperial Institute of Agricultural Research, Pusa, regarding—

- (i) Enquiry into minerals in pastures and fodders and study of mineral requirements of cattle (Rs. 26,520 spread over a period of 3 years).
- (ii) Introducing blood analysis in animal nutrition work. (Rs. 32,366 spread over a period of 3 years.)
- (iii) Value of Oil Cakes and Oil Seeds for working bullocks. (Rs. 45,490 spread over a period of 3 years).
- (iv) Extension of laboratory facilities. (Capital expenditure Rs. 23,100.)
- (v) Feeding values of oil seeds, cakes and other concentrates to milch animals (Rs. 46,530 spread over a period of five years.)
- (vi) Study of the composition and nutritive value of milk of the cow, buffalo and goat. (Rs. 50,588 spread over a period of three years.)

The Governing Body accepted the recommendation of the Advisory Board that schemes (i) and (ii) should be rejected and schemes (iii)—(vi) should be sanctioned.

35. Enquiry into the supply of coconut products and coconut oil in India at a cost of Rs. 5,800.

Sanctioned.

APPENDIX II

NOTE DATED THE 5th FEBRUARY 1934, BY SECRETARY, ON SUBJECT NO. 2.—APPOINTMENT OF COMMITTEES.

1. *Standing Cattle Breeding Committee*.—This Committee has been appointed by the Imperial Council of Agricultural Research on the recommendation of the Board of Agriculture and Animal Husbandry and it consists of the following members :—

1. Vice-Chairman, Imperial Council of Agricultural Research—Chairman.
2. Animal Husbandry Expert, Imperial Council of Agricultural Research.
3. Mr. E. J. Bruen.
4. Sardar Dost Mohammad Khan.
5. Captain C. E. MacGuckin.
6. Mr. T. F. Quirke.

Secretary, Imperial Council of Agricultural Research—Secretary—*Ex-officio*.

It has been decided by the Vice-Chairman of the Council, subject to confirmation by the Advisory Board that the annual report of Mr. Slater's Goat Breeding scheme, for 1932-33 [subject No. 28 (i)] should first be examined by this Committee. In addition it is intended to consult the Committee in regard to certain questions relating to the improvement of cattle breeding which are not on the Agenda of the Advisory Board Meeting.

It is proposed that the Committee should meet at New Delhi on Monday the 19th February 1934 at 2.30 p.m. in one of the Committee Rooms attached to the Conference Room in the first floor, South Block, Imperial Secretariat Buildings.

2. *Soil Science Committee*.—At its last meeting held in August 1933 the Advisory Board unanimously recommended that a standing technical committee should be appointed for the examination of all schemes of soil research submitted to the Board. The personnel of the committee was left to be settled by the Vice-Chairman to the Council. At its meeting held in November 1933 the Governing Body agreed to the appointment of a Soil Science Committee under rule 30 of the Rules and Regulations of the Imperial Council of Agricultural Research consisting of the following :—

The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

Dr. J. K. Basu, Soil Phycist, Sugarcane Research Scheme, Padegaon, Bombay-Deccan.

Mr. A. P. Cliff, Deputy Director of Agriculture, North Bihar Range, Muzaffarpur, Bihar and Orissa.

Dr. J. C. Ghosh, D.Sc., Head of the Department of Chemistry, Dacca University, Dacca.

Dr. Krishnan, Agricultural Chemist to the Government of Hyderabad.

Dr. E. Makenzie Tayler, M.B.E., Ph.D., D.Sc., F.I.C., Director, Irrigation Research, Punjab.

Rao Bahadur B. Viswanath, F.I.C., Agricultural Chemist to the Government of Madras, Coimbatore.

The Agricultural Chemist to the Government of the Central Provinces.

The Secretary, Imperial Council of Agricultural Research, Secretary—*ex-officio*.

The Committee will meet at 2.45 p.m. on Monday the 19th February 1934 and consider the undermentioned items of the Agenda.

27. (i) Application from the Government of Bengal for a continuation grant of Rs. 18,800 spread over three years for research into properties of colloid soil constituents by Prof. J. N. Mukherjee of the Calcutta University.

(ii) Application from the Government of the Punjab for a grant of Rs. 13,120 spread over three years for a scheme to investigate the changes in the microflora of Kallar and alkaline soils during reclamation—by Dr. Jagjivan Singh, M.Sc., Ph.D.

(iii) Report on the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D./A.I.C., on the standardisation of Physico-chemical "single-value" measurements most suitable for Indian soils.

In addition the Committee will also consider :—

(i) Proposed formation of an Indian National Section of the International Society of Soil Science;

(ii) Papers regarding the third International Soil Science Congress.

The Vice-Chairman to the Council has also invited Prof. J. N. Mukherjee of the Calcutta University to attend the meetings of the Committee and of the Advisory Board as a visitor.

3. *Rice Committee*.—There are certain schemes of rice research and progress reports on rice research schemes which are included in the agenda for the consideration of the Advisory Board. The Vice-Chairman to the Council considers that it will be an advantage to have them all examined in the first instance by the Committee of the Board which examined similar reports at the last meeting of the Board held in August 1933, and which consisted of the following gentlemen :—

The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

Prof. J. C. Ghosh, Dacca University, Dacca.

Prof. P. K. Parija, Ravenshaw College, Cuttack.

Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.

Rao Bahadur B. Viswanath, F.I.C., Agricultural Chemist to the Government of Madras, Coimbatore.

Mr. M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.

The Director of Agriculture, Madras.

The Director of Agriculture, Bombay.

The Director of Agriculture, Bengal.

The Director of Agriculture, United Provinces.

The Director of Agriculture, Bihar and Orissa.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The Committee will meet at 2.45 p.m. on Tuesday the 20th February 1934 in the Committee Room and consider the undermentioned items of the Agenda of the present meeting of the Advisory Board :—

30. Annual reports on the working of the rice research schemes in Bengal and Burma for the year 1932-33.

31. Application from the Government of Bengal for a grant of Rs. 21,600 spread over five years for a scheme of research on the bio-chemical and physico-chemical properties of rice at the Dacca University.

32. Application from the Government of Bengal for a grant of Rs. 20,812 spread over three years for a scheme of research work on the physiology of the rice plant by Dr. S. P. Agharkar.

33. Application from the Government of the Central Provinces for a grant of Rs. 10,088 spread over four years for research work on the "Gangai" pest of rice-entomological work under the scheme of rice research already sanctioned by the Council for the Central Provinces.

The Vice-Chairman to the Council has also requested the Public Health Commissioner with the Government of India to attend the meeting of the Committee in connection with the Dacca University scheme of research work on the bio-chemical and physico-chemical properties of rice.

4. *Fruit Committee.*—In accordance with the practice followed in the past the Committee of the Council which consists of the members named below will examine the fruit schemes on the Agenda :—

The Vice-Chairman, Imperial Council of Agricultural Research. Chairman, *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

The Director of Agriculture, Madras.

The Director of Agriculture, Bombay.

The Director of Agriculture, Bengal.

The Director of Agriculture, United Provinces.

The Director of Agriculture, Punjab.

The Director of Agriculture, Bihar and Orissa.

The Director of Agriculture, Central Provinces.

The Director of Agriculture, Assam.

The Director of Agriculture, Hyderabad.

The Director of Agriculture, Baroda

The Agricultural Officer, Baluchistan.

Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association.

The Chief Publicity Officer, Indian State Railways.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The Committee will meet at 2.45 p.m. on Wednesday the 21st February 1934 in the Conference Room and consider the following fruit schemes :—

34. (i) Application from the Baluchistan Administration for a grant of Rs. 49,600 spread over a period of five years for a scheme for establishing a "Canning and Fruit Preserving Research Laboratory" at the Fruit Experiment Station, Quetta.
- (ii) Application from the Government of the Central Provinces for a grant of Rs. 1,49,640 spread over a period of ten years for a scheme for research on the orange crop of the Central Provinces.
- (iii) Application from the Government of His Exalted Highness the Nizam for a grant of Rs. 74,300 spread over a period of five years for a fruit research scheme.
- (iv) Application from the Government of the Punjab for a grant of Rs. 57,430 spread over a period of five years for a scheme of research on citrus stock and grape vines in the Punjab.
- (v) Application from the Government of the Punjab for a grant of Rs. 35,052 spread over a period of three years for a scheme for a San Jose Scale survey in the Punjab.

5. *Agricultural Progress Reports Committee.*—In accordance with the usual practice the Vice-Chairman to the Council has subject to the Advisory Board's approval appointed the undermentioned committee to examine the progress reports of agricultural schemes on the Agenda :—

The Vice-Chairman, Imperial Council of Agricultural Research. Chairman, *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

The Director of Agriculture, Bombay.

The Director of Agriculture, Bengal.

The Director of Agriculture, Punjab.

The Director of Agriculture, Bihar and Orissa.

The Director of Agriculture, Assam.

The Director, Imperial Institute of Agricultural Research, Pusa.

Mr. P. H. Carpenter.

Prof. T. Ekambaram.

Prof. J. C. Ghosh.

Dr. Nazir Ahmad.

Prof. P. K. Parija, Ravenshaw College, Cuttack.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The Committee will meet at 2.45 p.m. on Thursday the 22nd February 1934 in the Conference Room and will consider the following progress reports :—

35. (i) Annual report of the Agricultural meteorology branch of the Indian Meteorological Department, Poona, for the year ending the 21st August 1933.
- (ii) Final report by Prof. P. K. Parija on the scheme of research work on Water Hyacinth in Bihar and Orissa.
- (iii) Report on the work done on the scheme of research on the effect of ions on the growth of plants by Dr. S. S. Bhatnagar during the period February 1931 to August 1933.

6. *Potato Schemes Committee.*—The Vice-Chairman to the Council considers that it will be an advantage to have the potato schemes on the Agenda examined in the first instance by a Committee and he has accordingly appointed, subject to the approval of the Board, the undermentioned Committee :—

The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

The Director of Agriculture, Bombay.

The Director of Agriculture, Bengal.

The Director of Agriculture, United Provinces.

The Director of Agriculture, Punjab.

The Director of Agriculture, Bihar and Orissa

The Director of Agriculture, Assam.

The Director of Agriculture, Central Provinces.

The Director, Imperial Institute of Agricultural Research, Pusa.

Dr. P. S. Hudson, Deputy Director, Imperial Bureau of Plant Genetics (for crops other than Herbage) Cambridge (now on a visit to India).

Prof. P. K. Parija, Ravenshaw College, Cuttack.

Dr. F. J. F. Shaw, Imperial Economic Botanist, Pusa.

Rao Bahadur B. Viswanath, Agricultural Chemist to the Government of Madras, Coimbatore.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The Committee will meet at 2.45 p.m. on Friday the 23rd February 1934, in the Conference Room and will consider the following schemes :—

36. Provincial Schemes of Potato Research :—

- (A) Application from the Government of Bengal for a grant of Rs. 48,950 spread over five years for a scheme of potato research.
- (B) Application from the Government of the United Provinces for a grant of Rs. 41,790 spread over five years for a scheme of potato research.
- (C) Application from the Government of the Punjab for a grant of Rs. 37,760 spread over five years for a scheme of potato research.
- (D) Application from the Government of Bihar and Orissa for a grant of Rs. 21,096 spread over three years for a scheme of potato research.
- (E) Application from the Government of the Central Provinces for a grant of Rs. 15,246 spread over three years for a scheme of potato research.
- (F) Application from the Government of Assam for a grant of Rs. 56,948 spread over five years for a scheme of potato research.

7. A statement showing the time and place of the meetings of the above mentioned Committees is enclosed (Annexure).

ANNEXURE.

Statement showing the time and place of the meetings of the various Committees which will meet from the 19th—23rd February 1934 in connection with the *Advisory Board Meeting*.

*Agriculture.**Animal Husbandry.*

Monday, 19th February 1934	Soil Science Committee— 2-45 P.M. Subject No. 27. (Conference Room).	Cattle Breeding Committee —2-30 P.M. Subject No. 28 (i). (Committee Room).
Tuesday, 20th February 1934	Rice Research Schemes Committee—2-45 P.M. Subject Nos. 30—33. (Conference Room).	
Wednesday, 21st February 1934.	Fruit Committee—2-45 P.M. Subject No. 34. (Conference Room).	
Thur-day, 22nd February 1934.	Progress Reports Committee —2-45 P.M. Subject No. 35. (Conference Room).	
Friday, 23rd February 1934	Potato Research Schemes Committee—2-45 P.M. Subject No. 36. (Conference Room).	

APPENDIX III.

NOTE DATED THE 20TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 6.—APPLICATION FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF Rs. 6,000 SPREAD OVER A PERIOD OF THREE YEARS FOR INVESTIGATIONS INTO THE MALTING AND BREWING QUALITIES OF BIHAR BARLEYS.

At its meeting held in February 1933, the Advisory Board considered an application (not printed) from the Government of the United Provinces for a grant for investigations into the malting and brewing qualities of improved barley and suggested that similar proposals be submitted by the Governments of the Punjab and Bihar and Orissa so that the requirements of the three provinces might be considered together at the Board's next meeting. At the meeting of the Board held in August 1933, however only the Punjab Scheme (not printed) had been received and the Board accordingly recommended both the United Provinces and the Punjab schemes for sanction.

2. Before the United Provinces and Punjab schemes were placed before the Governing Body, the Bihar and Orissa scheme was also received and it was submitted to the Governing Body at its meeting held in November 1933 along with the first two schemes. A copy of the note dated the 11th November 1933 regarding the Bihar and Orissa scheme which was circulated to the Governing Body at its last meeting is attached (Annexure). The Governing Body sanctioned all the three schemes, the sanction to the Bihar and Orissa scheme being subject to approval by the Advisory Board at the Board's next meeting.

The scheme is accordingly for the consideration of the Advisory Board.

ANNEXURE.

NOTE DATED THE 11TH OF NOVEMBER 1933, BY SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, FOR GOVERNING BODY MEETING, NOVEMBER 1933.—APPLICATION FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF Rs. 6,000 SPREAD OVER A PERIOD OF THREE YEARS FOR INVESTIGATIONS INTO THE MALTING AND BREWING QUALITIES OF BIHAR BARLEYS.

The note dated the 22nd August 1933, already circulated to the Governing Body dealt with applications from the Governments of the United Provinces and the Punjab for grants for investigations into the malting and brewing qualities of improved barleys grown in those provinces. The scheme for similar investigations in the case of Bihar barleys, referred to therein, has now been received (Enclosure) from the Government of Bihar and Orissa. This scheme involves an expenditure of Rs. 6,000 spread over a period of three years. It is proposed to place this scheme before the Advisory Board at its next meeting to be held about February 1934. As, however, the scheme is on the same lines as the United Provinces and the Punjab schemes and as it is important that if sanctioned it may come into operation at the same time as the other two schemes, it is requested that this scheme may also kindly be considered by the Governing Body along with the United Provinces and the Punjab schemes and that provisional sanction may be accorded to it with the same priority as to the other two, subject to its approval by the Advisory Board.

Enclosure.

INVESTIGATIONS INTO THE MALTING AND BREWING QUALITIES OF BIHAR BARLEYS.

Bihar is one of chief barley growing provinces in India and has 15,25,000 acres under the crop. The question of exporting barley has become important in view of the 10 per cent tariff preference under the Ottawa agreement and as a first step it is essential to find out the malting and brewing qualities of barley types grown in the province.

2. The Imperial Economic Botanist has done and is doing a great deal of work on evolving new barley types and he has agreed to co-operate with Department in so far as this scheme is concerned. The Assistant Economic Botanist is surveying the various types now grown in the province samples of which will also be sent for testing.

3. It is proposed to ship during the first two years two sets of 20 samples from Calcutta and Karachi to the Organiser of Research to the Institute of Brewing in London for testing by Dr. Bishop's method of bag malting. Calcutta is the proper port of shipping for the produce of Bihar and Orissa but it is well known that malting and brewing qualities are profoundly affected by lengthy sea voyages and other causes. It is, therefore, proposed to send duplicate samples from Karachi as well. In the third year only one set will be shipped from the port which is indicated the best after the first two years' tests.

4. The cost of the scheme for three years will be Rs. 6,000 as per details below :—

	1st year.	2nd year.	3rd year.	Total.
	Rs.	Rs.	Rs.	Rs.
1. Cost of 20 duplicate samples for 2 years and single samples for 1 year including packing, freight, insurance and other charges in England.	400	400	200	1,000
2. Brewing and malting charges of above samples at Rs. 50 each.	2,000	2,000	1,000	5,000
Total	2,400	2,400	1,200	6,000

APPENDIX IV.

NOTE DATED THE 22ND JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 7.—SCHEME FOR THE INVESTIGATION OF THE LIFE-HISTORY, BIONOMICS AND DEVELOPMENT OF FRESH WATER FISHES OF BENGAL BY DR. H. K. MUKHERJEE OF THE CALCUTTA UNIVERSITY AT A COST OF RS. 7,870 SPREAD OVER A PERIOD OF THREE YEARS.

Attention is invited to the attached letter from the Government of Bengal, No. 142, dated the 10th January 1934, forwarding a scheme for research on the scheme for investigation of the life-history, bionomics and development of fresh water fishes of Bengal (Annexure). The scheme involves a non-recurring and recurring expenditure of Rs. 650 and Rs. 7,220 respectively or a total expenditure of Rs. 7,870 spread over a period of three years. Out of this, Rs. 650 towards non-recurring expenditure and Rs. 600 towards recurring expenditure will be provided by the Calcutta University. The net amount required from the Council is thus Rs. 6,620.

2. The scheme is now for the consideration of the Advisory Board.

ANNEXURE.

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH No. 142, DATED THE 10TH JANUARY 1934.

Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

In continuation of this Department letter No. 1, dated the 2nd January 1934, on the subject mentioned above, I am directed by the Government of Bengal (Ministry of Agriculture) to forward herewith, for inclusion in the agenda of the meeting of the next Advisory Board, two under-noted* schemes (Enclosure I), which are also approved by the Provincial Agricultural Research Committee, together with relevant extracts from the minutes of the meeting of the Committee (Enclosure II). As suggested by the Committee, the Calcutta University is willing to meet the cost of items—

	Rs.
(3) for cleaning the tank	300
(4) small observational hatchery	550
(5) contingencies	300
and (8) special apparatus, reagents, etc.	100

in respect of fresh water fishes scheme [*vide* copy of letter dated 12th December 1933 from Dr. H. K. Mukherjee, D. Sc., Head of the Department of Zoology, University College of Science and Technology, Calcutta enclosed (Enclosure III)]

* I am to say that the Local Government recommended the schemes subject to the condition that no financial liability devolves on them.

2. One hundred and fifty spare copies each of the scheme will be forwarded to you direct by the Director of Agriculture, Bengal.

ENCLOSURE II.

EXTRACT FROM THE MINUTES OF THE SEVENTH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD ON THURSDAY THE 7TH DECEMBER 1933.

3. Scheme for the Investigation of the Life-history, bionomics and development of fresh water fishes of Bengal by Dr. H. K. Mukherjee of the Calcutta University.—Dr. Ghosh said that he was very doubtful of the scheme being accepted by the Advisory Board as it had no direct reference to Agriculture. A scheme had been approved for Madras where it was considered that the perennial tanks were intimately concerned with the agriculturists' life.

* (1) Scheme for the investigation of the life-history, bionomics and development of fresh water fishes of Bengal by Dr. H. K. Mukherjee of the Calcutta University

(2)

As the scheme was inexpensive, it was agreed that it should go forward with the following proviso:—

That items 3, 4, 5 and 8 in the estimate of expenditure should be met by the University of Calcutta.

* * * * *

ENCLOSURE III.

COPY OF LETTER, DATED THE 12TH DECEMBER 1933, FROM DR. H. K. MOOKERJEE, D.Sc., HEAD OF THE DEPARTMENT OF ZOOLOGY, UNIVERSITY COLLEGE OF SCIENCE AND TECHNOLOGY, CALCUTTA, TO THE DIRECTOR OF AGRICULTURE, BENGAL.

I have the honour to inform you that the University is willing to undertake the cost of the following items—

	Rs.
3. For cleaning the tank	300
4. Small observational hatchery	550
5. Contingencies	300
8. Special apparatus, reagents, etc.	100

for the investigation of the life-history, bionomics and development of fresh-water fishes of Bengal of the scheme submitted by me.

ENCLOSURE I.

Scheme for the investigation of the life-history, bionomics and development of fresh-water fishes of Bengal.

[By Dr. H. K. Mookerjee, D.Sc., Head of the Department of Zoology, University College of Science and Technology, Calcutta.]

Fish is a staple food with the people of Bengal. The price of fish is pretty high and is now getting beyond the capacity of ordinary people to have it as food. On the other hand there are exceptional opportunities in Bengal for rearing fish and pisciculture may well form a sort of home industry. Unfortunately there is no fishery department in Bengal where, if I may be allowed to say, there is ample room for improvement in fish-culture applying well-directed scientific methods. Although certain amount of systematic study on fishes has been done in India, the life-history and biology of fresh-water food-fishes remain to be investigated. The knowledge of these has great bearing not only on the economic aspect of fish culture but will be of great help in the control of malaria by employing it in rearing fishes which feed on mosquito larvæ. It is my intention, therefore, to study the life-histories of fresh-water food-fishes of Bengal, and to start with, I shall take up the study of the life-history, development and habits of the common carp. My laboratory is well equipped and has an unique opportunity of enquiring into these problems by reason of having within its compound a very big tank. The investigation from the economic standpoint can be fruitful if the methods as practised by fishermen are correlated with laboratory methods. Furthermore, this laboratory being situated in the suburbs of Calcutta, first hand information as to the methods used by local fishermen in carp culture can easily be gathered and the various fish-fries of carp sold in the market can be readily procured for examination. Fries obtainable from dealers as carp very often contain certain harmful fish larvæ which destroy the carp population in tanks. The practical difficulty, however, is great in stocking the tanks with carp fries owing to the lack of knowledge of methods of separating the various species of fish larvæ mixed together. Therefore, the characteristics of fish larvæ particularly of carp, should be determined before the latter can be reared in tanks with profit. The habits of fish larvæ and their adults and the duration of

time to complete the life-cycle under different cond. λ , should be investigated in this connection. It is interesting to observe that so far the carp was known only to breed in the open stream or river, and that they did not breed in fresh-water tanks. But certain fishermen in the district of Midnapore actually breed carps in specially devised tanks and I am, at present, studying these methods and trying to investigate how carp-culture can be done with profit by all.

For the investigation of the problems, my University is prepared to render all laboratory facilities, excepting special apparatus that will be required for the purpose. Besides this investigation requires research scholars to be employed exclusively to work under my direct guidance.

The cost of the scheme will be as follows :—

	Rs.
1. Research Assistant at Rs. 150 a month for three years	5,400
2. Special attendant to look over the tank Hatchery, etc., at Rs. 20 per mensem for three years	720
3. For cleaning the tank	300
4. Small observational hatchery	550
5. Contingencies (for 3 years) at Rs. 100 per year	300
6. Purchase of fry and adult carp	300
7. Travelling for visiting various fishery tanks	200
8. Special apparatus, reagents, etc.	100
Total	7,870

APPENDIX V.

NOTE DATED THE 22ND JANUARY, 1934, BY SECRETARY, ON SUBJECT NO. 8 (i).—REQUEST FROM THE DACCA UNIVERSITY, DACCA, FOR SANCTION TO THE PURCHASE AT AN ESTIMATED COST OF RS. 1,695 OF APPARATUS REQUIRED FOR THE YEAR 1934-35 IN CONNECTION WITH THE SANCTIONED SCHEME OF RESEARCH WORK (i) ON THE MECHANICAL ANALYSIS OF LATERITIC SOILS AND (ii) ON THE NUTRITION OF THE RICE PLANT.

Attention is invited to the attached letter (Annexure I) from the Government of Bengal, Agriculture and Industries Department, No. 1, dated the 2nd January 1934, and enclosures on the subject mentioned above.

2. On the recommendation of the Advisory Board, in 1929, it was decided that each year's requirement for apparatus, etc., should be examined on its merits on receipt of details from the University. The annual requirements for apparatus were originally estimated at Rs. 2,000 per annum, but the recurring amounts actually sanctioned up to the year 1933-34, are as follows :—

1930-31	. . . . .	Rs. 6,518 including a capital grant of Rs. 5,000.
1931-32	. . . . .	Rs. 1,806.
1932-33	. . . . .	Rs. 2,000.
1933-34	. . . . .	Rs. 1,756.

3. The proposal to spend Rs. 1,695 on apparatus for the year 1934-35, is now for the consideration of the Advisory Board. The proposal is within the approved limit of Rs. 2,000.

ANNEXURE I.

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NO. 1, DATED THE 2ND JANUARY, 1934.

Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

With reference to your letter No. F-6(1)/33/G., dated the 6th December, 1933 (not printed), on the subject mentioned above, I am directed by the Government of Bengal (Ministry of Agriculture) to forward herewith, for inclusion in the Agenda of the meeting of the Advisory Board to be held in February, 1934, the undernoted schemes, which have been approved by the Provincial Agricultural Research Committee, Bengal, together with relevant extracts (Annexure II), from the minutes of the meeting of the committee held on December 7, 1933, and to say that the Local Government recommend the scheme subject to the condition that no financial liability devolves on them.

7. Renewal of recurring grant for Dr. Ghosh's (Dacca University) scheme for investigation into (1) method of mechanical analysis of Lateritic soils and (2) the nutrition of the rice plant, during the financial year 1934-35. (Annexure III.)

ANNEXURE II.

EXTRACT FROM THE MINUTES OF THE SEVENTH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD AT 11 A.M., ON THURSDAY, THE 7TH DECEMBER 1933.

* * * * *

11. Renewal of Recurring Grant for Dr. Ghosh's (Dacca University) scheme for Investigation into—

(a) method of Mechanical Analysis of Lateritic Soils, and

(b) the Nutrition of the Rice Plant,

during the financial year 1934-35 (Annexure III).

It was agreed to submit the proposal to the Imperial Council of Agricultural Research.

ANNEXURE III.

FROM DR. J. C. GHOSH, PROFESSOR OF CHEMISTRY, DACCA UNIVERSITY, TO THE DIRECTOR OF AGRICULTURE, BENGAL, No. I.C./A-40, DATED DACCA, THE 30TH NOVEMBER 1933.

With reference to the letter No. 3277-Edn., dated the 23rd instant from the Assistant Secretary, Education Department, a copy of which is enclosed, I beg to forward herewith estimates of recurring grant necessary for carrying out researches into—

(a) method of mechanical analysis of lateritic soils, and

(b) the nutrition of the rice plant,

during the financial year 1934-35.

I hope it will be possible for you to place these estimates before the next meeting of the Provincial Research Committee on the 7th December 1933.

FROM S. M. MURSHED, Esq., B.A., ASSISTANT SECRETARY TO THE GOVERNMENT OF BENGAL, EDUCATION DEPARTMENT, TO THE REGISTRAR, DACCA UNIVERSITY, No. 3277-EDN., DATED CALCUTTA, THE 23RD NOVEMBER 1933.

Minister in charge: The Hon'ble Mr. K. Nazimuddin, C.I.E.

Budget estimates of receipts and assets of the Imperial Council of Agricultural Research.

I am directed to invite a reference to paragraph 2 of this office letter No. 1609-Edn., dated the 12th May 1932, on the above subject and to request that the estimates for 1934-35 which were due on the 15th of November may be forwarded to this office at an early date.

MEMO. BY N. AHMED, Esq., REGISTRAR, DACCA UNIVERSITY, No. 8253, DATED RAMNA, DACCA, THE 27TH NOVEMBER 1933.

Copy forwarded to Prof. J. C. Ghosh, D.Sc., Head of the Department of Chemistry, for favour of report as soon as possible as to what recurring and non-recurring grant will be required for the scheme in connection with the Agricultural Research, during the session 1934-35.

Note regarding grant to Dacca University for researches into—(a) method of mechanical analysis of lateritic soils and (b) the nutrition of the rice plant.

Requirements for the session 1934-35.

Catalogue Reference.	Description.	Quantity.	Price.
			Rs.
Richard Book . . .	Special glass chamber with cover to enclose the entire rice plant for experiment on the fixation of nitrogen by that plant under controlled conditions, to be made to order.	6 only	300
Burn & Co. . . .	Earthenware pot with cover for sand culture experiment.	1 doz.	60
Hearson No. 7438.	S6-121, Electric hot air sterilizer and drying oven.	1 only	415
	Miscellaneous glass and other apparatus	..	380
	Pure quartz sand	100 lbs.	100
	Conc. Sulphuric Acid (Ex. pure)	240 lbs.	210
	Caustic Soda	240 lbs.	120
	Other chemicals . . . . .	..	110
	Total . . . . .	..	1,695

Cost of carrying out manurial experiments on paddy in cultivators plots at various places within the lateritic area in the district of Dacca to test out results contained by field trials at the Dacca Government Farm.

J. C. GHOSH,

Professor of Chemistry, Dacca University.

DACCA;

The 30th November 1933.

APPENDIX VI.

NOTE DATED THE 20TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 8 (ii).—REQUEST FROM THE DACCA UNIVERSITY, DACCA, FOR THE EXTENSION OF THE TERM OF THE PRESENT SCHEME OF RESEARCH WORK (I) ON THE MECHANICAL ANALYSIS OF LATERITIC SOILS AND (II) ON THE NUTRITION OF THE RICE PLANT.

Attention is invited to the attached letter from the Registrar, University of Dacca, No. 10439, dated the 21st December 1933 (Annexure) on the subject mentioned above. In this connection it will be remembered that at its first meeting held in December 1929 the Board recommended "that an immediate grant for a period of five years be given to cover the cost of one Junior Assistant for the proposed soil investigations in order that the method of approach may be worked out and of one Senior Assistant" to enable work to be started on the assimilation of nitrogen by the rice plant. The cost involved was Rs. 24,000 spread over a period of five years. In addition a recurring grant on account of apparatus (estimated at Rs. 2,000 per annum) was to be sanctioned from year to year during the pendency of the scheme. The scheme was started in June 1930 and is to terminate in June 1935.

2. Subject to the approval of the Advisory Board, it is proposed that :—

- (i) a copy of the present communication from the Registrar, Dacca University (Annexure) be forwarded to the Government of Bengal with the request that the opinion of the Provincial Agricultural Research Committee and the Local Government's recommendation thereon be sent to the Council not later than the 30th June 1934; and
- (ii) that the future of the scheme be considered at the next meeting of the Board when the report on the work of the fourth year will also be up for discussion.

ANNEXURE.

COPY OF A LETTER No. 10439, DATED THE 21ST DECEMBER 1933, FROM KHAN BARADUR NAZIRUDDIN AHMAD, M.A., REGISTRAR, UNIVERSITY OF DACCA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

I am directed to say that the Executive Council of this University adopted the following resolution at their meeting held on 6th December 1933, re the extension of the scheme for Agricultural Research :—

"That the Imperial Council of Agricultural Research be requested to sanction the grants which they are at present making to the Dacca University for carrying on Agricultural Research, for a further period of five years with effect from July 1935, and that they be informed that the University, on their part, will, during the above period, continue to bear their own share of expenditure and provide the necessary facilities for agricultural research as communicated in Registrar's letter No. 7019, dated the 16th November 1929. (Not printed.)"

I am to enclose herewith for ready reference a copy of this office letter No. 7019, dated the 16th November, 1929 (not printed) referred to in the above resolution.

I am to request that you will be so good as to move the Imperial Council of Agricultural Research, for the extension of the term of the scheme for Agricultural Research in the University and communicate the decision of the Council in regard to this matter to the University at an early date.

APPENDIX VII.

NOTE DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 9.—APPLICATION FROM THE GOVERNMENT OF THE UNITED PROVINCES FOR A GRANT OF RS. 33,000 SPREAD OVER A PERIOD OF THREE YEARS, FOR UNDERTAKING EXPERIMENTS TO INVESTIGATE THE POSSIBILITIES OF COMMERCIAL UTILIZATION OF LINSEED FIBRE FROM STRAW AFTER HARVESTING THE SEED.

Attention is invited to the letter from the United Provinces Government No. 2658/XVIII-306, dated the 19th January 1934 (Annexure I) forwarding scheme (Enclosure to Annexure I) for undertaking experiments to investigate the possibilities of commercial utilization of linseed fibre. The scheme involves a total expenditure of Rs. 53,900, viz. Rs. 20,900 non-recurring and Rs. 33,000 recurring spread over a period of three years. The Local Government propose to bear the whole of the non-recurring expenditure. There is expected to be an income of Rs. 20,000 by the sale of the fibre which the Government of the United Provinces propose to divide between themselves and the Council in the ratio of 2 : 3, i.e., the share of the Local Government will be Rs. 8,000 and that of the Council Rs. 12,000. Assuming that the Council gets Rs. 12,000 from receipts the net cost so far as the Council is concerned will be Rs. 21,000.

2 The scheme has arisen out of suggestions made in the course of discussion in the Oil Crushing Industry Committee of means of making linseed production more profitable. It does not appear necessary however to refer the scheme to that Committee since it is essentially a scheme for fibre production. The Oil Crushing Industry Committee has already recommended that a scheme should be carried out in the United Provinces.

Information has also been received from commercial sources that a regular supply of short linseed fibre would probably be taken up for use in the so-called cottonising processes.

3. The scheme has been recommended by the Provincial Research Committee (Annexure II).

4. The subject is for the consideration of the Advisory Board.

ANNEXURE I.

COPY OF A LETTER FROM THE SECRETARY TO THE GOVERNMENT OF THE UNITED PROVINCES, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 2658/XVIII-306, DATED THE 19TH JANUARY 1934.

SUBJECT :—*Scheme for experiments to investigate the possibilities of commercial utilization of linseed fibre from straw.*

I am directed to forward a copy of this Government's scheme (Enclosure to Annexure), for a grant of Rs. 33,000 from the Imperial Council of Agricultural Research, for experiments to investigate the possibilities of commercial utilization of linseed fibre from straw after harvesting the seed. The scheme has been recommended in a resolution (Annexure II) passed at a meeting of the Provincial Agricultural Research Committee.

ANNEXURE II.

COPY OF RESOLUTION No. 3 PASSED AT THE 9TH MEETING OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE HELD ON NOVEMBER 28, 1933.

Agenda.

Resolution.

3. Consideration of an application from the United Provinces Government to the Imperial Council of Agricultural Research for a grant of Rs. 33,000 (recurring spread over three years) for undertaking experiments to investigate the possibilities of commercial utilization of linseed fibre from straw after harvesting the seed.

Resolved that the scheme be recommended to the Imperial Council of Agricultural Research.

ENCLOSURES TO ANNEXURE I.

AN APPLICATION FROM THE UNITED PROVINCES GOVERNMENT TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A TOTAL GRANT OF Rs. 33,000 (Rs. 33,000 RECURRING, SPREAD OVER A PERIOD OF THREE YEARS, i.e., Rs. 11,000 PER YEAR), FOR UNDERTAKING EXPERIMENTS TO INVESTIGATE THE POSSIBILITIES OF COMMERCIAL UTILIZATION OF LINSEED FIBRE FROM STRAW AFTER HARVESTING THE SEED.

Introduction.—Linseed is one of the important oilseed crops in United Provinces, Bihar, Central Provinces, etc., the total production of the seed in India being 378,000 tons. At present the straw is being used as a fuel. The present work is to utilize this straw for fibre production after the seed has been harvested. In this proposal there is no attempt to produce an article for the purpose of replacing flax, which is produced from the green plant before the formation of seed, as used in Europe. |

The Agricultural Department of United Provinces, and Bihar and Orissa did a considerable amount of work in attempting to produce flax from linseed, when the seed crop was immature, and in consequence the seed crop was sacrificed to fibre production. The quality of fibre produced was not equal to that of Europe consequently the Indian fibre did not find favour with flax buyers. The present work should not be confused with the above. |

Work in progress.—In 1924 samples of linseed straw and fibres, prepared at the Harcourt Butler Technological Institute, United Provinces, were submitted to flax-experts in Ireland. The opinion expressed was that the fibres were too old and harsh to be used in the linen trade. It was then thought that the fibres could possibly be used for making ropes, twines and also as a material for paper pulp. Funds were not available for any large scale experiments until 1930. During 1930-31, 699 lbs. of linseed straw were obtained from Agriculture Department, Cawnpore, which gave the following results:—

Fibre 14 inches to 18 inches in length	6.75 per cent.
Short fibre for tow	21.00 do.
Woody cores	55.75 do.
Loss and wastage	16.50 do.
	Total . 100.00

It is considered that the long fibres are of greater length than would be found in the average crop grown by the cultivator, but for the purpose of paper manufacture even fibres of much shorter length would give satisfactory results. This is borne out by the report received from the Forest Economist, Dehra Dun (*vide* Enclosure II), who expressed his opinion as follows:—

“Flax waste appears to be an excellent paper-making material for better class of paper.” |

In 1931, Mr. J. W. Walker of the Gauripore Company, Limited, Calcutta, carried out an experiment on behalf of the firm with linseed straw from 13 acres of land. He found that a profit of Rs. 4 per acre could easily be made (*vide* Enclosure III).

Further experiments during the years 1931-32 and 1932-33, have shown the possibilities of preparing fibres of various grades of colour and softness by controlling the processes of retting and chemical treatment. |

Future lines of work.—The future line of work under the scheme may be summarised as follows:— |

Production of retted straw and fibre on a commercial scale for various uses, *viz.*,—

- (i) Rope and twine manufacture |
- (ii) A material for straw-board industry; |
- (iii) Fibre free from woody core for use as paper material; and
- (iv) Bleached fibre for textile industry. .

Non-recurring expenditure.

	Rs. a.
Cost of the machines	10,000 0
Railway freight on the machines	600 0
Cost of factory building including store house	3,500 0
Nine retting-tanks, brick lined 30' x 6' x 3'	1,246 8
*Overhead trolley for charging and unloading tanks	250 0
Cost of 1/25 Horse Power Oil Engine	2,500 0
Erection of machinery	1,830 0
Small Oil Engine and pump for water lifting	970 0
Total	<u>20,896 8</u>

Recurring expenditure.

	Rs.
Cost of 10,000 maunds of straw at five annas per maund.. . . .	3,125
Fuel oil	900
Lubricating oil and stores	200
Freight on fibre and miscellaneous expenses	2,500
Travelling expenses	500
Salary of the staff (for eight months)—	
	Rs.
One supervisor at	150 per mensem,
One mistri	60 "
Coolies 15 at Rs. 12 each	180 "
One peon	12 "
One chaukidar	12 "
One clerk	40 "
	<u>454 x 8</u>
	Rs. 3,632
Contingencies	143
Total	<u>11,000</u>

The cost of recurring expenditure for three years would amount to Rs. 33,000.
Estimated income per year—

	Rs.
Good fibre 600 maunds at Rs. 6 per maund.	3,600
Short fibre or Tow 2,000 maunds at Rs. 2 per maund	4,000
Total	<u>7,600</u>
The income would thus amount to for three years	20,000
Non-recurring expenditure	20,900
Recurring expenditure for three years.	33,000
Total	<u>53,900</u>
Less estimated income	<u>20,000</u>
Th share of the United Provinces Government for non-recurring expenditure will be	20,900
The share of the Imperial Council of Agricultural Research for recurring expenditure distributed over three years at Rs. 11,000 per year	33,000

The income will be divided between the United Provinces Government and the Imperial Council of Agricultural Research in the ratio of 2: 3, i.e., out of Rs. 20,000 the share of the United Provinces Government will be Rs. 8,000 and the share of the Imperial Council of Agricultural Research Will be Rs. 12,000.

*This overhead trolley will not be erected unless found absolutely necessary.

ENCLOSURE II.

Investigation on flax waste sent by the Principal, Harcourt Butler Technological Institute, Cawnpore.

Three samples of the waste, viz., (a) long fibres, (b) short fibres of tow and (c) woody cores were sent here for investigation. The long and short fibres contained a large number of shives, entangled in the mass and not easily or economically separable. Whilst the fibres were easily digestible and bleachable, the shives were found to be rather refractory to chemical treatment, with the result that pulp obtained by the normal process of digestion contained a fairly large proportion of partially cooked fibres and shives. A departure from the normal process was, therefore, made by subjecting the partially cooked mass to mechanical treatment prior to second stage digestion, or in case of 'overhead' method of digestion, prior to bleaching. In this way the shives were sufficiently disintegrated to be attacked by chemicals and a satisfactory yield of clean bleached pulp was obtained. When digested with 16 per cent. caustic soda by the 'fractional' method, the material required 2.3 per cent. standard bleaching powder and yielded nearly 43 per cent. bleached pulp of fairly white shade. When digested by the 'overhead' method, the material required 10 per cent. caustic soda, 5.2 per cent. bleaching powder and yielded nearly 50 per cent. bleached pulp of slightly yellowish shade. This pulp can be used, I think, for the manufacture of ordinary grades of white papers. Average length of fibres is found to be 4.75 mm.; maximum being 11 mm. and minimum 1.5 mm. I attach herewith a sample sheet of pulp for your inspection. Grit from concrete rollers of our kollergang is responsible for the few black specks which appear in the sheet.

2. Approximate average figures for the quantities of raw materials and chemicals required to produce a ton of bleached pulp from flax fibres, sabai grass and bamboos are as below:—

	Raw material.	Caustic soda.	Bleaching powder.
	Cwts.	Cwts.	Cwts.
Flax waste (1) Fractional method	48.5	7.4	1
(2) Overhead method	40.0	4.0	2
Sabai grass (Fractional method)	52.5	6.8	1.25
Bamboos (Fractional method).	45.0	8.0	2.0

It will be seen from the above table that the chemicals cost of pulping flax waste is less than that in the case of bamboo and it compares very favourably with that of pulping sabai grass particularly if the waste is digested by the 'overhead' method. As the length of fibres from flax waste is nearly 5 mm. the pulp from it can be used for the manufacture of better classes of papers and for blending with short fibred pulps, e.g., from grasses, etc. Flax waste, therefore, appears to be an excellent paper-making material and, I dare say, would be welcomed by paper mills, in this country as a supplementary source of raw material. Before, however, expressing a definite opinion on the material and trying to assess its value as a paper making material, I think, it is necessary and desirable to confirm the laboratory results by carrying out semi-commercial or commercial tests. It is not possible to perform the tests on a large scale here, as we have not got a kollergang or rod mill for the intermediate mechanical treatment. There is a kollergang at Lucknow Paper Mills. I am sure the firm there would be interested in the experiments, and would agree to have the tests carried out in their mills, either we may approach the firm directly or the Principal, Technological Institute, Cawnpore, may fix up for carrying out the experiments there, through the Director of Industries, United Provinces. Probably the Industries Department, United Provinces, may also pay

the cost of raw materials, chemicals, etc., required for the experiments. The large trials at Lucknow would also indicate what lines of papers can possibly be produced from flax waste. I shall have to go to Lucknow to carry out the tests. I would also like to go to Cawnpore to see how the waste is obtained and to collect statistics regarding the possible supplies of the material to paper mills in this country.

3. Experiments on woody cores from flax waste will shortly be taken up to find out if it is possible to utilize them for the production of wrapping papers and strawboards.

4. As you are aware, Messrs. The Titagorh Paper Mill's, are interested in this raw material, I am submitting herewith a letter to the firm on the subject.

ENCLOSURE III.

In 1931, Mr. J. W. Walker of the Gouripore Company, Limited, Calcutta, in conjunction with his firm, had carried out an experiment with the Linseed-straw from 13 acres in Bihar. The results from which are as under:—

Total acreage under experiment.....13 acres. |
 Total yield of linseed 59·8 maunds or 4·6 maunds per acre.
 Total weight of linseed straw 135 maunds, or 10·3 maunds per acre.
 The straw after being retted yielded—
 Long fibres 8·1 per cent. or 11 maunds. |
 Short fibres or tow 5·5 per cent. or 7½ maunds. |
 Total available for paper pulp manufacture 18½ maunds.

Samples of these fibres were submitted to a Calcutta paper mill and were valued at between Rs. 8 and Rs. 10 per maund.

Taking the lower figure of	Rs. 8 per maund.
Total value of fibre	Rs. 148
Less cost of retting and freight to Calcutta	Rs. 95·12

Net profit Rs. 52·4 or Rs. 4 per acre.

APPENDIX VIII.

NOTE, DATED THE 19TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 10.

SUBJECT.—*Layout of Field Experiments—Proposal to refer to the Crops and Soils Wing of the Board of Agriculture in India.*

Attention is invited to the enclosed extract (Annexure) of paragraph 7 of the proceedings of the last meeting of the Advisory Board held on the 9th August 1933 relating to the application from Professor P. C. Mahalanobis for a grant for a scheme for statistical studies relating to agricultural work in India. It will be observed that in the course of discussion a suggestion was made for the appointment of a Standing Committee of the Council to advise Provinces on the lines on which experiments and their layout should be conducted. In the end the Chairman informed the Board that proposals for a Standing Committee to advise on the layout of experiments would be placed at the next meeting of the Advisory Board, and that the question of a suitable publication giving relevant mathematical formulæ would also be considered.

2. The object of the proposed Committee is to secure a higher standard of field experiments and some measure of uniformity in varietal trials. In order to make progress, it is in the opinion of the Chairman, necessary to secure the active interest of the Officers in the Provinces who are actually conducting field experiments. He is therefore inclined to the view that in the first instance the subject should receive special attention at the next meeting of the Crops and Soils Wing of the Board of Agriculture which is likely to meet during the cold weather of 1934-35, and that a Committee of the Board should devote itself for at least a day to the subject. Having secured a measure of agreement on the various points connected with the subject, a Standing Committee of the Council could thereafter be devised to carry out the suggestions of the Board of Agriculture. If this suggestion is agreed to the Directors of Agriculture of Provinces and States will be requested to secure notes and papers for the Crops and Soils Wing Meeting of the Board of Agriculture from those of their staffs who are interested in this subject.

3. As regards publication of a suitable manual giving relevant mathematical formulæ, it is understood that Dr. Shaw's lectures to post graduate students on the subject with a chapter by the statistician to the I. C. A. R. are being printed for circulation. The Chairman is inclined to the view that we might see how far this will meet provincial needs before going further.

4. The subject is now for the consideration of the Advisory Board.

 ANNEXURE.

EXTRACT OF PARAGRAPH 7 OF THE PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD HELD ON THE 9TH AUGUST 1933.

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That the Proposals for a Standing Committee to advise on the layout of experiments will be placed at the next meeting of the Advisory Board, and that the question of a suitable publication giving relevant mathematical formulæ has also to be considered.

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APPENDIX IX.

SUPPLEMENTARY NOTE DATED THE 23RD FEBRUARY 1934, BY SECRETARY, ON SUBJECT No. 11.—APPLICATION FROM THE GOVERNMENT OF ASSAM FOR A GRANT OF Rs. 47,972 SPREAD OVER A PERIOD OF 3 YEARS IN CONNECTION WITH A SCHEME FOR INVESTIGATION INTO VACCINATION OF CATTLE AGAINST RINDERPEST.

Report of the Committee appointed to examine the scheme from the Government of Assam for investigation into vaccination of cattle against rinderpest (Subject No. 11 on the Agenda for the Advisory Board meeting, held on the 22nd February 1934).

The following were present :—

1. Colonel A. Oliver.
2. Mr. P. J. Kerr.
3. Mr. T. F. Quirke.
4. Mr. W. Taylor.
5. Major R. F. Stirling.
6. Mr. G. P. Sen.

The meeting lasted from 2-45 to 4-10 P.M.

The Committee considered that some of the work proposed was of provincial interest only and that the scheme was too expensive for the information likely to be obtained from it. Dealing in detail with the problems to be investigated it was agreed that valuable information of more than local importance could be obtained from items No. 1, 2, 4 and 6, but that work on these items could be carried out with a comparatively small staff working under the immediate control of the Disease Investigation Officer. On these lines the extra staff required would be four veterinary assistant surgeons only and the cost of the scheme could be much reduced, as suggested in the attached schedule (enclosure). It was emphasized however that work of the description proposed would require careful expert supervision and it was considered that such a scheme should not in any case be started until an experienced and fully qualified veterinary surgeon was available to direct and control the work of the Disease Investigation Officer and of the staff employed on this work.

Enclosure.

The following expenditure will be required during the three years for which the scheme will function :—

	Rs.
(1) Four Veterinary Assistant Surgeons at Rs. 60 for 3 years .	8,640
(2) Travelling allowance, Veterinary Assistant Surgeons and peons.	4,000
(3) Peons for the officers 4 at Rs. 11 per month	1,584
(4) Contingencies towards the purchase of Goats and other heads.	1,500
(5) Daily allowance for the peons	720
Total	<u>16,444</u>

APPENDIX IX-A.

NOTE DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 11.—APPLICATION FROM THE GOVERNMENT OF ASSAM FOR A GRANT OF RS. 47,972 SPREAD OVER A PERIOD OF 3 YEARS IN CONNECTION WITH A SCHEME FOR INVESTIGATION INTO VACCINATION OF CATTLE AGAINST RINDERPEST.

Attention is invited to the letter from the Government of Assam, No. 74-E., dated the 11th January 1934, forwarding the scheme mentioned above (Annexure). The estimated recurring cost of the scheme is Rs. 47,972 spread over a period of 3 years.

2. The Local Government have referred the scheme to the Provincial Agricultural Research Committee and its opinion when received will be circulated to the Advisory Board.

3. The application is for the consideration of the Advisory Board.

ANNEXURE.

COPY OF LETTER FROM THE SECRETARY TO THE GOVERNMENT OF ASSAM, TRANSFERRED DEPARTMENTS, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 74-E., DATED THE 11TH JANUARY 1934.

I am directed to forward a scheme (Enclosure) for investigation into the vaccination of cattle against rinderpest (with one hundred and fifty spare copies) prepared by the officiating Superintendent of the Civil Veterinary Department in Assam, for inclusion in the agenda of the next meeting of the Advisory Board of the Imperial Council of Agricultural Research. As explained in the introductory part the scheme has an all-India importance and will benefit other provinces besides Assam. Full details regarding its nature and scope are given. The Government of Assam consider the scheme to be a sound one and commend it for the favourable consideration of the Imperial Council of Agricultural Research.

2. The provincial Research Committee are being consulted on the scheme and their opinion will be forwarded to the Imperial Research Council when received.

Enclosure.

SCHEME FOR INVESTIGATION INTO VACCINATION OF CATTLE WITH GOAT VIRUS AGAINST RINDERPEST.

The "virus alone" method of inoculation against Rinderpest has recently been carried out on a limited scale in Assam on the Government farms (444 cattle and 6 buffaloes inoculated) and in one or two cases of privately owned cattle. The results have been promising, and if it were proved possible to introduce the method on a wide scale the advantages gained by its cheapness and the vastly greater immunity produced would be enormous. Rinderpest is an all-India problem, and the investigation of immunization, which has not been so seriously pursued in the past as it deserves, promises results which will mean an advance in veterinary vaccine therapy valuable to the whole of the country. The investigation of the problem of applying the goat virus method on a wide scale is now desired by veterinarians, so that the difficulties which will be met in practice may be surmounted, and the best means of securing the necessary control over treated cattle, which is easily obtained on the farms, may be ascertained in the very different circumstances of rural areas.

Assam with its wide range of altitude and climatic conditions, and its many breeds of cattle and buffaloes, furnishes a very favourable area for determining the various problems which will attend the use of the method in India. There are not only the divergent breeds of native cattle and buffaloes in the hills and plains areas, and the imported cattle, but also the wild bison (*bos gaurus*) and domesticated bison (*bos frontalis*) which are found in the hills and *terai* with certain crossed strains. It is believed that by its susceptibility to rinderpest *bos gaurus* has in the past brought about very serious epidemics in this province. The experiments undertaken in the use of goat virus can therefore be very usefully supplemented by investigation of its effects when tried in a variety of different climatic and other conditions in Assam.

It is proposed therefore to entertain a number of qualified workers, not less than eight, under a supervisor, the whole working on a plan, and with a measured technique approved (under the general control of the Superintendent, Civil Veterinary Department) by the Veterinary Investigation Officer who, has been recently appointed at

the cost of the Research Council and who will tabulate and scrutinise the results. They will work in limited areas from suitable centres, generally in the neighbourhood of veterinary dispensaries, and will be moved from time to time in order to investigate the effect on different breeds and at different altitudes etc. The supervisor will direct the party under the control of the Investigation Officer.

The problems to be investigated generally will be :—

- (1) To determine the effect of goat virus in varying climatic conditions on :—
 - (a) hill cattle in their native environment;
 - (b) plains cattle of various breeds in their native environment,
 - (c) those various breeds when taken out of their environment,
 - (d) imported cattle and crosses,
 - (e) bison and their crosses,
- (2) to ascertain seasonal variations in the efficacy of goat virus and in its immunising effect;
- (3) to determine the number of passages through goats for a safe and effective inoculation for the various breeds and conditions already outlined,
- (4) to study the approved precautions and methods of treatment in regard to complications such as Piroplasmosis, Coccidiosis etc.
- (5) to ascertain the most convenient times for inoculation and the most convenient methods of securing control, *e.g.*, in the Surma Valley where the very limited areas available either for standings or for pasturage render isolation difficult,
- (6) to study any other problems which occur.

The following expenditure will be required during the three years for which the scheme will function :—

(1) The Supervisor at Rs. 150 per mensem $150 \times 12 \times 3 =$	Rs. 5,400	
(2) Eight Veterinary Assistant Surgeons		
at Rs. 55 for 1st year $55 \times 8 \times 12 =$ Rs. 5,280	} Rs. 16,992	
at Rs. 59 for 2nd year $59 \times 8 \times 12 =$ Rs. 5,664		
at Rs. 63 for 3rd year $63 \times 8 \times 12 =$ Rs. 6,048		
(3) Local allowance for eight Veterinary Assistant Surgeons at Rs. 10 per month $8 \times 10 \times 12 \times 3 .$		„ 2,380
(4) Fixed travelling allowance for the above officers—		
(i) Supervising officer at Rs. 50 a month		
$50 \times 12 \times 3$		„ 1,800
(ii) Veterinary Assistant Surgeons at Rs. 40 a month, $40 \times 8 \times 12 \times 3$		„ 11,520
(5) Peons for the officers 10 at Rs. 11 per month $10 \times 11 \times 12 \times 3$		„ 3,960
(6) Costs of Goat Virus at Rs. 20 a month, $20 \times 12 \times 3$		„ 720
(7) Contingencies towards the purchase of Goats and other heads, $30 \times 12 \times 3$		„ 1,080
(8) Travelling allowance for the peons at Rs. 7-8-0 per month, $10 \times 7\frac{1}{2} \times 12 \times 3$		„ 2,700
(9) Instruments and appliances, Rs. 416 (first year)		
252 (subsequent) years		„ 920
		<u> </u>
Total		<u> 47,972</u>

APPENDIX X.

NOTE DATED THE 22ND JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 12.—APPLICATION FROM THE GOVERNMENT OF THE CENTRAL PROVINCES, FOR A GRANT OF RS. 46,200 SPREAD OVER A PERIOD OF FOUR YEARS FOR A SCHEME OF RESEARCH WORK ON "PAN CULTIVATION".

Attention is invited to the attached letter from the Government of the Central Provinces, No. 48-1052-XIV, dated the 8th January 1934 (Annexure I) and the extract from a letter from the Director of Agriculture, Central Provinces, No. 5551, dated the 12th/15th December 1933 (Annexure II) forwarded therewith.

The Scheme (Annexure III) involves a non-recurring expenditure of Rs. 6,400 and recurring expenditure of Rs. 39,800 or a total expenditure of Rs. 46,200, spread over a period of four years. As against this it is expected that a sum of Rs. 25,600 will be realised by way of profits which should be credited to the funds of the Council. This will reduce the grant asked for from the Council to Rs. 20,600 spread over four years.

The scheme is for the consideration of the Advisory Board.

ANNEXURE I.

EXTRACT FROM LETTER NO. 48/1052-XIV, DATED THE 8TH JANUARY 1934, FROM THE REVENUE SECRETARY, GOVERNMENT OF THE CENTRAL PROVINCES, AGRICULTURE DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Grant in aid from Imperial Council of Agricultural Research for certain schemes of research in the Central Provinces.

I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward a copy of letter No. 5551, dated the 12th/13th December 1933, from the Director of Agriculture, Central Provinces, together with the undermentioned six schemes and to recommend them for the favourable consideration of the Imperial Council of Agricultural Research. The schemes are being printed and 150 copies of them will be furnished to you in due course.

(6) Scheme for research on the Pan Cultivation (Annexure III).

2. These schemes have been considered by the Provincial Agricultural Research Committee on the 9th December 1933 and approved by that body. The local Government has also accepted them. I am accordingly to request that they may be placed before the Advisory Board of the Imperial Council of Agricultural Research at its next meeting to be held in February 1934.

ANNEXURE II.

COPY OF LETTER NO. 5551, DATED THE 12TH/15TH DECEMBER 1933, FROM THE OFFG. DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES, TO THE SECRETARY TO GOVERNMENT, AGRICULTURE DEPARTMENT.

I have the honour to attach herewith six schemes of research which were placed before the Provincial Agricultural Research Committee on the 9th December 1933 and recommended for transmission to the Imperial Council of Agricultural Research for the provision of funds. The Provincial Agricultural Research Committee placed them in the following order of importance :—

Schemes for Research on the Orange Crop.	} A
Schemes for Research on the Oilseeds.	
Schemes for Research on the Potato Storage.	} B
Schemes for Research on the Gangai pest of Rice.	
Schemes for Research on the Sann Hemp.	} C
Schemes for Research on the Pan cultivation.	

The cultivation of the Betel vine in India is not confined to one province only and the results acquired will be of value elsewhere. Pan growing is a specialized vocation but the money invested in the industry is very considerable and the losses from disease enormous. Controlled experiments in cultivation and treatment are essential if reliable results are to be gained. If this scheme is rejected by the Imperial Council of Agricultural Research, I wish to commend it to Government as a

Provincial undertaking. It will be noticed that it is expected to be run at considerable profit and in addition to dealing with the several diseases of the plant, we shall acquire a large amount of information regarding the crop and its cultivation, about which we know very little at present.

ANNEXURE III.

SCHEME ON PAN CULTIVATION.

This province produces or at least has produced in the past, a very large quantity of "pan" annually; but on account of the incidence of disease pan cultivation has completely been abandoned in many parts of the province, *e.g.*, Ramtek, Drug, Saugor, etc. Since it is not only one disease that makes pan cultivation uneconomical in various parts of the province, remedial measures have to be tried for the control of diseases where they occur. A few attempts in the past have been made to study remedial measures for the control of these diseases, *e.g.*, in Ramtek it has been shown that foot-rot can be controlled by treating the soil systematically with Bordeaux Mixture; at Timarni there are two diseases, *viz.*, anthracnose and foot-rot, and they can be also controlled by the use of proper fungicides. At Piparia and Saugor our trials for the control of pan diseases were unsuccessful. The reason may be that there may have been more organisms than one infecting the crop and the remedy found effective for controlling foot-rot caused by *Phytophthora* was not useful against foot-rot caused by some other organism.

For the study of the causes of pan disease and for evolving suitable remedial measures a continuity of experiments for a period of years is essential; and this continuity cannot be ensured unless the department has pan gardens in different districts. A pan garden to give any reliable results must be not less than three-fourth of an acre at least and since the cost of starting a garden on this scale is rather prohibitive under our present financial conditions, I suggest that the Imperial Council of Agricultural Research be approached for a grant to start pan gardens in the following places, each garden to be of one acre :

- (1) Richai (Adhartal).
- (2) Silari.

(The Deputy Director of Agriculture, Northern Circle, proposes to start two small gardens at these two places at the end of this cold weather.)

- (3) Saugor.
- (4) Nagpur.
- (5) Ramtek.
- (6) Bhanduk.
- (7) Drug or Raipur.
- (8) Badnera or any other suitable place in Berar.

The recurring and non-recurring expenditure will vary from place to place but approximately the non-recurring expenditure for a garden of one acre will be Rs. 800 for a period of four years and recurring expenditure will be approximately Rs. 800 per year. Therefore in four years the total expenditure will be Rs. 4,000.

If we have these gardens we cannot only investigate the pathological side of the problem but also agricultural. This latter problem can be studied by the Deputy Director of Agriculture in whose circle the garden is situated and his agricultural assistant in the district can look after the garden.

For the study of the pathological problem a special assistant under me will be required on Rs. 150 per month for four years with an annual increment of Rs. 25 he will need a travelling allowance of Rs. 300 a year and my travelling allowance grant will also need to be increased.

For the experiments an annual recurring grant of Rs. 1,000 will be required. The total expenditure for eight gardens for four years will be Rs. 46,200. A healthy garden normally shows a net profit of about Rs. 800 per acre annually. That is the eight gardens will bring a net profit of Rs. 6,400 per year. After meeting the extra cost for the pay of a special assistant his travelling allowance and agricultural experiments from this profit, a large surplus will be available.

J. F. DASTUR,
*Mycologist to Government,
 Central Provinces,
 Nagpur.*

APPENDIX XI.

NOTE DATED THE 30TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 13 (a).—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A NET GRANT FROM THE FUNDS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH OF Rs. 65,510 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME FOR ADDITIONAL RESEARCH ON OILSEED CROPS IN THE PUNJAB.

Attention is invited to the attached scheme (Enclosure) forwarded by the Government of the Punjab for additional research on oilseed crops in the Punjab. The scheme involves a total expenditure of Rs. 71,910, viz., Rs. 5,000 non-recurring and Rs. 66,910 recurring spread over a period of 5 years but the Local Government are agreeable to meet out of the non-recurring expenditure a sum of Rs. 1,400 and on the recurring side a sum of Rs. 1,000 per annum against the annual receipts from the area at Ludhiana under the scheme. The net cost of the scheme to the Council, if sanctioned will come to Rs. 65,510. The scheme has the approval of the Punjab Provincial Research Committee.

2. It is proposed subject to approval of the Advisory Board that the scheme should first be examined by the Indian Oil Crushing Industry Committee.

3. The subject is for the consideration of the Advisory Board.

Enclosure.

SCHEME FOR ADDITIONAL RESEARCH ON OILSEED CROPS IN THE PUNJAB.

The Indian Oil Crushing Industry Committee and the Imperial Council of Agricultural Research have emphasised the necessity for investigating and introducing new varieties of oilseeds, in view of the preferential tariffs which are in operation in the markets of the United Kingdom in favour of Indian oilseeds. No less important in this connection is the necessity for research towards an improvement in the quality and an increase in the outturns of oilseed crops already established.

2. The various oilseed crops are distributed over India in fairly sharply defined areas. Thus groundnuts and coconuts are oilseed crops of Southern India. Castor is also mainly grown in the South; whilst rapeseed and mustard are mainly confined to Northern India and Linseed to Northern and Central India. The present scheme of research is designed mainly to deal with research on the Brassicæ oilseeds of which the Punjab grows about 34 per cent. of the total area in India, Bihar and Orissa about 19 per cent., the United Provinces about 7 per cent. and the North-West Frontier Province about 3 per cent.

3. The following Brassicæ oilseeds are grown on a commercial scale:—

1. Toria,
2. Sarson,
3. Mustard,
4. Taramira.

Toria is a crop mainly confined to canal irrigated areas. Sarson and Taramira are the most important Rabi oilseed crops in barani areas, whilst Mustard is grown on a small scale in both irrigated and barani localities. The present scheme proposes to increase the research work already in progress on these crops and, as they are all grown during the Rabi season, it is intended to include other Kharif oilseed crops, such as groundnut and sesamum, which show promise of possibilities under certain conditions in the north of India.

4. The Punjab offers special facilities for this work in having a senior experienced Oilseed Botanist specially trained for research on crops of this kind. He is actively engaged in research mainly on the Brassicæ oilseeds and has been provided with two Research Assistants and the necessary subordinate staff. His experiments are carried out on an area of about 12 acres of irrigated land at the Research Institute, Lyallpur, and on his work the Punjab Government is spending at present about Rs. 17,000 per annum. A large expansion of the work on these crops in the immediate future is essential, so that cultivators may obtain the full benefit of the preferential tariffs which now exist under the Ottawa Agreement for Indian oilseeds. The present scheme is submitted to the Imperial Council of Agricultural Research with a view to their financing part of the additional expenditure proposed during the next five years.

5. It is intended to increase the area on which oilseed research is carried out at Lyallpur by a further 8 acres. In the canal colonies Toria is the principal Brassicæ oilseed and conditions there are not so suitable for growing certain others, such as sarson and taramira, as are certain other parts of the province. It is proposed,

therefore, that a small Botanical sub-station should be opened on the Agricultural Department's District Farm at Ludhiana which is a suitable tract for these crops, and also for work on other newly introduced crops like groundnut. Already in the Ludhiana district, as a result of what little work has been done so far by the Department, groundnuts covered an area of 1,500 acres during the past Kharif. The Ludhiana Farm has facilities in buildings, implements and land, and it also can cater for work under both irrigated and *barani* conditions.

PROBLEMS TO BE STUDIED.

6. So far as is known no extensive research work on the Brassicæ oilseeds has been done elsewhere, although they are of commercial importance in India, and it is known that in this genus of plants there is a wide variation in fertility from species to species and from variety to variety within the same species. The investigations carried out on these crops in the Punjab up-to-date have opened up new avenues of work and indicate that considerable improvements can be effected. The main Brassicæ oilseed crops are highly self-sterile and are extensively cross-pollinated in nature. They depend almost entirely for their pollination on insects. The breeding investigations on these crops in the Punjab have proved successful in obtaining selfed seed by means of certain artificial pollination treatments and hence there are possibilities of breeding desirable pure cultures for further improvement of these crops. Intercrossing, which has been done between certain forms of Brassicæ, shows possibilities of obtaining entirely new forms of toria and sarson which would be self compatible and could be kept pure. The further development of this line of work is of very great economic importance since, if the discoveries recently made in the above connections are borne out by future work there would become available self-compatible strains which would not depend for pollination on insects, and the failures of these crops from time to time due, as is believed, to insufficiency of insect pollinators might disappear.

7. Many other important problems connected with these crops await investigation. These include an improvement in the oil content of different types and an investigation of the mycological diseases of the individual oilseed crops. Diseases of Brassicæ oilseed crops found to be of importance in Northern India are Leafspot, Downy Mildew, and White Rust. Sesamum suffers from Die Back, Stem Rot and Wilt; and Groundnut from Tikka disease, Root, rot, Leaf Blight, Die Back and Stem rot. A considerable amount of research remains to be done in order to determine control measures of some of these diseases.

8. *Cost.*—The proposed expansion of the research at Lyallpur and the opening of a sub-station at Ludhiana involves the addition of two Research Assistants on the Botanical side, one on the Chemical side and one for Mycological investigations, together with the other inferior establishment and the provision of funds for the items shown in the attached statement. A small non-recurring expenditure is also necessary.

9. For this scheme the Punjab Government will make available 8 acres of canal irrigated land at Lyallpur paying the Water Rates connected with it and providing the necessary bullocks, implements for its cultivation, labour and all working expenses. Ten acres of land, partly irrigated by wells and partly *barani* will be allotted at the Ludhiana Farm, where buildings, quarters for labourers and bullocks, irrigation wells and implements will be provided free of cost. On the recurring side Government will also contribute a sum of Rs. 1,000 per annum against the annual receipts from the area at Ludhiana under the scheme and as a partial contribution towards the running expenses. Of the non-recurring expenditure Government will provide the necessary funds for the purchase of bullocks, the fencing of the breeding plots and the furniture required by the staff.

10. The total cost of the scheme is estimated to be—

	Rs.
Non-recurring	5,000
Recurring for a period of five years	66,910
	Total . 71,910

Of these amounts the Imperial Council of Agricultural Research is requested to provide—

	Rs.
Non-recurring	3,600
Recurring	66,910

Non-recurring expenditure.

	Rs.
4 Bullocks	700
Fencing for breeding plots	400
Furniture	300
Bird proof enclosure for breeding work	200
2 Bird proof threshing floors	1,000
Apparatus (hydraulic press, iron kohlu, etc.)	2,000
Seed bins	400
Total	5,000

Recurring expenditure.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
2 Botanical Research Assistants with post-graduate training on Rs. 120—10—160 (less 15 per cent.).	2,448	2,688	2,928	3,168	3,408	14,640
1 Chemical Research Assistant with post-graduate Training, on Rs. 120—10—160 (less 15 per cent.)	1,224	1,344	1,464	1,584	1,704	7,320
1 Mycological Research Assistant with post-graduate training on Rs. 120—10—160 (less 15 per cent.).	1,224	1,344	1,464	1,584	1,704	7,320
1 Entomological Research Assistant with post graduate training, on Rs. 120—10—160 (less 15 per cent.)	1,224	1,344	1,464	1,584	1,704	7,320
1 Mukaddam on Rs. 25—1—29 .	300	312	324	336	348	1,620
2 Plant Observers on Rs. 20—1—24	480	504	528	552	576	2,640
3 Laboratory Attendants on Rs. 20—1—24.	720	756	792	828	864	3,960
1 Clerk on Rs. 40—2—48 (less 15 per cent.).	408	432	456	480	504	2,280
5 Beldars on Rs. 15 each	900	900	900	900	900	4,550
2 Chowkidars at Rs. 13 each	312	312	312	312	312	1,560
Casual labour	300	300	300	300	300	1,500
Seeds and manures	200	200	200	200	200	1,000
Food stuffs	250	250	250	250	250	1,250
Contingencies (including bags for crossing work).	1,000	1,000	1,000	1,000	1,000	5,000
Travelling Allowance	1,000	1,000	1,000	1,000	1,000	5,000
Total	11,990	12,616	13,382	14,078	14,774	66,910

APPENDIX XII.

NOTE DATED THE 23RD JANUARY 1934, BY SECRETARY ON SUBJECT NO. 13 (b).—APPLICATION FROM THE GOVERNMENT OF BENGAL FOR A GRANT OF RS. 63,680 SPREAD OVER A PERIOD OF FIVE YEARS FOR RESEARCH ON THE LINSEED CROP, BY THE DEPARTMENT OF AGRICULTURE, BENGAL.

Attention is invited to the attached extract from a letter from the Government of Bengal No. 1, dated the 2nd January 1934 (Annexure I) forwarding a scheme (enclosure to annexure) for research on the linseed crop, by the Department of Agriculture, Bengal. The scheme involves a total expenditure of Rs. 63,680, viz., non-recurring Rs. 5,000 and recurring Rs. 58,680 spread over a period of five years. The Local Government have expressed their inability to share any portion of the cost.

2. The scheme has been approved by the Bengal Provincial Research Committee (Annexure II) and subject to the concurrence of the Advisory Board it is proposed to place the scheme before the next meeting of the Indian Oil Crushing Industry Committee. It may be mentioned that the annual area now under linseed in Bengal is only about 125,000 acres (3·8 of the total Indian area as compared to averages of 27·4 per cent., 26·3 per cent., 18·5 per cent., and 9·9 per cent., for the Central Provinces, United Provinces, Bihar and Orissa and Hyderabad State)—the prospects of expansion of the area are not stated.

3. The subject is for the consideration of the Advisory Board.

ANNEXURE I.

EXTRACT FROM A LETTER NO. 1, DATED THE 2ND JANUARY, 1934, FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT.

Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

With reference to your letter No. F.6 (1)/33/G., dated the 6th December 1933, on the subject mentioned above, I am directed by the Government of Bengal (Ministry of Agriculture) to forward herewith, for inclusion in the Agenda of the meeting of the Advisory Board to be held in February 1934, the undernoted scheme (Enclosure to Annexure I), which has been approved by the Provincial Agricultural Research Committee, Bengal, together with relevant extract (Annexure II) from the minutes of the meeting of the Committee held on December 7, 1933, and to say that the Local Government recommend the scheme subject to the condition that no financial liability devolves on them.

* * * * *

4. Scheme for research on the linseed crop, by the Department of Agriculture, Bengal.

* * * * *

ANNEXURE II.

EXTRACT FROM THE MINUTES OF THE SEVENTH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD ON THE 7TH DECEMBER 1933.

* * * * *

8. Scheme for research on linseed, by the Bengal Agricultural Department. The scheme was approved by the Committee.

Dr. Mukherjee referred to the fact that the work would be done in collaboration with the Dacca University. He did not wish to interfere with the present scheme, but would like to point out that there is a general feeling in the Calcutta University that the Dacca University was being more favoured on account of its proximity to the Research Station at Dacca. Dr. Mukherjee was informed that there was no intention on the part of the department to favour one university or the other, and that the department was only too glad of the assistance given by the Calcutta University.

ENCLOSURE TO ANNEXURE I.

SCHEME FOR RESEARCH ON THE LINSEED CROP.

The Advisory Board of the Imperial Council of Agricultural Research examined at its meeting held in February 1933, the question of the action to be taken so as to derive full advantage from the tariff preference on Indian linseed. As a result of the Ottawa Conference they emphasised firstly, the importance of experimental work on linseed in each of the major linseed growing provinces and suggested the advantage of exchange of seeds of improved varieties between different provinces and a wider and more systematic trial of the 94 good types of linseed bred at the Imperial Research Institute, and, secondly, of the desirability of a wider publication of the importance and advantage of Ottawa Preference on linseed amongst the cultivators through the co-operative societies, vernacular papers and magazines; and with this end in view to arrange for the publication of the latest price and trade information on linseed and linseed oil, with the Indian Trade Commissioner in England and the Director-General of Commercial Intelligence and Statistics, Calcutta.

It is, however, to be mentioned that though there has been always a preference on Indian linseed owing to its cleanliness and higher oil content, this is considered to be too high by many English users, who prefer Argentine linseed to Indian linseed as the latter is always cheaper even giving due consideration to the premium noted above, particularly by those who do attach much importance to the quality of oil. From the information furnished by the Indian Trade Commissioner, it is seen that the actual yield of oil from Argentine linseed varies from 32 to 35 per cent. in two cases, whereas Calcutta linseed gave a uniform yield of 38 per cent. of oil in two cases.

From the preliminary work that has been done in Bengal, it has been found that there is a marked variation (35 to 42 per cent.) in the oil content of Bengal linseed, as well as in agricultural characters, so much so that already 85 pure lines have been isolated from the samples so far available. The Pusa types have also been tested with the local types in the provincial farms but these have not been found to suit the soils quite so well as they have been bred to a longer period of growth, which is not possible under Bengal conditions. Agronomic work in the linseed tract has not made any headway on account of paucity of staff. There is however one advantage in Bengal that linseed is mostly concentrated in and around the central part of the Province comprising the districts of Nadia, Murshidabad, Pabna and Jessore which form nearly 64 per cent. of the total area.

Along with the agronomic work on the crop, the chemical part of the work is not less important. It is proposed, therefore, that we should have all our linseed types thoroughly analysed as regards their oil content on a moisture free basis. Further, it is necessary to find out whether the oil content and its quality varies with the time of sowing, situation and type of land, manuring and rotation employed, and see how far the samples collected at different rural trade centres vary as to their oil and moisture contents, thus carrying through all chemical analysis of the oil seed from the growers to the manufacturer in London. Should the fixing of some standards in the linseed trade on oil content and quality be successful, it may be possible to oust the Argentine linseed from the field. It will be seen that with the imposition of the tariff, the proportion of Indian linseed to Argentine imports into the United Kingdom, has increased from 2 to 31 per cent. during the period of January to August 1933, as compared with that of 1932.

In order to take the best advantage of the preference, the department is trying to push on with this work by lending an officer during the sowing period, but this is obviously a tentative arrangement and is bound to fall through unless a special staff is employed for the purpose, to be employed not only for agronomic work but also to carry out propaganda on the marketing of the crop on the lines suggested by the Advisory Board. It will be one of his principal duties to see that the growers receive full advantage of the prices at London and the same is not dissipated through the various channels of middlemen. Linseed with its normal area of 193,000, once brought a sum of over one crore of rupees when linseed was selling at Rs. 9 per maund in the village market.

The work will mainly be chemical and agronomic. For the chemical work an analyst will have to be retained on a salary of Rs. 160—10—200 or on an average pay of Rs. 180 per month, and for the agricultural work of breeding, demonstration and marketing studies, a man of the Provincial cadre on the grade of Rs. 250—20—330 or on an average salary of Rs. 290 per month will have to be taken. He will be assisted by four demonstrators on the grade of Rs. 30—5—50 or an average salary of Rs. 40

per month to be stationed on the main centres of work at Chuadanga, Meherpur, Beldanga and Iswardi, and an overseer at the two Farms, Berhampore and Krishnagar of the grade of Rs. 50—5—70 or an average pay of Rs. 60. The chemical work will be conducted in collaboration with the Dacca University and the headquarters of the Linseed Officer will be either at the Berhampur or Krishnagar Farm.

The scheme would entail a capital expenditure of Rs. 5,000 and a recurring expenditure of Rs. 58,680, the total expenditure being Rs. 63,680 for 5 years as detailed below :—

Capital Expenditure.

	Rs.
1. Chemical and apparatus (Dacca University additional equipment)	1,000
2. Building, godown and laboratory	3,000
3. Furniture, laboratory equipment, stores, seed bins, balances implements, sprays, etc., reference books	<u>1,000</u>
Total	<u>5,000</u>

Recurring Expenditure.

	1st year.	2nd year.	3rd year.	4th year.	5th year.
	Rs.	Rs.	Rs.	Rs.	Rs.
Agronomist (Rs. 250—25—330)	3,000	3,240	3,480	3,720	3,960
Chemical Analyst (Rs. 160—10—200)	1,920	2,040	2,160	2,280	2,400
Fieldmen (4) (Rs. 30—5—50)	1,440	1,880	1,920	2,160	2,400
Overseer (Rs. 50—5—70)	600	660	720	780	840
Peon (Rs. 13)	156	156	156	156	156
Contingencies (office expenses, periodicals, books, and journals).	500	500	500	500	500
Labour for experimental work	700	700	700	700	700
Chemicals.	500	500	500	500	500
Seeds, manure and implements, etc	100	100	100	100	100
Travelling allowance.	1,500	1,500	1,500	1,500	1,500
Total	<u>10,416</u>	<u>11,076</u>	<u>11,736</u>	<u>12,396</u>	<u>13,056</u>
Total for 5 years . . . . .	..	..	..	..	58,680
Grand total . . . . .	..	..	..	..	63,680

KENNETH McLEAN,
Director of Agriculture, Bengal (Offg.).

APPENDIX XIII.

NOTE, DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 13 (c).—
APPLICATION FROM THE GOVERNMENT OF THE CENTRAL PROVINCES FOR A GRANT OF
RS. 61,400 SPREAD OVER A PERIOD OF FIVE YEARS FOR RESEARCH WORK ON OIL-SEEDS
IN THE CENTRAL PROVINCES.

Attention is invited to the enclosed extracts from a letter No. 48-1052-XIV, dated the 8th January 1934 (Annexure) from the Government of the Central Provinces forwarding, *inter alia*, a scheme (Enclosure II to annexure) for research work on oilseeds in the Central Provinces. The scheme involves an expenditure of Rs. 61,400 spread over a period of five years. The grant asked for is intended to be utilized for the augmentation of staff and for items such as travelling expenses, laboratory and field requisites and contingencies. The Local Government have agreed to provide all the land necessary for the work on any farm where the trials and investigations may be carried out and also laboratory accommodation. No grant for non-recurring expenditure has been applied for. The mycological work connected with the scheme will also be provided for by the Local Government.

2. The scheme has been approved by the Central Provinces Provincial Research Committee, and subject to the approval of the Advisory Board it is proposed to place the scheme before the next meeting of the Indian Oil Crushing Industry Committee.

3. The subject is for the consideration of the Advisory Board.

ANNEXURE.

COPY OF LETTER NO. 48-1052-XIV, DATED THE 8TH JANUARY, 1934, FROM THE REVENUE SECRETARY, GOVERNMENT OF THE CENTRAL PROVINCES AGRICULTURE DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Grant in aid from Imperial Council of Agricultural Research for certain schemes of research in the Central Provinces.

I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward a copy of letter No. 5551, dated the 12th/13th December 1933 from the Director of Agriculture, Central Provinces (Enclosure I to annexure) together with the undermentioned six schemes and to recommend them for the favourable consideration of the Imperial Council of Agricultural Research.

* * * * *

(2) Scheme for research on Oilseeds. (Enclosure II to Annexure).

* * * * *

2. These schemes have been considered by the Provincial Agricultural Research Committee on the 9th December 1933 and approved by that body. The local Government has also accepted them. I am accordingly to request that they may be placed before the Advisory Board of the Imperial Council of Agricultural Research at its next meeting to be held in February 1934.

ENCLOSURE I TO ANNEXURE.

EXTRACT FROM A LETTER NO. 5551, DATED THE 12/13TH DECEMBER 1933, FROM THE OTTG. DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES TO THE SECRETARY TO GOVERNMENT, AGRICULTURE DEPARTMENT, CENTRAL PROVINCES.

I have the honour to attach herewith six schemes of research which were placed before the Provincial Agricultural Research Committee on the 9th December 1933 and

recommended for transmission to the Imperial Council of Agricultural Research for the provision of funds.

• • • • •

Scheme for Research on Oilseeds.

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The importance of oilseeds—particularly linseed—in these provinces and the interest taken by the Imperial Council of Agricultural Research in this crop in connection with the Ottawa Agreement should be sufficient commendation for a scheme to improve the quality and quantity of the oilseeds of the Province.

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ENCLOSURE II TO ANNEXURE.

SCHEME FOR RESEARCH WORK ON OILSEEDS

In the agricultural year ending 31st May 1932 the area under oilseeds in the Central Provinces and Berar amounted to 2,055,525 acres or 14 per cent. of the total area under oilseeds in India. This area was made up as follows:—

	Acres.
Linseed	937,224
Til or jingli	504,924
(Sesamum indicum) Rape and mustard	69,821
Groundnut	164,333
Castor	58,263
Other Oilseeds	340,960
[mostly Jagni and Niger or ramtil (Guzotia abyssinica)]	

It will be seen that linseed is the principal oil crop of the Province. The area however fluctuates considerably from year to year owing to changes in price, the incidence of 'rust' and the state of the seed bed at sowing time. The Central Provinces is the largest grower of linseed in India producing roughly about 45 per cent of the total Indian output despite the fact that the outturn per acre is by far and away the lowest of any Province in India. The United Provinces outturn is 500 lbs. per acre; Bihar and Orissa 492; Bengal 467; Bombay 360; Assam 336, while the Central Provinces yields only 226 lbs. per acre. From these figures it will be seen that there is great scope for improving the yield of the linseed crop of the Province.

As mentioned above, the area fluctuates greatly from year to year, but there is also a distinct tendency for the total area to diminish each year. In the quinquennium ending 1908-09 the area was nearly double the present one while as recently as 1925-26, there were 1,147,600 acres under the crop. The chief reasons for this decline are (1) the susceptibility of the crop to attacks of rust, which often wipes out large areas particularly in the north of the province and (2) the low yield per acre so that it cannot compete with food crops especially when the market price is low.

The work of improvement therefore involves (1) the production of high yielding types and (2) the evolution of rust resistant strains. During the past, some selection work has been done and the Department has evolved some types which yield better than the local ones. Hybridization work is also in progress with a view to evolve rust resistant strains. Some crosses have been made with European flaxes and the rust resistant Pusa varieties with the idea of combining high yield with rust resistance.

It has been found that the linseeds of the Central Provinces and Berar differ materially in their root system from those grown in the Gangetic alluvium and this probably explains why the shallow rooted Pusa types have not proved successful in these provinces. It will be necessary to undertake a detailed study of the root system with the object of finding out which type will be most suitable for a particular tract. Four types of root system have been made out even though an exhaustive study has not so far been made.

Another important item of investigation is to find the place of linseed in the rabi rotation and manurial and rotational experiments will be therefore have to be conducted.

A botanical classification of the local linseeds is in progress and there is every possibility of isolating from them some types with the desired characters.

A study of the diseases and pests will also be made.

Til.—Til occupies the largest area among the oilseeds of this country and the Central Provinces and Berar stand third in order of importance being beaten only by Burma and Bombay. Here again the outturn in the Central Provinces is lower than in other provinces, being 224 lbs. per acre compared with 400 lbs. in Bombay, 503 lbs. in Bengal and 300 lbs. in Madras. There is thus much room for improvement and it is certain that an increased yield will result in a much larger area being put under the crop. Work will consist (1) of a systematic classification of the local varieties (2) the isolation of high yielding types by selection or hybridization (3) trial of different varieties from different provinces and countries, e.g., the Levant seed recommended in the Indian Oil Trade Industry Report and (4) manurial and cultural experiments and (5) investigation into diseases and pests of the crop. Work on this crop has only recently been taken up by the staff of the Department. A correlation between various morphological characters and yield was established last year and selection work will be based on these morphological characters.

Niger.—Ramtil or Jingily occupies quite an extensive area in the more jungly parts of the provinces where other crops are difficult to grow on account of the ravages of wild animals. The area could be extended considerably on the lighter soils of the province. No work has been done on this crop by the department but the outlines of work for linseed and til mentioned above would apply in this case also.

Safflower.—Safflower is grown in the Central Provinces and Berar mainly for the oil content of its seed and not for the dye from its florets. It is grown in black soil as a rabi crop and very often on the borders of fields to protect the more valuable crops from damage by animals. The crop is not recorded separately in the agriculture statistics so that its area and outturn cannot be ascertained but the area is appreciable.

No botanical work has so far been undertaken on this crop in the province and the first step would be to make a botanical classification of the varieties being grown. Work on selection for better yield, higher oil content, etc., will be conducted simultaneously.

Mustard and rape.—Of the three sub-species of Brassica grown in India, viz., Sarson (*B. Campestris*), Tori (*B. Napa*) and Rai (*B. Nucea*) only the last is grown in the Central Provinces in an area amounting to about 2 per cent. of the cultivated area. A botanical classification of the local varieties will be made with a view to finding out suitable types with high yield and large oil content.

Castor.—The Central Provinces and Berar stand third in the production of this crop. There are 2 main varieties—the large seeded type grown as a kharif crop and the small seeded grown as a rabi crop. The former is usually grown in "baris" or on well drained waste and fallow patches, while the rabi crop is grown as a field crop. No work has been done on the crop in this Province and as a preliminary step a collection of all the local varieties will be made with a view to isolate heavy yielding types with high oil content. Suitable varieties from other parts of India will also be tested.

Groundnut.—Groundnut is dealt with as one of the crops grown in rotation with cotton and will not come within the purview of this scheme.

The work to be performed on each of the oil crops has been outlined above. Owing to paucity of staff, however, progress is bound to be slow and much of the work will not be taken in hand at all unless extra staff is recruited. It is for this reason that this scheme has been framed and is now put up before the Imperial Council of Agricultural Research. It was thought advisable to include all the oil seeds, except groundnut, under the one scheme so as to make it as economical as possible.

In my opinion the following staff is necessary to carry out the work detailed above :—

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. Central Provinces Agricultural Service Class I Officer on pay Rs. 250—250—275—300—325.	3,000	3,000	3,300	3,600	3,900	16,800
2. 3 Botanical Assistants Rs. 70—70—75—8—85.	2,520	2,520	2,700	2,880	3,060	13,680
3. Entomological Assistant Rs. 70—70—75—80—85.	840	840	900	960	1,020	4,560
4. Clerk Rs. 30—2—38.	360	384	408	432	456	2,040
5. 2 Laboratory Assistant at Rs. 20.	600	600	600	600	600	3,000
6. 2 Peons on Rs. 11	264	264	264	264	264	1,320
7. Travelling Allowance	1,000	1,000	1,000	1,000	1,000	5,000
8. Books, Laboratory and field Requisites	1,000	1,000	1,000	1,000	1,000	5,000
9. Contingencies	2,000	2,000	2,000	2,000	2,000	10,000
Total	11,584	11,608	12,172	12,736	13,300	61,400

The Central Provinces Government will provide all the land necessary for the work on any farm where the trials and investigations may be carried out. Laboratory accommodation will also be provided for the workers. The existing varieties and types will be handed over to the new Section as a nucleus for these experiments while work in connection with oil content will be handled by the Agricultural Chemist and his staff. The mycological work will be done by Government.

APPENDIX XIV.

NOTE, DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 13 (d).—(1) APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF Rs. 5,000 FOR ONE YEAR FOR AN ENQUIRY INTO THE ECONOMICS OF THE VILLAGE OIL-CRUSHING INDUSTRY IN THE PUNJAB. (2) APPLICATION FROM THE GOVERNMENT OF THE UNITED PROVINCES FOR A GRANT OF Rs. 5,000 FOR ONE YEAR FOR A CENSUS RELATING TO THE INDIGENOUS OIL-CRUSHING INDUSTRY AND AN ENQUIRY INTO ITS ECONOMICS.

At its meeting held in December 1931, the Indian Oil Crushing Industry Committee considered the question of helping village presses and larger scale oil factories and recommended (Annexure III) that the Boards of Economic Enquiry in the Punjab and the United Provinces should be invited to make enquiries into the economics of the village oil-crushing industry. This recommendation was approved by the Advisory Board at its meeting held in July 1932 and by the Governing Body at its meeting held in October 1932. The Governments of the Punjab and the United Provinces were accordingly addressed in the matter but they stated that in the existing state of finances and staff, the Provincial Boards of Economic Enquiry could not undertake the enquiries desired by the Indian Oil Crushing Industry Committee without financial assistance from the Council. Both the Local Governments have accordingly submitted schemes [*vide* letter from the Government of the Punjab, No. 575-D. (S.), dated the 22nd June 1933 (Annexure I) and letter from the Government of the United Provinces, No. 25-I., dated the 11th January 1934 (Annexure II)] which involve total expenditure of Rs. 10,000, i.e., Rs. 5,000 for each province.

2. The schemes (Enclosures to Annexures I and II) have been approved by the respective Provincial Research Committees and subject to the concurrence of the Advisory Board, it is proposed to place both these schemes before the next meeting of the Indian Oil Crushing Industry Committee in the first instance.

ANNEXURE I.

COPY OF LETTER No. 575-D. (S.), DATED THE 22ND JUNE 1933, FROM THE DEPUTY SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT :—*Village Presses and large scale Oil Factories.*

With reference to your letter No. 679/Agri., dated the 9th March 1933 (not printed), I am directed by the Punjab Government (Ministry of Agriculture) to intimate that the Board of Economic Enquiry was invited to make an enquiry into the economics of the village oil-crushing industry.

2. The proposal was considered at a meeting of the Board of Economic Enquiry held in March 1933. During the last three years the funds allotted to the Board have been considerably curtailed and such funds as the Board possesses are already earmarked for printing several investigations which have already been completed or are about to be completed. Very little money is, therefore, available with the Board to start new enquiries at present. The Board, therefore, passed a resolution in the following terms :—

“That the Secretary write to the Provincial Council of Agricultural Research, asking them to recommend to the Imperial Council of Agricultural Research to give a grant to the Board to enable it to conduct an enquiry for one year. In case the grant was not forthcoming the Board would reconsider the matter later.”

3. In pursuance of this resolution the Board of Economic Enquiry has submitted the attached scheme (Enclosure to Annexure I). The Board decided that if the Imperial Council of Agricultural Research provided the necessary funds a trained investigator on the permanent staff of the Board will be allotted to this inquiry. This scheme was considered by the Provincial Council of Research at its meeting held on 29th April 1933 and was approved by the Council.

4. If the proposal meets with the approval of the Imperial Council of Agricultural Research, I am to request that provision may be made by the Council of funds to the extent of Rs. 5000 (five thousand rupees).

ANNEXURE II.

COPY OF LETTER No. 25-1., DATED THE 11TH JANUARY 1934, FROM THE SECRETARY TO GOVERNMENT, UNITED PROVINCES, INDUSTRIES DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT :—*Helping village presses and large scale oil factories.*

With reference to the correspondence resting with your letter No. F. 23/33/O.S., dated August 25th 1933, on the above subject, I am directed to forward a copy of this Government's application (Enclosure to Annexure II) for a grant of Rs. 5,000 for a census relating to the indigenous oil-crushing industry and an enquiry into its economics.

2. In the original scheme, involving an expenditure of about Rs. 2,000 the intention was to complete the enquiry in three months. The Provincial Agricultural Research Committee, which considered the proposal in November last, expressed the view that the period suggested was not sufficient for an effective enquiry. The Committee accordingly amplified the scheme to cover a period of one year at a cost of Rs. 5,000. A copy of the Committee's resolution on the subject is enclosed.

3. The Governor, acting with his Minister, approves of the scheme, as recast, and I am to request that it may be placed before the Advisory Board of the Imperial Council at its next meeting.

COPY OF RESOLUTION No. 2 PASSED AT THE 9TH MEETING OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE, HELD AT LUCKNOW, ON NOVEMBER 28, 1933.

Agenda.

2. Consideration of an application from the United Provinces Government to the Imperial Council of Agricultural Research for a grant of Rs. 2,000 (recurring spread over three months) for a census relating to the indigenous oil-crushing industry and an inquiry into its economics.

Resolution.

2. Resolved that a period of three months is not sufficient for an effective inquiry of this nature, and that a scheme as amplified to cover a longer period and at a cost of Rs. 5,000 be recommended to the Imperial Council of Agricultural Research.

ENCLOSURE TO ANNEXURE I.

BOARD OF ECONOMIC INQUIRY, PUNJAB.

Proposed Inquiry into the Economics of the Village Oil Crushing Industry in the Punjab.

Introductory.—The matter arose out of a letter from the Punjab Government* drawing the attention of the Board to paragraph 3 of an accompanying letter† from the Secretary, Imperial Council of Agricultural Research. In this paragraph it was suggested that the Board may be invited to make an inquiry into the economics of the village oil crushing industry. This proposal was considered at a meeting of the Board held on 29th March 1933. The Board regretted that it was not in a position at present to finance this enquiry, but decided that if the Imperial Council of Agricultural Research made the necessary funds available, the Board would provide the services of one of its trained investigators. Accordingly it was resolved—

“That the Secretary write to the Provincial Council of Agricultural Research asking them to recommend to the Imperial Council of Agricultural Research to give a grant to the Board to enable it to conduct an inquiry for one year. In case the grant was not forthcoming the Board would reconsider the matter later.” (Paragraph 4-x.)

Scope and extent of inquiry.—It is noted that the inquiry should be limited to oil crushing in villages and should not deal with large scale oil factories. Oil crushing being general in the province the field of operation will be wide and the nature of the investigation extensive; and therefore it would be advisable to select representative tracts for investigation. It is expected that a trained investigator of the Board would be able to collect sufficient data in twelve months, devoting a limited amount of time to each area selected and reserving the last month or so to the writing up of his report.

* 1336-E., dated 24th March 1933. †679 Agri., dated 11th March 1933.

Travelling.—The inquiry will entail a good deal of moving about by the investigating staff and, consequently, the Travelling Allowance will be heavier than usual. It may, however, be mentioned that the present rules of the Board allow investigators only single Railway fare and actual for other journeys, and no halting allowance for inquiries such as this; the charges under this head, therefore, tend to keep to a minimum.

Additional help.—It has been found in such inquiries that the assistance of a junior investigator or muquddams has proved very useful as these men help to prepare the ground for the head investigator and also assist in routine work, like copying out figures from revenue records, etc., leaving him to concentrate on actual inquiry work. It is anticipated that the employment of such assistants will greatly add to the value of the report.

Cost of inquiry.—The following is an estimate of the cost :—

	Rs.	A.	P.
One head investigator at Rs. 235 per mensem	2,820	0	0
Contribution towards his Provident Fund at anna 1 per rupee	176	4	0
To Muquddams at Rs. 20 for 10 months	400	0	0
Travelling allowance	1,400	0	0
Contingencies	200	0	0
	4,996	4	0
Say Rs.	1,000	0	0

FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI, TO THE SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, No. 679-AGRI., DATED THE 9TH/11TH MARCH 1933.

Helping Village Presses and large scale Oil Factories.

I am directed to state that at its Second Meeting, held in December 1931, the Indian Oil Crushing Industry Committee, appointed by the Imperial Council of Agricultural Research, considered the question of helping village presses and large scale oil factories. Whether technical assistance could be given to village oil-crushers and small industrial oil-crushers arose as part of a general question. Whilst it is realised that these are provincial matters it is considered that Local Government may be glad to know the Committee's suggestions.

The Committee considered that—

- (a) it is desirable that work should be undertaken at the various provincial institutions with the object of assisting the village *teli*, and that such assistance might include the devising of improved methods and appliances suitable for village use, for crushing various oil seeds; simple and practical methods of refining oil in small quantities, and the manufacture of soap in villages;
- (b) considerable assistance could be given to the small industrialist type of oil-crusher (*viz.*, owners of small oil mills which do not come under the Factory Act) if personal contact with them could be established. This would appear to fall within the sphere of the various Departments of Industries, and it is suggested that the Department of Industries and Agriculture might co-operate in ascertaining the exact number of these small mills which exist in each province. Accurate information as to the number of village *telis* and the capacity of their plant is also badly needed.

2. I am to commend the suggestions made by the Committee to the consideration of the Government of the Punjab and to request, that, if there is no objection, this Department may kindly be informed of the action taken in due course.

3. I am to add in this connection that the Committee also suggested that the Board of Economic Inquiry in the Punjab should be invited to make an inquiry into the economics of the village oil crushing industry. I am to request that if the Local Government have no objection the Board may kindly be invited to undertake such an inquiry and the results communicated to this Department in due course.

ENCLOSURE TO ANNEXURE II.

ITEM.

COPY OF A LETTER No. 482/461—IND., DATED OCTOBER 17, 1933, FROM THE DIRECTOR OF INDUSTRIES, UNITED PROVINCES, CAWNPORE, TO THE SECRETARY, UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE, LUCKNOW.

SUBJECT:—*United Provinces Government's application to the Imperial Council of Agricultural Research, for a grant of Rs. 5,000 for a census relating to the indigenous oil-crushing industry and an inquiry into its economics.*

In compliance with Industries Department endorsement No. 1857/XVIII—130 of September 15, 1933 (copy reproduced below), I have the honour to enclose herewith three copies of a scheme prepared by the Bureau of Statistics and Economic Research for a grant from the Imperial Council of Agricultural Research for the purpose of an inquiry into the economics of the village oil-crushing industry and a census relating thereto. I have been directed to submit it to Government after the views of the Provincial Agricultural Research Committee, United Provinces, have been obtained thereon.

I hope it will be possible for you to arrange to have this scheme included in the business coming up before the Committee at its next (i.e., October) meeting.

COPY OF A LETTER No. F-23/33-O.S., DATED AUGUST 25, 1933, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO THE SECRETARY TO THE GOVERNMENT OF THE UNITED PROVINCES, AGRICULTURE DEPARTMENT.

SUBJECT:—*Helping village presses and large scale oil factories.*

With reference to your letter No. 879/XVIII—130, dated July 31, 1933, on the subject mentioned above, I am directed to say that any concrete proposals which the Local Government desire to put forward for a grant for an inquiry into the economics of the village oil-crushing industry would receive the careful consideration of the Oil-Crushing Industry Committee and subsequently of the Council. It would be an advantage if the views of the Provincial Agricultural Research Committee on the proposals could be communicated at the same time. The date of the next meeting of the Oil-Crushing Industry Committee has not yet been fixed. This will be notified in due course.

GOVERNMENT OF THE UNITED PROVINCES.

No. 1857/XVIII—130.

INDUSTRIES DEPARTMENT.

Dated Allahabad, September 15, 1933.

Copy forwarded to the Director of Industries, United Provinces, in continuation of Government endorsement No. 879-1, dated July 31, 1933, with the request that a scheme may please be framed applying to the Imperial Council of Agricultural Research for the grant in question, and submitted to Government after the views of the Provincial Agricultural Research Committee have been obtained thereon.

By order, etc.,

P. M. KHAREGAT,

Secretary.

UNITED PROVINCES GOVERNMENT'S APPLICATION TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A GRANT OF RS. 5,000 FOR A CENSUS RELATING TO THE INDIGENOUS OIL-CRUSHING INDUSTRY AND AN INQUIRY INTO ITS ECONOMICS (AS MODIFIED IN ACCORDANCE WITH RESOLUTION NO. 2 OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE HELD ON NOVEMBER 28, 1933.)

(1) *Oil-seeds from important commercial crops in the United Provinces.*—In the matter of oil-seeds the United Provinces can claim to be the most representative area in India. In the light of the information already* supplied to the United Provinces Provincial Agricultural Research Committee it is perhaps not necessary to elaborate this point. In 1931-32 the area under oil-seeds was 1,037,314 acres and the estimated yield of oil-seeds was 1,689,000 tons.

(2) There are only 21 power mills for crushing oil-seeds in the United Provinces. A large quantity of oil-seeds are thus exported or crushed—generally with bullock power—in the indigenous *ghannis* or *kolhus*. The *teli* has been able to maintain his ground even against the competition of modern and well-equipped oil mills. It is desirable to find out the *teli's modus operandi* and its economics. Simultaneously it is desirable to collect information regarding the types and capacities of indigenous plants, their number, the conditions under which they are operated, the quantity of oil expelled, the average extraction of oil, the cost of operation, methods of marketing, existence of a preference (if any) still enjoyed by oil obtained by the *ghanni* or *kolhu* method, profit or loss, etc.

No precise information on these and cognate subject is available and the Imperial Council itself has felt the need of collecting it.

(3) The scheme outlined below is for a census of the village oil-crushing industry and an inquiry into its economics.

So far as the census is concerned the agency of the revenue authorities in the districts will be utilized.

The inquiry into the economics of this industry will, however, require a specially trained and experienced staff. It will be undertaken in selected representative (or average) villages and towns in the province, and will be conducted under the Statistician's supervision. It is estimated to cost as below :—

	Rs.
1. Three investigators on Rs. 100 per mensem for 6 months	1,800
2. One investigator on Rs. 100 per mensem for 12 months	1,200
3. Three peons on Rs. 10 per mensem for 6 months	180
4. One peon on Rs. 10 per mensem for 12 months	120
5. Travelling allowance to Statistician for supervision	300
6. Travelling allowance to investigators and peons	1,100
7. Contingencies (including clerical assistance)	300
Total	5,000

ANNEXURE III.

Extract from the proceedings of the 2nd meeting of the I. O. C. I. Committee held in December 1931.

5. *Helping village presses and large scale oil-factories.* (Subject 4 of the Agenda)

Mr. Menon considered that work should be done with the object of assisting the village *teli*. Such assistance should include the devising of improved methods and plant for crushing various oil-seeds, simple and practical methods of refining oil in

* *Vide* proposal that oil section of Technological Institute should be utilized as an All-India Oil Institute.

small quantities and manufacture of soap in villages; the plant and processes should be essentially suitable for village use. The Committee agreed that this work should be undertaken at the various provincial institutions. Mr. Duke suggested that considerable assistance could be given to the small industrialist type of oil-crusher, *viz.*, owners of small oil-mills which did not come under the Factory Act. He was of the opinion that, in order to do this, it is necessary to establish personal contact with the oil-millers. The Committee considered that this contact should be established through the various Departments of Industries, and that the Departments of Industries and Agriculture should co-operate in ascertaining the exact number of these small mills and village *telis* which exist in each province. Mr. Roberts suggested that the Board of Economic Enquiry in the Punjab should be invited to make an enquiry into the economics of the village *teli* and his business. Mr. Duke said that the recently established Board of Economic Enquiry in the United Provinces might also be approached. This was approved.

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APPENDIX XV.

NOTE DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 14-PARTICIPATION OF INDIA IN THE TENTH WORLD'S DAIRY CONGRESS, ROME—MILAN, 30TH APRIL TO 6TH MAY 1934.

India has been invited to participate in the Tenth World's Dairy Congress which is to be held at Rome—Milan in April—May 1934. Copy of the Programme of the Congress and a list of subjects connected with the Tropical Section of the Congress are enclosed (Annexure). The question whether India should participate in the Congress is now for the consideration of the Advisory Board.

2. A delegation consisting of Messrs. Zal R. Kothawala, F. J. Gossip, C. H. Parr and Sardar Datar Singh represented India at the Ninth International Dairy Congress which was held in Copenhagen in July 1931. The reports of these delegates were circulated to the members of the Council.

ANNEXURE.

PROGRAMME OF THE TENTH WORLD'S DAIRY CONGRESS.

The Congress is composed of the following Sections :

- (1) Cattle Breeding and Milk Production;
- (2) Hygiene, chemistry and bacteriology of milk and dairy products—Milk and dairy products as human food;
- (3) Industrial utilisation and commerce of milk and dairy products;
- (4) Teaching experimentation and propaganda concerning milk and dairy products;
- (5) Legislation and control of milk and dairy products;
- (6) Veterinary problems concerning milk;
- (7) Tropical Dairies.

PROGRAMME OF THE 7TH SECTION—TROPICAL DAIRY.

Some of the Dairy Problems of particular interest to all the Tropical Countries.

1. Dairy Stock. Improvement of the milk yields of native or local breeds by crossing or by selection. Introduction and acclimatization of good breeds of cattle giving a high yield of milk.
2. Improvement of the pasturages in tropical countries.
3. Day-light starvation following of perpetual confinement : indoors made necessary by local conditions.
4. Treatment, control and eradication of :
 - (a) Tick borne diseases (in the whole world);
 - (b) Other diseases such as contagious abortion, nagana, surra, foot and mouth disease, tuberculosis, etc.
5. Regulation and control of the native production and sale of milk.
6. Development of dairying amongst the native races to provide an improved standard of diet and a remunerative peasant industry.
7. Teaching of better and more sanitary methods of milking and the propaganda directed against the existing primitive methods of customs of the natives.
8. Evolution of a simple and inexpensive system of farm refrigeration for the purpose of milk and cream cooling. This would mean a better milk supply for the community.
9. Rational milk production under tropical conditions. Establishment of up-to-date dairies. Improved methods of milk production and the presentation for sale of milk and milk products. Methods of transporting milk in the Tropics.
10. Manufacture of butter, cheese and dairy by-products, under tropical conditions.
11. The economic storage of dairy products under tropical conditions. Refrigeration as it affects transport of butter.

PROGRAMME OF THE CONGRESS OF THE VISITS AND EXCURSIONS.

Monday, April 30th.

- 10 A.M.—Inauguration of the Congress at the Capitol in the presence of Their Majesties the King and the Queen of Italy. Appointment of the Presidential Board of the Congress.
- 3 P.M.—6 P.M.—Beginning of the work of the Sections.
- 9 P.M.—A reception offered by H. E. the Governor of Rome.

Tuesday, May 1st.

- 9 A.M.—12 A.M.—Work of the Sections.
- 3 P.M.—6 P.M.—Continuation of the proceedings.
- 6-30 P.M.—Visit to the Municipal Dairy Factory. Visit to the large Seasoning Warehouses of Roman 'Pecorino' cheese.

Wednesday, May 2nd.

- 9 A.M.—12 A.M.—Work of the Sections.
- 2 P.M.—Visit to the 'Bonifiche' (Land Improvement works) of Torre in Pietra, Casetta Mattei.

Thursday, May 3rd.

- 8 A.M.—(a) Excursion to the 'Agro Romano' (Roman Campagna)— Visit to the Pope's Model Stables at Castel Gandolfo—Visit to the 'Bonifiche' (Land Improvement works) of the Pontine Marshes.
- (b) Train journey to Caserta and Naples with visit to the Dairy and Zoo-technical Institute of Caserta; visits to the Royal Villa in Caserta and to the city of Naples.
- (c) Train journey to Naples and Pompei.
- (d) Visit to the City of Rome—Excursion to Villa Adriana and Villa d'Este.

Friday, May 4th.

- 7 A.M.—Special trains to Milan through Florence or Pisa.
- 12 A.M.—Stop at Florence—Luncheon and Visit the city in motor coaches (or stop at Pisa—Luncheon and visit the city).
- 6 P.M.—Departure from Florence or from Pisa—Dinner in Restaurant Car—Arrival at Milan at 12 P.M.

Saturday, May 5th.

- 9-30 A.M.—Continuation of the sittings in the Castello Sforzesco Welcome by the Lord Mayor (Podesta) of Milan.
- 2 P.M.—5 P.M.—Work of the Sections.
- 5-30 P.M.—Visit to the Milk Centre of Milan.

Sunday, May 6th.

- 9 A.M.—General Sitting of the Congress for the final resolutions.
Closing of the Congress.
Reception offered by the Lord Mayor of Milan.

FREE EXCURSIONS AFTER THE CONGRESS.

Monday, May 7th.

First Excursion.—From Milan to Salvanesco : visits to the Hygienic Milk Plants; to the Milk Collecting Centre in Locate Triulzi; to the Agricultural Establishment in Carpiavo. Visits to the Cheese and Zoo-technical Exhibition; to the Experimental Cheese-making Institute and the Cheese Factories in Lodi.

Second Excursion.—From Milan to Cascina Lavagna : visits to the Plant for the production of crude milk; to the Agricultural Establishment in Sagrate; to the Cheese Plant in Casale Cremasco. Lodi : visits to the Cheese and Zoo-technical Exhibition and the Experimental Cheese-making Institute.

Third Excursion.—From Milan to Soresina : visits to the Milk Centre in Soresina; to the Mutual Milk Centre in Casalbuttano; to the Cheese Plants in Codogno. Lodi : Visits to the Cheese and Zoo-technical Exhibition, to the Experimental Cheese-making Institute and the Cheese Factories.

Fourth Excursion.—In Milan : visits to the Eggs storage plant. From Milan to Tavazzano : visits to a Porkmeat Plant and to the Agricultural Establishment in Tavazzano. Lodi : visits to the Cheese and Zoo-technical Exhibition, to the Experimental Cheese-making Institute and the Cheese Factories.

Fifth Excursion.—In Novare : visits to the Seasoning warehouses for 'Gorgonzola' Cheese and to the Agricultural Establishment.

Tuesday, May 8th.

First Excursion.—From Milan to Monza : visits to the Milk Centre, to the Porkmeat Plant, to the Royal Park and Palace. Excursions to the Brianza; visit to Como and excursion on the lake; return to Milan.

Second Excursion.—From Milan to Valsassina : visits to the natural cellars for the seasoning of 'Gorgonzola' Cheese; excursion on the Lake of Como; return to Milan.

Third Excursion.—From Milan to Venice : return to Milan on the evening of May 9th.

Fourth Excursion.—From Milan to Stresa; excursion in the 'Lago Maggiore' and on the Mottarone; return to Milan in the evening.

Fifth Excursion.—From Milan to Genoa and S. Remo : return at 9 p.m.

Sixth Excursion.—From Milan to Desenzano-Brescia : visits to the General Trade Warehouses and the Milk Centre; from Brescia to the Lake Garda; return on the evening of May 9th.

Wednesday, May 9th.

First Excursion.—From Milan to Lecco and Morbegno : Zoo-technical Exhibition. On the return visit to the Villa Carlotta. Excursions N. 3, 4, 5, 6 are here repeated.

Thursday, May 10th.

First Excursion.—From Milan to Reggio Emilia : visits to the Cheese Warehouses of the 'Cassa di Risparmio' and to the Secondary Royal Agricultural School 'A. Zanelli' specialized in Cheese-making; to the Mutual Milk Centre in Massenzatico. Excursions N. 3, 4, 5, 6 are here repeated.

Friday, May 11th.

First Excursion.—From Milan or from Reggio Emilia to Bologna : visits to the refrigerating Warehouses of the 'Cassa di Risparmio', to the Sugar Plant and to the Agricultural Establishments.

Excursions N. 3, 4, 5, 6 are here repeated.

Notice.—For the round train journeys from the Italian frontier line to Milan and Rome and *vice-versa*, the Italian Railways are granting a special 70 per cent. reduction as well as a 50 per cent. reduction for all other facultative travels in Italy.

Other reductions will be granted by the Railways of foreign countries.

The information about these reductions will appear in the final programme of the Congress.

The Women's Section of the National Committee for Milk and Dairy Products, will organize, for the Ladies who take part in the Congress, special visits to Institutions, Galleries, Museums, etc., in Rome and Milan.

APPENDIX XVI.

NOTE DATED THE 10TH JANUARY, 1934, BY SECRETARY, ON SUBJECT NO. 16, APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF RS. 45,000 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON THE CHEMISTRY OF SUGARCANE.

Attention is invited to the enclosed note dated the 11th September 1933 (Annexure I) on the subject mentioned above which was circulated to the Sugar Committee of the Council for consideration at its last meeting held in November 1933. It may be added with reference to that note that the Government of Madras subsequently intimated that the Provincial Research Committee at its meeting held on the 2nd September 1933 recommended the scheme for the consideration of the Council.

2. The Sugar Committee approved of the scheme in question at its meeting held in November 1933 subject to the condition that the question of leave contribution should be further discussed with the Government of Madras, *vide* attached extracts from the proceedings of the meeting (Annexure II).

The subject is now for the consideration of the Advisory Board.

ANNEXURE I.

NOTE DATED THE 11TH SEPTEMBER 1933, BY SECRETARY, ON APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF RS. 45,000 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON THE CHEMISTRY OF SUGARCANE.

At its fifth meeting held in March 1933, the Sugar Committee considered a note by the Agricultural Chemist to the Government of Madras, on the need for work on the Chemistry of sugar and suggested (page 25, printed proceedings) that definite proposals on the subject might be submitted to the Council in the usual manner. The Government of Madras have now submitted a scheme (Enclosure to Annexure I) for research work on the Chemistry of sugarcane, which, in its present form, would involve expenditure by the Council of about Rs. 45,000 spread over a period of five years. The recommendations of the Madras provincial research committee will, on receipt, be communicated to the Committee. The question of the pay to be drawn by any Government officers deputed to work under this scheme will be discussed further with the Local Government if the scheme is approved.

2. The proposals are for the consideration of the Sugar Committee.

Enclosure to Annexure I.

LETTER FROM S. V. RAMAMURTI, Esq., I.C.S., DIRECTOR OF AGRICULTURE, MADRAS, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA, THROUGH THE SECRETARY TO GOVERNMENT, DEVELOPMENT DEPARTMENT, DATED 2ND AUGUST 1933, R.O.C. No. D-1-982/33.

[Scheme for research on the chemistry of sugarcane—Submission of. *Reference.*—Your letter No. F. 133/33-A, dated 9th June 1933, to the Secretary to Government, Development Department, Madras, and Endorsement No. 2115-III/33-1, Development, dated 16th June 1933.]

I have the honour to enclose a copy of the scheme for research on the chemistry of sugarcane prepared by the Government Agricultural Chemist for the consideration

of the Sugar Committee at the next meeting to be held at Coimbatore. I recommend that it may be forwarded to the Imperial Council of Agricultural Research for consideration.

ENCLOSURE

Scheme for Research on the Chemistry of Sugarcane.

Efforts at developing the sugar industry in India are almost entirely in the direction of breeding and agriculture of sugarcane and the manufacture of sugar. Development in these two directions should undoubtedly receive the first consideration but when progress in them has reached a certain stage it is necessary to make a systematic study of the chemistry of sugarcane in this country. Otherwise, the development will be lop-sided. It will be evident from the history of sugar development in other countries, that unless the present efforts are supplemented with chemical studies, Indian sugar industry will not attain its rightful position.

2. *Application of chemistry to breeding.*—The change in the sugarcane varieties for planting as a consequence of breeding new ones, may be advanced as an argument against the usefulness of spending time, labour and money on the study of the chemistry of sugarcane. The argument appears to me fallacious. It is because of this change in varieties that a knowledge of the chemistry of cane is desirable. Such a knowledge is fundamental and is pregnant with many practical possibilities. Once the knowledge is available, new varieties can be studied in the light of this knowledge and modifications made as and when necessary. It is on this basis that manurial and varietal experiments are now being carried out. It will take at least five years to obtain dependable results from manurial experiments. The studies in the chemistry of sugarcane do not take as long as manurial experiments. While the results of manurial experiments with one variety may or may not always be applicable to another, the knowledge of chemistry has greater chances of wider application and of giving more precise information. Further, the application of chemistry to breeding is a fertile source of useful research.

3. The co-operation between the breeder and the chemist has been so far very restricted and superficial. In testing new seedlings, it is limited to the estimation of sucrose and glucose and rarely fibre in the cane. These ordinary methods have been successful till now but these cannot carry one very far. It will be desirable to supplement breeding methods by careful chemical studies of the breeding material. It is a well-known fact that the ash and salt content of cane are in some way related to its quality which is reflected in the sugar content and purity of the juice and the quality of the final product. The presence of chlorides and nitrates in the juice are suspected to impoverish its quality while the presence of phosphate is believed in some quarters to endow the juice with better defecation properties. Recent experience with sugarcanes at the Coimbatore and Anakapalle Research stations lends strong support to the view that the behaviour of the juice in manufacturing operations and in the concentrating pan is considerably influenced by the inorganic salt content of the juice. Is it not then desirable to investigate the possibilities of applying this knowledge to breeding, in selecting material for breeding and propagation? Consider the newest creations—the sorghum crosses. In sorghum non-crystallizable sugars, dextro-rotatory gums and salts predominate. If the entry of sorghum blood is responsible for early ripening, is there not the possibility of undesirable non-sugars being in excess and should we not assure ourselves that the polarization value represents crystalline sucrose and not non-crystalline dextro-rotatory substances which are not precipitated by lead acetate and that the salt content of the juice is low?

4. *The formation of sugar in the sugarcane.*—As one writer puts it sugar in the sugarcane is nothing but sunshine concentrated into crystallized form. This is a poetical way of putting it but the statement is not far from scientific fact. In this land of plenty of sunshine there is no need for augmenting it but it should be utilized to the best advantage by knowing how it helps in the production of sugar in the cane plant. We hear now of varieties of canes with low manurial requirements and of raising a thirty to forty ton crop without manurial treatment. What does this mean? It may mean that the variety is capable of extracting from the soil reserves, less readily available food material which is beyond the power of another variety or it may mean that the variety is capable of more efficient utilization of lesser amount of

food material and or also is a more efficient utilizer of sunshine resulting in a better and larger synthesis of sugar. Which of the two is responsible for normal yields in the absence of manure is not known. If it is the former it is obvious that continued cropping without manure will ultimately lead to disaster; if it is the latter the study of the process in the cane by methods involving dynamical and static considerations and of the way in which nitrogen, phosphate, potash, lime and magnesia are concerned in the growth, metabolism and the ultimate formation of sugar should lead to results of far reaching importance.

5. *The composition of the cane in relation to factory behaviour of the juice.*—The composition of the cane varies with such factors as soil conditions, fertilizers and climate. There is a close connexion between environment and growth and metabolism of sugarcane. This is clearly brought out in the recent ripening tests on sorghumhybrids. These new creations which are expected to come to maturity in six months after planting behaved in different ways, among themselves and in different localities in the presidency. The effect of soil conditions on the quality of juice, particularly with reference to phosphate on account of its importance in the factory behaviour of juices deserves careful study in this country where phosphate deficiency is known to exist over a wide area. The evidence on this is rather conflicting. For instance Walker (Louisiana Planter 1922, 70, page 127) found some correlation between phosphate added to the soil and phosphate in the juices of canes grown thereon; but Pratt (Hawaii Plant Record 1924, 28, page 34) failed to confirm him. His investigations show, however, that different varieties of cane are characterized by different phosphate contents of their juices. In this study it is necessary to ascertain first whether phosphate manuring has really contributed to the rate of increase at which the phosphate entered the cane.

6. The effect of the composition of the juice on clarification and filtration is well known. Whatever knowledge there is in this connexion, is entirely with reference to factory scale operations, but not in relation to sugar or jaggery manufacture by the open pan system. In the factory clarification is done by precipitation whereas in the simple open pan system the impurities and non-sugar constituents float on the surface and are then skimmed off. The two methods are so different and it is obvious that the knowledge obtained with reference to factory conditions is not applicable to small scale work on which nothing has so far been done. It is necessary to have a more precise knowledge of the nature of the constituents in the juice and their response to liming and skimming before more efficient methods of clarification by surface skimming are considered.

7. The study of the chemistry of sugarcane in the provincial research laboratories with their normal staffs and equipments is a discontinuous and slow process. The demands on their time from other directions do not permit of undivided attention. I had planned fifteen years ago for the study of the chemistry of sugarcane, made a beginning and published two papers, one in 1919 and another in 1925 and some more are awaiting publication. Owing to other demands on my time and staff it has not been possible to do sustained work on the subject. A few years ago the chemistry of sugarcane was of lesser practical importance and now it is urgent and all-important. I, therefore, propose to continue vigorously the work commenced years ago if my staff and equipment are augmented for a period of five years. The total cost of the scheme for a period of five years will be Rs. 45,000 in round figures, the details for which are given in the appendix.

RESEARCH ON THE CHEMISTRY OF SUGARCANE.

Supplementary note.

In the scheme submitted by me in July last, I discussed in broad outlines the directions in which research is proposed to be done. The Provincial Research Council, the Sugar Committee and the Imperial Council of Agricultural Research may wish to have more detailed information on what I propose to do and why I propose to do it. I am, therefore, submitting this supplemental note to the scheme already submitted, indicating briefly the major lines of studies.

Commencing in 1914 (see Agricultural Journal of India, 1919; Memoirs, Pusa, Chemistry Series, 1924), I made extensive determinations of the total sugar contents of each joint of sugarcane during various stages of its growth, while it was standing in

the field, by methods which obviated the necessity of cutting the cane from the field and crushing it. By this means it was possible to understand the life history of the cane, in respect to sugar, as told by the cane itself. This study revealed the fact that in a young cane the maximum sugar content is at the basal joints, and as the cane matures, this maximum moves higher and higher till it is at the highest dead leaf joint. Above this joint, the total sugar content falls off rapidly as the topmost joint is reached. A large increase of sugars occurs in the internode after the death of its attendant leaf. Thus the presence of sucrose in the cane does not seem to be due to such a simple process as the direct polymerisation, in the stem, of reducing sugars translocated by the leaf.

From the experimental evidence obtained *in vitro* and *in vivo* it would appear that whatever may be the form in which sugar enters the stem from the leaf, the sugars sent by the leaf into the stem are converted into carbohydrates of higher molecular weight for building cane tissues. After the death of the leaf, there appears to be a reverse cycle of changes in the internode whose supporting leaf is dead, and the carbohydrates of high molecular weight are slowly reconverted into simple sugars before that portion of the cane becomes perfectly ripe.

The formation of various complex carbohydrates is largely governed, if not entirely, by enzymes controlled by the pH of the substrate. In studying the different stages leading to the formation of sucrose in the sugarcane, it is necessary to study the influence which enzymes exercise over the synthesis of sucrose in particular and of the other carbohydrates in general. Enzymes such as diastase, oxidase, catalase, invertase, are present in the different parts of the sugarcane and the function of these in the economy of sugar production is not clearly known.

Certain peculiarities in the behaviour and degradation of higher carbohydrates may be mentioned here. Cellulose and starch belong to the group of polysaccharides and both can be represented by the general formula $(C_6H_{10}O_5)_n$ and are said to be derived by the polymerisation of glucose. Cellulose, on complete hydrolysis with strong acids, gives rise to glucose, the end product obtained being starch. Cellulose is, however, not a polymer of starch because, on hydrolysis by enzymes, starch gives rise to maltose and on further action by maltase yields glucose. On the other hand, hydrolysis of cellulose by cytases results in the production of cellobiose which is not influenced by the enzyme maltase but cellobiose converts it into glucose. Again sucrose is not influenced by either maltase or cellobiose but by invertase. These substances which are present in the sugarcane are not identical but are brought about by different mechanisms.

The exact processes that lead to the formation and storage of sucrose in sugarcane are of importance in knowing the changes that may come over when sugarcane is exposed to several environmental factors, such as drought, water-logging, lodging, flowering, etc. The work on the formation of sugar in sugarcane will be somewhat on the following lines :—

- (i) Formation and nature of carbohydrates in the leaf and their transport to the stem.
- (ii) The fate of carbohydrates transported to the stem.
- (iii) Carbohydrate gradient in the inner, middle and outer zones of the epidermis.
- (iv) The effect of light with and without manure on the respiratory and assimilatory activities of leaves.
- (v) Enzymes present in different parts of the plant and the effect of fertiliser treatment on catalase and oxidase activities.
- (vi) The nature of carbohydrates in the stem at different stages of growth.
- (vii) *The composition of the cane.*—Sugarcane contains on the average 75 per cent. water and 25 per cent. solid matter. In the mature whole cane 97 per cent. of the solid matter is organic and 3 per cent. is mineral matter. In the top portions of the cane 90 per cent. of the solid matter is organic and 10 per cent. is mineral matter. Of the organic matter about 98 per cent. constitutes sugars and 2 per cent. constitutes non-sugars. The nature of these substances in two or three more important standard varieties of canes will be studied.

Details of Staff

	First year.	Second year.	Third year.	Fourth year.	Fifth year.
	Rs.	Rs.	Rs.	Rs.	Rs.
A senior officer with previous experience in sugarcane work and in the cadre of a gazetted officer in the department, Rs. 200-30/2-280 (40/2-500-50/2-700 new scale).	2,400	2,400	2,760	2,760	3,120
Leave contribution calculated at 12½ per cent. of the pay.	300	300	345	345	390
One assistant on Grade I (Rs. 155-15/2-200, new scale).	1,800	1,860	2,040	2,040	2,220
Leave contribution calculated at 12½ per cent. of the pay.	233	233	255	255	278
One cler.-typist (Rs. 30-3/2-45-2/2-55, new scale).	360	360	396	396	432
Leave contribution calculated at 12½ per cent. of the pay.	45	45	50	50	54
One fieldman (Rs. 30-3/2-48, new scale).	360	360	396	396	432
Leave contribution calculated at 12½ per cent. of the pay.	45	45	50	50	54
One laboratory attendant (Rs. 19-2/2-33, new scale)	228	228	252	252	276
Leave contribution . . .	29	29	32	32	35
Travelling allowance . . .	1,000	1,000	1,000	1,000	1,000
Apparatus and chemicals . . .	1,000	1,000	1,000	1,000	1,000
Other contingencies . . .	500	500	500	500	500
Total for five years . . .	8,360	8,360	9,076	9,076	9,791
Total in round figures . . .	44,663 rounded to 45,000				

SUPPLEMENTARY NOTE, DATED THE 29TH SEPTEMBER, 1933, BY SECRETARY, ON APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF Rs. 45,000 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON THE CHEMISTRY OF SUGARCANE.

In continuation of the note dated the 11th September 1933 on the subject mentioned above, the Government of Madras have since intimated that the Provincial Research Committee at its meeting held on the 2nd September 1933 has recommended the scheme for the consideration of the Council.

ANNEXURE II.

EXTRACTS FROM THE PROCEEDINGS OF THE SIXTH MEETING OF THE SUGAR COMMITTEE HELD AT COIMBATORE ON THE 16TH NOVEMBER 1933.

APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF Rs. 45,000 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON THE CHEMISTRY OF SUGARCANE.

Mr. Ramamurty introduced the subject and emphasised the need to study the physiology, physics and chemistry of sugarcane. At his request Rao Bahadur B. V. Nath explained technical details of the scheme. As an example of the type of chemical

problems to be studied he stated that in nature sugar as well as non-sugars were produced and stored in the sugarcane plant. It was necessary to know how this process went on and what was the effect of various factors on the elaboration of the sugars. Again in the clarification of juice for sugar manufacture special problems arise thus in the open pan system the impurities have to be removed by skimming, whilst under the factory method of operating, the impurities are allowed to settle at the bottom and are then separated by decantation. It was necessary to study the nature of the impurities and the conditions of clarification which will suit the different requirements of the two processes. Mr. Allan referred to the financial side of the scheme and enquired if the leave contributions for the staff mentioned in the Appendix to the scheme would be payable by the Madras Government or by the Research Council. Mr. Ramamurthy explained that the Madras Government had taken objection to paying leave contributions and these would have to be paid by the Research Council. The Chairman pointed out that leave contributions had never figured in estimates of schemes sanctioned by the Research Council.

Mr. Sethi supported the scheme on its merits, but considered it to be expensive. He also referred to the fact that there was no mention anywhere in the scheme of any contribution by the Madras Government. Besides the question of leave contribution which had already been raised by Mr. Allan, he pointed out that the Research Council had decided at one of its previous meetings that clerk-typists should not be allowed in any of its schemes. The present scheme included provision for such a clerk-typist. Finally Mr. Sethi suggested that the cost of apparatus and chemicals and the salary of one assistant in grade I amounting in the aggregate to Rs. 15,020 should be paid by the Government of Madras. Mr. Ramanathan enquired if the scheme was so urgent that it could not wait till the proposed Imperial Sugar Research Institute was started which could then easily handle the work covered by the present scheme.

Mr. Burd strongly supported the scheme and stated that he did not share the view that all research work should be concentrated at the proposed central institute which had already a heavy programme of work. He added that the scheme should be started as quickly as possible. He considered that the conditions for the study of certain aspects of the chemistry of sugarcane were ideal at Coimbatore not only because a large number of varieties and new seedlings were available but because the Chemist and plant-breeder could work in close collaboration. He supported the proposal as a whole and emphasized particularly the necessity for studying the chemical differences of the Cane-Sorghum Hybrids. Rao Bahadur Venkatraman also supported the scheme and considered that Rao Bahadur B. V. Nath would be the most suitable person to carry out this work. He however warned the Committee that this was long range research and a great deal should not be expected immediately in the way of actual results. He considered that the sooner the work was begun the better and added that Coimbatore would be the most suitable place as the largest number of varieties were available there for such studies. Mr. Ramamurthy pointed out that the scheme was of more importance to the whole of India than to the Madras Presidency alone. He also considered that Rao Bahadur B. V. Nath's services should be valued at a high figure. He felt that if Madras Government had to contribute towards the cost of the scheme, the work would be held up and perhaps shelved. The Committee in the end approved the scheme subject to the condition that the question of leave contribution be further discussed with the Madras Government.

APPENDIX XVII.

NOTE DATED THE 9TH JANUARY 1933, BY SECRETARY, ON SUBJECT NO. 17, APPLICATION FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF RS. 6,000 SPREAD OVER A PERIOD OF THREE YEARS FOR A SCHEME OF INVESTIGATION ON THE POSSIBILITIES OF MANUFACTURING KHANDSARI SUGAR BY THE SINGLE-PAN METHOD.

Attention is invited to the enclosed note dated the 4th September 1933 (Annexure I) on the subject mentioned above which was circulated to the Sugar Committee of the Council for consideration at its last meeting held in November 1933. The Committee approved of the scheme in question, *vide* extracts from the proceedings at Annexure II.

The scheme is now for the consideration of the Advisory Board.

ANNEXURE I.

NOTE DATED THE 4TH SEPTEMBER 1933, BY SECRETARY, APPLICATION FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF RS. 6,000 SPREAD OVER A PERIOD OF THREE YEARS FOR A SCHEME OF INVESTIGATION ON THE POSSIBILITIES OF MANUFACTURING KHANDSARI SUGAR BY THE SINGLE-PAN METHOD.

Attention is invited to the attached letter (Enclosure) from the Government of Bihar and Orissa, No. 600-D.R., dated the 28th August 1933, on the subject mentioned above. The scheme involves an expenditure of Rs. 6,000 spread over a period of three years.

The subject is for the consideration of the Sugar Committee.

(Enclosure).

COPY OF A LETTER FROM THE SECRETARY TO GOVERNMENT, EDUCATION AND DEVELOPMENT DEPARTMENT, TO THE SECRETARY TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NO. 600-D.R., DATED THE 28TH AUGUST 1933.

Scheme of investigation on the possibilities of manufacturing Khandsari sugar by the single-pan method.

With reference to your letter No. F-133/33-A., dated the 9th June 1933, I am directed by the Government of Bihar and Orissa (Ministry of Education) to forward herewith a scheme of investigation on the possibilities of manufacturing *Khandsari* sugar by the single-pan method and to say that the scheme has been drawn up by the Director of Agriculture, Bihar and Orissa, and unanimously approved by the Bihar and Orissa Agricultural Research Committee. As explained by the Director of Agriculture, the scheme is of more than provincial importance and promises results which will be valuable throughout India.

2. I am to request that the scheme may be forwarded to the Sugar Committee appointed by your Council, at its sixth meeting which will be held at Coimbatore sometime between the middle of October and the middle of November 1933, for favourable consideration and, if the result be favourable, the scheme may then be submitted to your Council for sanction and allotment of funds.

3. The Director of Agriculture, Bihar and Orissa, is being instructed to forward direct to you 200 printed copies of the scheme at a very early date.

Investigations on the possibilities of manufacturing Khandsari Sugar by the single-pan method.

The indigenous method of manufacturing white sugar from sugarcane commonly known as the *Khandsari* method is so well known that it does not need any detailed description. The two well known systems employed are the "Bhopal" and the "Rohilkhand". Both these methods require the use of complicated furnaces and multiple pans. For the successful operation of these furnaces expert boilers are necessary and a certain amount of extra fuel over and above the bagasse obtained from

cane is always necessary. The initial cost of either method although very much lower than that of the smallest modern plant is yet beyond the resources of the average sugarcane cultivator.

2. The most profitable method of disposing off cane is its sale to a modern factory. All growers of sugarcane are however not so fortunate as to be able to always sell their crops to a mill and a fair proportion of them have to fall back upon the manufacture of gur. This commodity at present sells in Bihar at about Rs. 1-12-0 to Rs. 2 per standard maund. It need hardly be said that this price is very much below the cost of production and the unfortunate cane cultivator who cannot dispose off his crop to a mill is deprived of the benefits of the Sugar Protection Act. The Sugar Technologist of the Imperial Council of Agricultural Research has repeatedly stressed the point that it is more profitable under present conditions to make *Khandsari* sugar even though the recovery be 5 to 6 per cent. only than to make gur. If, therefore, some method of making this sugar could be devised which was capable of being adopted by the small cultivator it would be of considerable benefit to him. With this object in view the Department of Agriculture, Bihar and Orissa, started investigations in the season 1931-32. As a result of the past two seasons' work it has been able to evolve a very simple *Chullah* (furnace) using one pan only. No expert boilers or extra fuel is necessary and the initial expenditure (about Rs. 15 including labour and materials) for the construction of the *Chullah* is well within the means of the smallest cultivator. No other boiling apparatus except what is required in the manufacture of gur is needed and it is possible to produce *Khandsari* sugar without any defectants or bleaching agents. The recovery of *Khandsari* sugar during these preliminary trials has been a little over 5 per cent. The process however requires further work before it can be definitely recommended for adoption. The furnace and the method of scumming, boiling and curing all require perfecting. Owing to its very limited resources in men and money, the Department is unable to pursue this very important work without extraneous help. The cultivation of cane by the small cultivator not being confined to Bihar and Orissa, the subject is of more than provincial interest and help of the Imperial Council of Agricultural Research is therefore sought to continue the investigations. The work is expected to be completed in another 3 seasons and provision has been made accordingly. In view of the importance of the work and the very small grant asked for it is hoped that the Imperial Council of Agricultural Research will consider this very modest scheme favourably.

3. Financial.

A. One Graduate Assistant at Rs. 90—5—100.

B. Contingencies and Boiling and Sugar curing equipment at Rs. 2,500 for 3 years.

The local Government's contribution will consist of the provision of crushing plant, boiling pans, a centrifugal machine and necessary quantity of sugarcane as also the casual labour required for these investigations. All receipts from this work will be credited to the local Government.

Details of 3 years' expenditure

	1st year.			2nd year.			3rd year.		
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
Staff	1,080	0	0	1,140	0	0	1,200	0	0
Contingencies and Equipment.	1,500	0	0	500	0	0	500	0	0
Total	2,580	0	0	1,640	0	0	1,700	0	0

Total for 3 years—Rs. 5,920—Say Rs. 6,000.

(Sd.) D. R. SETHI,

Director of Agriculture, Bihar and Orissa.

The 3rd August 1933.

NOTE.—Expenditure on contingencies and equipment is required for such alterations or additions as may become necessary during the course of the work to the boiling and curing equipment and to furnaces, flues, etc. The Graduate Assistant will work on the chemical control under the instructions of the Agricultural Chemist. When not employed on these investigations he will work at the Sugarcane Research sub-station, Patna.

ANNEXURE II.

APPLICATION FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF RS. 6,000 SPREAD OVER A PERIOD OF THREE YEARS FOR A SCHEME OF INVESTIGATION ON THE POSSIBILITIES OF MANUFACTURING KHANDSARI SUGAR BY THE SINGLE-PAN METHOD.

Mr. Sethi in introducing the subject explained that experiments with the single-pan method of making Khandsari sugar had been conducted by him during the last season and promising results obtained. He now intended to study the subject more scientifically and to introduce further improvements. It was also necessary to improve the fuel consumption beyond that of the existing Bels in which it was found that bagasse was not sufficient for boiling all the juice. For this purpose it was necessary to employ a chemist with some knowledge of sugar making. The present scheme was intended to provide funds for engaging such a chemist and for the cost of equipment and contingencies. He added that the experiments conducted during the last season were seen, amongst others, by the Director of Agriculture, Madras, who agreed that the system had possibilities in the Madras Presidency. A report of the experiments was being published in "Agriculture and Live Stock".

Mr. Ramamurty supporting the scheme stated that he had seen the experiments last season and considered the process to be less costly and tedious than the Rohilkhand or Hadi Bel systems and therefore more likely to be suitable for Madras conditions. Continuing he pointed out that the Rohilkhand Bel was more economical to work, specially in regard to labour, but as under agricultural conditions the grower does not generally take into account the cost of his own labour, the small single pan method will be of advantage to him as it involved small capital expenditure. Khan Bahadur Fateh-ud-din did not consider that there was any necessity for experimenting with the single pan method as there was nothing new about it, the method being extensively used in the United Provinces and the Punjab. He pointed out that the Rohilkhand Bel is used by Khandsaris who are really industrialists. The agriculturist or cane grower in Northern India does not use such a Bel, but only a single pan. Lala Har Sahai Gupta did not agree with Mr. Sethi that the Rohilkhand Bel takes more fuel than can be obtained from the cane used. His experience was contrary to this. He also enquired as to how the Rab made by the small grower by the single pan method would be handled. Generally such men would not be able to afford Centrifugal machines. Finally he opposed the grant as work along similar lines would be done by the Sugar Technologist at the Research and Testing Station which had already been sanctioned. Mr. Srivastava supported the scheme as he considered that the single pan method was important for the small grower. Although work on similar problems would be conducted by him at the Research and Testing Station, he welcomed the co-operation of provincial departments. In reply to a query by Khan Bahadur Fateh-ud-din, Mr. Srivastava explained that the research intended to be carried out would not be in the nature of a scientific investigation, but rather the development of a practical technique and the study of conditions most suitable for reducing the decomposition of sugar and increasing the quality of the finished product. As the total cost of the scheme was small and the subject an important one, he recommended that the scheme should be approved. Mr. Sane also supported the scheme as it would be of importance to the small grower.

Mr. Sethi replying to the discussion explained that the object of the single pan method was to enable the cultivator to make Rab instead of gur without much additional expense. The research work necessary would not be of highly scientific nature. For centrifugalling the Rab, it would not be necessary for each grower to have his own centrifugal machines; he would be working on too small a scale to permit of this. Co-operative Societies and others owning centrifugal would purchase the Rab. If he is able to make Rab of a better quality with the single pan method, he would get better return for it.

The scheme was then put to the vote and carried *nem con.*

APPENDIX XVIII.

NOTE, DATED THE 24TH JANUARY, 1934, BY SECRETARY ON SUBJECT No. 20, SCHEME OF RESEARCH WORK ON THE DEVELOPMENTAL MORPHOLOGY AND ANATOMY OF SUGARCANE-SORGHUM HYBRIDS AND OF THE INDIAN SUGARCANE AND WILD SACCHARUMS COSTING RS. 7,600 SPREAD OVER A PERIOD OF THREE YEARS. NOTE BY PROF. EKAMBARAM (MADRAS UNIVERSITY).

Attention is invited to the attached note (Annexure I) dated the 24th October 1933, on the subject mentioned above, which was considered by the Sugar Committee of the Imperial Council of Agricultural Research at its last meeting held in November 1933. It will be seen from the enclosed extracts from the proceedings of the Sugar Committee (Annexure II) that the scheme was unanimously approved.

The scheme which involves an expenditure of Rs. 7,600 spread over a period of three years is now for the consideration of the Advisory Board. It may be added that the views of the Madras Agricultural Research Committee and the Government of Madras on the scheme have not yet been received. A reminder is being issued for the same and if received in time these will be circulated to the members of the Board in a supplementary note.

ANNEXURE I.

NOTE DATED THE 24TH OCTOBER, 1933, BY SECRETARY, ON SCHEME OF RESEARCH WORK ON THE DEVELOPMENTAL MORPHOLOGY AND ANATOMY OF SUGARCANE—SORGHUM HYBRIDS AND OF THE INDIAN SUGARCANE AND WILD SACCHARUMS—NOTE BY PROF. EKAMBARAM (MADRAS UNIVERSITY).

Attention is invited to the attached note by Prof. T. Ekambaram, Director, University Botanical Research Laboratory, Madras, regarding a scheme for the study of the Anatomy of Sugarcane, Wild Saccharums and Sorghum Sugarcane hybrids. The scheme involves an expenditure of Rs. 7,600 (Rupees seven thousand and six hundred only) spread over a period of three years. The Scheme is, as usual, being submitted to the Council through the Madras University and the Government of Madras, with their views and those of the Provincial Research Committee. Meanwhile, the advance copy of the scheme is for the consideration of the Sugar Committee.

SCHEME FOR THE STUDY OF THE ANATOMY OF SUGARCANE, WILD SACCHARUMS AND SORGHUM SUGARCANE HYBRIDS.

Very detailed studies have been made by different workers on the variations in the external morphological characters in the different varieties of sugarcane and the cane-hybrids. Recently a comparative study of these characters was made in the wild-Saccharums and the indigenous canes in the Botany Department of this University and the results are embodied in a paper sent for publication in the Indian Journal of Agricultural Science. But so far anatomical studies of either the canes or their hybrids have not been carried out in India. Such studies have now become more imperative because of the importance of the fibre factor in the canes under cultivation. So far there is no information as to the inheritance of Anatomical characters in the canes. It would have been a very difficult task to have acquired any tangible results as to the inheritance of anatomical characters as long as hybridisation in sugarcane was confined to varieties. Now with sugarcane-sorghum hybrids such a study is more promising. A preliminary investigation of the anatomy of a few hybrids has shown a wide variation of structure between the parents and the hybrids. It is expected that a detailed study will reveal the lines of segregation of anatomical characters and probably the linkage between the external and the internal characters.

There is very little knowledge at present as regards the inheritance of anatomical characters in any group of plants. The importance of such a knowledge on the side of pure science is great. Its importance on the economic side is also great, since this knowledge will be of value in the breeding of sugarcane.

If the grant asked for is received, it is intended to take up the following programme of research :—

1. A study of the development of the tissues of the seedlings of sugarcane, the wild Saccharums and the Sorghum-Sugarcane hybrids.

2. A study of the adult anatomy of the above with a view to gain a knowledge of the inheritance of anatomical characters.

The work will be carried out under the supervision of the University, in its Department of Botany. The necessary laboratory equipment will be provided by the University. It will be necessary to obtain material for study from the Imperial Sugarcane Station at Coimbatore, and the co-operation of the Imperial Department of Agriculture and the Sugarcane-Expert will be sought for facilities for the supply of material and for any studies on the spot.

The grant asked for is in round figures Rs. 7,600 spread over a period of three years.

Details of cost.

	Rs.
1. One research worker on Rs. 100 (1st year), Rs. 125 (2nd year), Rs. 150 (3rd year)	4,500
2. One peon on Rs. 16 (1st year), Rs. 17 (2nd year), Rs. 18 (3rd year)	612
3. Contingent expenses at Rs. 350 per year	1,050
4. T. A. for the Superintendent at Rs. 500 per year for visiting the Impl. Sugarcane Station, Coimbatore	1,500
5. T. A. for the research worker at Rs. 300 per year for visiting the Impl. Sugarcane Station, Coimbatore	900
Total	<u>7,562</u>

ANNEXURE II.

EXTRACTS FROM THE PROCEEDINGS OF THE SIXTH MEETING OF THE SUGAR COMMITTEE HELD AT COIMBATORE ON THE 16TH NOVEMBER, 1933.

5. Scheme for research work on the developmental Morphology and Anatomy of Sugarcane-Sorghum hybrids and of the Indian Sugarcane and Wild Saccharums—Note by Professor Ekambaram (Madras University) :—

After Mr. Ramamurty had introduced the subject, Rao Bahadur Vekatraman stated that he had been in close touch with Dr. Ekambaram's work and considered that the scheme was an extremely useful one. He would himself have undertaken work on these lines if he had the necessary time. He also considered that University would be in a better position to give attention to general problems of this type. He recommended the scheme on the distinct understanding that the work should be carried on directly under Dr. Ekambaram, as in such cases the choice of the person directing the work is of great importance. Rao Bahadur B. Viswanath said that at Padegaon the physiology of sugarcane was under study but that no provision has so far been made for systematic anatomical investigations on sugarcane. In the absence of this, structure had to be assumed in physiological mechanistic explanations. With new creations like sorghum-hybrids, such assumptions might not be valid and it would be necessary to ascertain the structure of each part for a correct understanding of the physiological relations that determine and maintain structure. He therefore supported the scheme. Dr. McRae referred to the importance of a better understanding of the factors which determine the standing power of a cane. He informed the committee that the Director of Pusa was already committed to supply material of cane seedlings from the Sugarcane Breeding Station, Coimbatore to the Professor of Botany, Benares Hindu University for a study of the vascular anatomy of sugarcane. There was room for both research workers in the investigation of the anatomy of the sugarcane. Accordingly he strongly supported the scheme which was unanimously approved.

APPENDIX XVIII-A.

SUPPLEMENTARY NOTE, DATED THE 7TH FEBRUARY 1934, BY SECRETARY, ON SUBJECT No. 20.—SUPPLEMENTARY NOTE ON SCHEME OF RESEARCH WORK ON THE DEVELOPMENTAL MORPHOLOGY AND ANATOMY OF SUGARCANE SORGHUM HYBRIDS AND OF THE INDIAN SUGARCANE AND WILD SACCHARUMS COSTING RS. 7,600 SPREAD OVER A PERIOD OF THREE YEARS—NOTE BY PROFESSOR EKAMBARAM (MADRAS UNIVERSITY).

In continuation of the note, dated the 27th January 1934, circulated to the Advisory Board on the subject mentioned above, the Government of Madras have since intimated that "the Provincial Agricultural Research Committee by a majority approve of the scheme. The Local Government regret, however, that they are unable to recommend it as they consider that the scheme is almost entirely of academical interest and one which the University should conduct at its own expense. They are of opinion that the funds of the Imperial Council of Agricultural Research should not be diverted to research of purely scientific interest when a large volume of work of immediate practical value remains to be done."

2. The Government of Madras do not appear to have been informed of the bearing of this research on the 'Standing Power' of sugarcane and the new cane-sorghum hybrids—a point of great practical importance. This is referred to in detail in the proceedings of the Sugar Committee enclosed with the earlier note on the subject.

APPENDIX XIX.

NOTE, DATED THE 24TH JANUARY 1934, BY SECRETARY ON SUBJECT No. 21.—PARTICIPATION OF INDIA IN THE ANNUAL CONGRESS OF THE ROYAL INSTITUTE OF PUBLIC HEALTH TO BE HELD AT NORWICH FROM 15TH TO 20TH MAY 1934.

Attention is invited to the attached letter (annexure) from the Government of India, Education, Health and Lands Department, to all the Local Governments, No. F.25-11/33-G., dated the 28th December 1933, a copy of which was endorsed to the Imperial Council of Agricultural Research Department (Annexure), regarding the Congress of the Royal Institute of Public Health to be held in the City of Norwich from the 15th to 20th May 1934. At this Congress subjects relating to Veterinary Medicine and Agriculture will be discussed and it is for the consideration of the Advisory Board whether India should participate in this Congress from the Veterinary and Agriculture side.

ANNEXURE.

COPY OF LETTER FROM THE ADDL. DEPUTY SECRETARY TO THE GOVERNMENT OF INDIA, E., H. & L. DEPT., TO ALL LOCAL GOVERNMENTS, NO. F.25-11/33-G., DATED THE 28TH DECEMBER 1933.

SUBJECT:—*Congress of the Royal Institute of Public Health to be held in the City of Norwich from the 15th to the 20th May 1934.*

I am directed to forward, for information, a copy of a letter No. G.52791/137-1-13, dated the 28th November 1933, from the High Commissioner for India, with enclosures (Enclosure) and to enquire whether the Government of Madras/ Bombay, etc., desire to depute, at their own expense any public health officer to attend the next annual Congress of the Royal Institute of Public Health to be held in the City of Norwich from the 15th to the 20th May 1934. The Government of India will be glad to be furnished, not later than the 15th February 1934, with the names of officers, if any, whom it is desired to depute, with the terms to be granted to them, for communication to the High Commissioner for India.

COPY OF LETTER NO. G.52791/137-1-13, DATED THE 28TH NOVEMBER 1933, FROM THE SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, GENERAL DEPARTMENT, LONDON, TO THE GOVERNMENT OF INDIA, DEPARTMENT OF EDUCATION, HEALTH AND LANDS, NEW DELHI.

SUBJECT:—*Congress of the Royal Institute of Public Health to be held in the City of Norwich from the 15th to the 20th May 1934.*

I am directed by the High Commissioner for India to refer to the correspondence resting with your letter No. F.25-1/32-G., dated the 11th April last, on the subject of the 1933 Congress of the above-mentioned Institute, and to forward herewith, for the information of the Government of India, a copy of the under-noted papers relating to the Congress to be held in 1934.

From Royal Institute of Public Health, dated 22nd November, with enclosure.

2 I am to ask that the names of such delegates to the 1934 Congress as the Government of India or Local Governments and Administrations may desire to appoint, may be communicated to this Office in due course. It is presumed that the High Commissioner will be informed at the same time of the terms granted to those nominated to attend.

COPY OF LETTER FROM THE ROYAL INSTITUTE OF PUBLIC HEALTH, LONDON, TO THE HIGH COMMISSIONER FOR INDIA, LONDON, NO. G.52791/137-1-10, DATED THE 22ND NOVEMBER 1933.

I have the honour to inform you that the next annual Congress of the Royal Institute of Public Health will be held in the City of Norwich from Tuesday, May 15th, to Whit-Sunday, May 20th, 1934, on the invitation of the Lord Mayor and Corporation; and under the Presidency of Alderman Henry N. Holmes, J.P., Ex-Lord Mayor of Norwich.

The Inaugural Meeting will be held on the morning of Tuesday, May 15th, and the scientific work of the Congress will be conducted in the following Sections :—

Section I. "State Medicine and Industrial Hygiene".

Section II. "Women and Children and the Public Health".

Section III. "Tuberculosis".

Section IV. "Veterinary Medicine and Agriculture".

Section V. "Pathology and Bacteriology".

To this Congress, delegates are being invited from the Governments, the Municipalities, the Universities, and other Public Bodies of Great Britain and Ireland and the British Dominions, as well as from Continental and Foreign Countries.

The Council will be obliged if you will obtain the necessary authority for the appointment of delegates to represent your Dominion, to whom will be forwarded full particulars when finally arranged, and I shall be glad if you will be so good as to cause a return on the accompanying form, giving the names and addresses of those so appointed, at your earliest convenience.

APPENDIX XX.

NOTE, DATED THE 23RD JANUARY 1934, BY SECRETARY ON SUBJECT No. 22.—APPLICATION FROM THE INTERNATIONAL INSTITUTE OF AGRICULTURE, ROME, FOR A SPECIAL CONTRIBUTION FOR THE PUBLICATION OF THE RESULTS OF THE WORLD AGRICULTURAL CENSUS.

Attention is invited to the attached letter from the President, International Institute of Agriculture, Rome, No. 14100, dated the 4th May 1933 (Annexure I) on the subject mentioned above.

2. It may be explained that the Government of India agreed to participate in the Institute's scheme for the World Agricultural Census and arrangements were made for the supply to the Institute of all the available information in respect of this country. It will be observed from paragraph 3 of the letter of the President of the Institute, dated the 4th May 1933 (Annexure I) and the note on the results of the World Agricultural Census referred to therein (Annexure II) that a large number of countries including India considered the scheme favourably and have already supplied or are at present working out the results of the census.

It may be added that the International Institute is already spending about a million lire (say Rs. 2 lakhs) per annum on its statistical section which seems to be largely occupied with the World Agricultural Census but additional technical staff is needed for some two or three years in order to speed up the work. It appears that to make any impression on the task in question the Institute wants something like 250,000 lire per annum for say three years. It seems that a 10 per cent. surcharge on all subscriptions for a period of three years might be the solution; this would cost the Council about £65 per annum. It is accordingly suggested that India might offer to pay such a surcharge if a reasonable number of other countries agreed to do something similar. If the Advisory Board favours this course, it is proposed that an enquiry should first be made from the High Commissioner for India in London, who is the representative of the Government of India on the Permanent Committee of the Institute on the suitability of such a proposal. The Vice-Chairman to the Council considers that unless some such effort is made, the results of the World Agricultural Census will largely be wasted.

The proposals are now for the consideration of the Advisory Board.

ANNEXURE I.

LETTER FROM THE PRESIDENT, INTERNATIONAL INSTITUTE OF AGRICULTURE, ROME, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH DEPARTMENT, No. 14100, DATED ROME, THE 4TH MAY 1933.

I desire to call your special attention to points Nos. 3 and 4 in Resolution No. 8 of the Eleventh General Assembly of the International Institute of Agriculture held in October last, which are worded as follows :—

"The General Assembly * * * resolves : * * *

"(3) to request the Permanent Committee, in view of the fundamental importance of the Agricultural Census, to use every endeavour to obtain the financial resources necessary to ensure as speedy a publication as possible of the results of the Agricultural Census.

"(4) to request the Permanent Committee to give every priority to the completion of the publication of the results of this most valuable World Agricultural Census, if and when the supplementary funds contemplated under letter (b) of No. 4 of Resolution I become available for the expenditure of the Institute".

Letter (b) of point 4 of Resolution No. 1, to which allusion is made above, has reference to any receipts which the Institute may realize in excess of the sum of 4,000,000 liras, the maximum sum allowed for the Budget by the General Assembly.

2. You are aware that the International Institute of Agriculture, with the assistance of all the Governments and with the aid also of sums expressly assigned for the purpose by the "Rockefeller Foundation" and by the United States Government, made all arrangements for carrying out a World Agricultural Census, intended to supply as complete, accurate and uniform a documentation as possible on the agricultural situation in the individual Countries and in the world as a whole.

3. The information supplied in Annex. I to the Report on the Services and Administration of the Institute, presented by the General Secretary to the last meeting of the General Assembly, of which a copy was sent to you at the time,

shows that this movement was most favourably received in a large number of Countries, which have already supplied or are at present working out the results of the Census.

4. Now in accordance with the original programme, as shown in the document quoted, these results should be published by the Institute, Country by Country, in accordance with a uniform plan, in the form of special Bulletins, with the object of making known and facilitating the comparison of the data received. It was intended thereafter to prepare general reports on each of the principal subjects covered by the Census based on the information obtained in the various Countries.

5. Up to the present it has only been possible to publish the two first bulletins of the series (for the Irish Free State and for Estonia), and the character of the task still to be accomplished is so complex and the amount of detailed work so heavy, that there is no hope that the programme can be completed within reasonable time, unless considerable supplementary resources for this special purpose can be made available for the Institute.

6. The situation thus seems to be very hazardous for the final issue of an undertaking of the highest importance, to which all Countries have made their contribution, while it is a matter of deep concern to all that it should be fully accomplished.

7. Hence the General Assembly in 1932, to which the question was referred, resolved to "request the Permanent Committee, in view of the fundamental importance of the Agricultural Census, to use every endeavour to obtain the financial resources necessary to ensure as speedily a publication as possible of the results of the Agricultural Census."

8. The Permanent Committee, after ascertaining that the financial position of the Institute did not allow an allocation of funds for this purpose in any way commensurate to the programme to be carried out, considered that it would be desirable to approach the Governments specially interested, with the request that they should consider whether they could not assist in furthering the work by making special contributions for the purpose.

9. I am therefore now asking your Government, and at the same time the Governments of other Countries, that you will kindly consider to what degree it may be able to assist in providing the funds required for the preparation and publication by the Institute of the results of the World Agricultural Census, in order that this international enquiry may provide all the advantages which were to be anticipated therefrom in the general interest, advantages which the Institute had in view when proposing that the Census should be carried out in each Country.

10. I should be glad to think that your Government, which has always displayed so much interest in the activities of the Institute, therein included the World Agricultural Census, may be willing to view the above statement with favour and to consider the possibility of making a special grant, the amount to be at your own discretion, in order to make properly effective all the work involved in the Census scheme.

ANNEXURE II.

A. G. 1932/No. 2/L

International Institute of Agriculture.

XIth GENERAL ASSEMBLY.

(17 October 1932.)

ANNEX TO THE SECRETARY GENERAL'S REPORT ON THE SERVICES AND ADMINISTRATION OF THE INSTITUTE

Note on the results of the World Agricultural Census.

I.—GENERAL REMARKS.

(1) In this report it is proposed to make known how many countries, having consented to co-operate with the Institute in this work, have actually participated in the world agricultural census and at the same time to outline the methods employed in the collection of the data, the nature of the latter and the stage arrived at, at present in the work of their elaboration and publication.

In this respect a brief note may be found for each country on and after page 11.

It has been deemed useful however to precede this analytical examination by a general review of the results of the world agricultural census and also by some information on the work recently accomplished by the Bureau of Statistics in connection with the census and its programme for the future continuation of the work.

(2) According to the information communicated to the Institute, 62 countries⁽¹⁾ have participated in the world agricultural census by carrying out a complete census, by making special inquiries or by attempting to obtain and furnish the Institute with information, for the census year, more complete and exact than that normally available.

The countries are distributed among the different parts of the world as follows:—

Europe	22
North America	4
Central America	8
South America	5
Asia	6
Africa	11
Oceania	6
	<hr/>
	62

The area and total population of the countries having participated in the world agricultural census represent more than half of the total area and population of the world; if China and the U. S. S. R. are excluded, the census covers about $\frac{2}{3}$ of the remaining area of the world.

(3) A distinction between the countries which have carried out a complete census and those which have otherwise contributed to the world agricultural census, can only be made on the basis of approximate criteria.

If, as census data, are considered only those obtained exclusively or principally by making records for each farm (independently of the method of record adopted), the countries which have carried out a complete census number 44, namely: 21 in Europe: (Albania, Austria, Belgium, Czechoslovakia, Denmark, Estonia, Finland, Germany, Great Britain and Northern Ireland, Greece, Iceland, Irish Free State, Italy, Latvia, Lithuania, Netherlands, Norway, Rumania, Spain, Sweden, Switzerland); 4 in North America (Alaska, Canada, Mexico, United States); 4 in Central America (American Virgin Is., Barbadoes, Guatemala, Puerto Rico); 2 in South America (Chile, Uruguay); 1 in Asia (Ceylon); 7 in Africa (Egypt, Kenya, Mauritius, Mozambique, Seychelles, Swaziland, Union of South Africa); 5 in Oceania (American Samoa, Australia, Guam, Hawaii, New Zealand).

It should be observed that there might be included in the same group some other countries which have followed a different method adopting as basis instead of the farm, the commune or other administrative unit, but where the inquiry carried out may, due to its scope, object and regulations, be considered as a census.

For Argentina, India and Japan, the census, which was not carried out on the basis of the farm but for the whole of the country, covered, however, a more restricted programme. In fact, in Argentina it was carried out only for livestock; in India for livestock, agricultural machinery and means of transport; in Japan, for the areas cultivated and their distribution according to the main crops and to the status of the farmer (proprietor or tenant farmer).

Lastly, a certain number of countries have communicated data, collected specially for the purposes of the agricultural census, which have been obtained through approximate estimates made by the administrative authorities. These are colonial countries in which the local conditions would not have permitted an actual census but which desired to participate in this initiative of the Institute as far as they could. The list is as follows: *Central America*: Bahamas, Leeward Is., Windward Is., *South America*: Falkland Is.; *Asia*: Lebanon Republic, Malaya, Sarawak; *Africa*: French West Africa, Nigeria, Nyasaland; *Oceania*: British Is. of the Western Pacific.

It may be added that certain countries (Brazil, Bulgaria, Hungary, Poland), had decided to participate in the world agricultural census and had accomplished the necessary studies and preparatory work but were obliged, at the last moment, to abandon the project for financial or other urgent reasons.

(4) The question of the date of the world agricultural census has been discussed at length during the work of the different commissions which prepared the programme. It was finally decided that the census in the northern hemisphere should refer to crops harvested in the calendar year 1929 and in the southern hemisphere to those during the season 1 July 1929 to 30 June 1930. As regards the actual date, or the

⁽¹⁾Including the colonies, but considering as a single unit certain groups of colonies such as the British Islands of the Western Pacific, British Malaya, French West Africa, the Leeward Is. and the Windward Is.

period of the year at which the census should be carried out, it was considered advisable to leave each country free to choose the period which appeared to be the most convenient.

The crop data collected refer, in nearly all the countries in which the census has been taken, to periods recommended by the Institute.

The chief exceptions to be noted are : Germany where the census had already been taken in 1925 ; Sweden, where it had been accomplished in 1927, so that the figures for these two countries refer to crops harvested in 1925 and 1927 respectively ; Canada, Czechoslovakia, Lithuania and the Netherlands, the data for which refer to crops harvested in 1930. It should, however, be remarked : (1) that these differences cannot, to any considerable degree, affect the comparability of the results of the censuses as far as concerns most of the questions considered, for which important changes in short periods are improbable ; (2) that in some cases, the countries themselves are to a certain extent in a position to complete the results of their censuses with other data referring to the year of the world agricultural census.

The periods at which the censuses have actually been taken vary owing to the special conditions existing in the different countries and to the nature of the questions considered.

As regards the latter point, there may be distinguished two principal groups : on the one hand, the countries which have limited the census of crops to the data of area and on the other, those which have sought to obtain also the data of production, the former have in general carried out the census in the spring or at the beginning of the summer and the latter, in the winter or during the following spring.

For a series of countries the periods at which the census was taken are as follows : *June 1929* : Estonia, Great Britain and Northern Ireland, Irish Free State, Norway ; *July 1929* : Denmark, Latvia ; *August 1929* : Switzerland ; *September 1929* : Ceylon, Japan ; *October 1929* : Alaska ; *end of 1929 or beginning of 1930* : Belgium, France, Greece, Barbadoes, India, Mauritius, Seychelles, Australia ; *March 1930* : Italy, Algeria ; *April 1930* : Iceland, Rumania, United States, Guatemala, Virgin Islands, Puerto Rico, Guam, Hawaii, Samoa ; *May 1930* : Mexico, Uruguay ; *June 1930* : Austria, Chile ; *July 1930* : Argentina ; *August 1930* : Kenya ; *September 1930* : Swaziland, Union of South Africa ; *November 1930* : Mozambique.

Among the countries for which the figures do not refer to the crops harvested in 1929, Germany carried out its census in June (1925) ; Sweden in September (1927) ; Czechoslovakia in May (1930) ; the Netherlands in June (1930) ; Lithuania at the end of 1930 and Canada in June (1931).

In Egypt, the census was taken at three different periods—those of the spring, summer and autumn crops respectively. In Spain also, the declaration forms were filled in by the farmers at four different dates. In New Zealand a large part of the census was effected in February 1930, but the data relating to certain questions were obtained some months before or after this period.

(5) With respect to the questions considered under the census in different countries, it is evidently impossible, in this general and preliminary report, to make an examination in full detail. The following synopsis table on page 10 however, throws into relief the principal groups of questions inserted in the questionnaires of the different countries which have carried out the census.

The table is limited to the groups of questions taken into consideration, in most of the censuses ; other separate questions have also been inserted in the questionnaires of the agricultural censuses of certain countries : buildings, silos, liquid manure pits, green-houses, etc., on the farm ; rural industries attached to the farm and their plant ; land improvement in recent years ; fresh water fish ; rearing and losses of livestock ; principal profession and secondary profession of the operator, his nationality, country of origin, membership of co-operative societies, etc. ; farm population, value of the farm and its products, operation expenses, farm indebtedness, etc. In some of the countries which, after the war, introduced agricultural reform, the census questionnaire also included special questions intended to determine the effects of the reform on the farm situation.

(6) Even if the scope of the census has varied in the different countries, it may be stated that there have been included, in nearly every case, the essential questions recommended in the standard form of the International Institute of Agriculture and notably the following questions : size of the farm ; tenure ; distribution of area according to the main groups of utilisation ; area under the different crops ; farm implements ; number of livestock ; farm labour.

It may be added that in general, as regards both these fundamental groups of questions and also the other supplementary questions furnished in the Institute's

standard form, the countries have endeavoured as far as possible to keep to the classifications and indications recommended.

It has, inevitably, not been possible in this first attempt at a world agricultural census, to obtain a complete unification of all the details. The results obtained in this direction constitute, however, a progress of the greatest importance, surpassing even the most optimistic expectations.

(7) Owing to the large amount of work involved in the checking, analysis and elaboration of the material, the complete and final publication of the results of a census cannot generally be effected as promptly as might be desired.

In certain cases, financial difficulties have also contributed to hinder the work.

This explains why, at present, final and complete results of the agricultural census are available for only a relatively restricted number of countries. For other countries publication is limited to preliminary data of the summary type or to partial data. Further, for some countries no data has so far been published.

Under these circumstances, it would be premature to attempt to summarise the principles followed by the different countries in the elaboration of the census results.

As regards the latter point, the Institute has limited itself to recommending the grouping to be adopted in the classification of farms according to area. The commission of statisticians which, at the period of preparatory work for the world agricultural census, studied the question of the elaboration of results, did not consider it opportune at this first attempt, to make resolutions on the other details.

On the basis of the data already published, it may be stated that some countries have made a very complex elaboration of the census material by grouping all the data according to farm area, to tenure or to a combination of both of these factors; others, on the contrary, have neglected these groupings or combinations or have used them only for some of the most important data.

(8) All of the information now available on the world agricultural census, justifies the conclusion that this initiative of the Institute has been remarkably successful. It is the first time in the history of the world that an attempt has been made to bring about an agreement among a large number of countries for the simultaneous carrying out of a census on a uniform basis. The results demonstrate that, despite the difficulties of the task it has been possible to make this agreement an actual fact; and that important results have actually been obtained and the ground prepared for future developments and improvements as the census is to be renewed periodically.

The International Institute of Agriculture has the credit for this achievement and also that of having constituted the centre for the preparatory activity necessary to lead this work to a successful end but, evidently, the Institute could not restrict itself to the performance of this work of preparation and organisation. It is the organisation specially interested in utilising the census results and in using them to furnish a better knowledge of the world agricultural situation as well as in the gradual perfection of agricultural statistics in general.

The work accomplished by the Institute in relation to the world agricultural census since the last General Assembly may be summarised as follows:—

- (a) It has endeavoured to complete and to keep up to date its documentation on the agricultural censuses taken in the different countries by obtaining from each of them the questionnaires and forms employed, the instructions followed and information on the stage at present arrived at in the work and on the results available;
 - (b) It has begun the methodological study of this documentation;
 - (c) It has utilised the data furnished by the census—as far as they come within the scope of the International Yearbook of Agricultural Statistics and the Monthly Crop Report—by reproducing them in these publications;
 - (d) It has studied and evolved a uniform plan for the publication of the results of the censuses in special bulletins for the purpose of making widely known and facilitating comparisons of the data obtained in each country;
 - (e) It has begun the publication of the first bulletins of the world agricultural census, edited as far as possible according to this plan, in two editions (French and English).
- (9) The continuation and development of the work thus begun will form one of the most important tasks of the Bureau of Statistics in the near future.

The programme of work is:

- (a) to continue the preparation of the bulletins of the agricultural census. Some countries have just recently published their data; others are about

to publish them. Consequently, a large amount of material, is now, or shortly will be, available. The work of utilising it along the lines of the fixed plan should be intensified in order that the bulletins for these countries may be issued as quickly as possible.

- (b) to continue and deepen the detailed examination of the documentation in order to obtain a series of comparative studies on the methods followed and the principles adopted by the different countries in the preparation of the questionnaires, in the taking of the census, in the analysis of the data and in the elaboration of the results. These studies will serve as basis for the exact interpretation of the census results and, at the same time, in providing a summary record of the experiences of the first world agricultural census, will furnish a valuable aid in the preparation of future censuses;
- (c) to attempt to furnish, for each of the principal questions considered in the census, a general summary compiled from the data published by the different countries.

The execution of this programme involves a large amount of work which alone would suffice to completely occupy the Bureau of Statistics for a long period of time. As the staff of the latter Bureau has, at the same time, other urgent tasks to perform, unless financial conditions permit it to be afforded supplementary assistance for this special purpose, it will not be in a position to fulfil the programme proposed with the desired rapidity.

But in any case the Bureau of Statistics should and will make the greatest efforts possible to arrive at a complete utilisation of the results of the world agricultural census and to derive full value from this initiative, the realisation of which constitutes one of the most important successes of the Institute and a unique achievement in the field of international statistics.

SUMMARY TABLE INDICATING THE COUNTRIES WHICH HAVE INCLUDED
IN THEIR QUESTIONNAIRES CERTAIN GROUPS OF QUESTIONS
FREQUENTLY CONSIDERED IN AGRICULTURAL CENSUSES.

(x signifies that the questionnaire of the country considered

Country.	Farm Area.	Tenure.	Main groups of land utilization.	Area of the different crops	Number of fruit trees.	Production of the principal crops.	Special information on		Improvements.	
							Horticulture.	Forests.	Irrigation.	Drainage.
Albania	x	x	x	x	x	x	..	..	..	..
Austria	x	x	x	x	x	..	..	x	..	..
Belgium	x	x	x	x	..	..	x	x	..	..
Czechoslovakia	x	x	x	x	..	..	x	x	x	x
Denmark	x	..	x	x	x	..	x	..	..	..
Estonia	x	x	x	x	x	..	x	..	x	x
Finland	x	x	x	x	x	x	..	..	..	x
France	x	x	x	x	x	x	x	x	..	..
Germany	x	x	x	x	x	..	..	..	..	..
Great Britain and Northern Ireland :--										
<i>England and Wales</i>	x	..	x	x	..	..	..	..	..	..
<i>Northern Ireland</i>	x	..	x	x	..	..	..	..	..	..
<i>Scotland</i>	x	x	x	x	..	..	..	..	..	..
Greece	x	x	x	x	x	x	..	..	x	..
Iceland	x	x	x	x	..	x	..	..	..	..
Irish Free State	x	x	x	x	x	..	..	..	..	..
Italy	x	x	x	x	x	x	x	x	x	x
Latvia	x	x	x	x	x	..	..	..	..	x
Lithuania	x	x	x	x	x	x	..	..	..	..
Netherlands	x	x	x	..	..	..	..	..	..	..
Norway	x	x	x	x	x	..	..	..	..	x
Rumania	x	x	x	x	x	x	..	..	..	..
Spain . . . . .	..	..	..	x	x	..	x	..	x	..
Sweden	x	x	x	x	x	..	..	..	..	x
Switzerland	x	x	x	x	x	..	x	x	..	..

includes the group of questions mentioned in the heading).

Motive power.	Equipment.			Fertilisers.	Number of livestock.	Poultry-rearing.	Bee-keeping.	Sericulture.	Livestock products.	Farm labour.	Country.
	Agricultural machinery.	Means of transport.									
..	x	..	..	..	x	x	x	..	..	..	Albania.
x	x	..	..	..	x	x	x	..	..	x	Austria.
x	x	..	x	x	x	x	x	..	..	x	Belgium.
x	x	..	..	x	x	x	..	..	..	..	Czechoslovakia.
..	..	..	..	..	x	x	x	..	..	..	Denmark.
x	x	x	x	x	x	x	x	..	..	x	Estonia.
x	x	..	x	x	x	x	x	..	x	..	Finland.
x	x	..	..	x	x	x	x	x	x	x	France.
x	x	..	..	x	x	..	..	..	..	x	Germany.
..	..	..	..	..	x	x	..	..	..	x	Great Britain and Northern Ireland :—
..	..	..	..	..	..	..	..	..	..	x	England and Wales
..	..	..	..	..	x	x	x	..	..	x	Northern Ireland.
..	..	..	..	..	x	x	..	..	..	x	Scotland.
..	x	..	..	..	x	x	x	x	x	x	Greece.
..	x	..	..	..	x	x	..	..	x	x	Iceland.
..	x	x	..	..	x	x	x	..	..	x	Irish Free State.
x	x	x	..	..	x	x	x	x	x	x	Italy.
x	x	x	x	x	x	x	x	..	..	x	Latvia.
x	x	x	x	x	x	x	x	..	..	x	Lithuania.
..	..	..	..	..	x	x	x	..	..	..	Netherlands.
x	x	..	x	x	x	x	x	..	..	x	Norway.
..	x	..	..	..	x	x	x	x	x	x	Romania.
x	x	..	x	x	x	x	x	x	x	..	Spain.
..	..	..	..	..	x	x	x	..	..	..	Sweden.
x	x	..	..	..	x	x	x	x	..	x	Switzerland.

Country.	Farm Area.	Tenure.	Main groups of land utilization.	Area of the different crops.	Number of fruit trees.	Production of the principal crops.	Special information on		Improvements.	
							Horticulture.	Forests.	Irrigation.	Drainage.
Alaska	x	x	x	x	x	x	x	...	...	...
Canada	x	x	x	x	...	x	...	x	...	...
Mexico	x	x	x	x	x	x	...	x	x	...
United States	x	x	x	x	x	x	x	x	x	x
Barbadoes . . . . .	...	...	x	x	...	x	...	...	...	...
Guatemala	x	...	...	x	...	x	...	...	...	...
Puerto-Rico	x	x	x	x	x	x	x	...	...	...
Virgin Is. (American)	x	x	x	x	x	x	x	...	...	...
Argentina . . . . .	...	...	...	...	...	...	...	...	...	...
Chile	x	x	x	x	x	x	x	x	x	...
Peru . . . . .	...	...	x	x	...	x	...	...	...	...
Uruguay	x	x	x	x	x	x	...	x	x	...
Ceylon (1)	x	...	...	x	...	x	...	...	...	...
India . . . . .	...	...	...	...	...	...	...	...	...	...
Japan . . . . .	...	x	x	...	...	...	...	...	...	...
Algeria	x	...	x	x	x	x	x	...	...	...
Egypt	x	x	x	x	x	...	x	...	...	...
Kenya (1)	x	...	x	x	x	x	...	x	...	...
Mauritius	x	...	x	x	...	x	...	x	...	...
Mozambique (1)	x	x	x	x	...	x	...	x	x	x
Seychelles	x	x	x	x	x	x	...	x	x	...
Swaziland	x	...	...	x	...	x	...	x	x	x
Union of South Africa	x	x	x	x	x	x	...	x	x	...
Australia	x	...	x	x	...	x	...	...	x	...
Guam . . . . .	...	...	...	x	...	x	...	...	...	...
Hawaii	x	x	x	x	x	x	x	...	...	...
New Zealand	x	x	x	x	...	x	x	x	x	...
Samoa (American) . . . . .	...	...	...	x	x	x	...	...	...	...

(1) The census is limited

Equipment.			Fertilizers.	Number of livestock.	Poultry-rearing.	Dye-keeping.	Sericulture.	Livestock's products.	Farm labour.	Country.
Motive power.	Agricultural machinery.	Means of transport.								
..	..	..	..	x	x	..	..	x	..	Alaska.
..	..	..	..	x	x	..	..	x	..	Canada.
..	x	x	..	x	x	x	..	x	x	Mexico.
x	x	x	..	x	x	x	..	x	..	United States.
..	..	..	x	x	x	..	..	..	x	Barbadoes.
x	x	..	..	x	x	x	..	x	..	Guatemala.
..	x	x	..	x	x	x	..	x	..	Puerto-Rico.
..	..	..	..	x	x	x	..	x	..	Virgin Is. (American).
..	..	..	..	x	x	..	..	..	..	Argentina.
x	x	x	x	x	x	x	..	x	x	Chile.
..	..	..	..	x	..	..	..	x	x	Peru.
x	x	x	..	x	x	x	x	x	x	Uruguay.
..	..	..	..	x	..	..	..	..	..	Ceylon (1).
..	x	x	..	x	..	..	..	..	..	India.
..	..	..	..	..	..	..	..	..	..	Japan.
..	x	..	..	x	x	x	x	x	x	Algeria.
..	x	..	..	x	x	x	..	..	..	Egypt.
x	x	x	..	x	x	..	..	x	x	Kenya (1).
..	x	..	..	x	x	..	..	x	x	Mauritius.
..	x	..	..	x	..	..	..	..	x	Mozambique (1).
..	..	..	x	x	x	x	..	x	x	Seychelles.
..	x	..	x	x	..	..	..	x	x	Swaziland.
x	x	..	x	x	x	..	..	x	x	Union of South Africa.
..	..	..	x	x	..	x	..	x	..	Australia.
..	..	..	..	x	x	..	..	..	..	Guam.
..	x	x	..	x	x	x	..	x	x	Hawaii.
x	x	..	x	x	..	..	..	x	x	New Zealand.
..	..	..	x	x	x	..	..	..	..	Samoa (American).

to non-native farms.

II.—INFORMATION FOR THE DIFFERENT COUNTRIES.

1. *Alaska*.—The agricultural census was taken in 1929 by means of individual questionnaires.

The questions considered in the census are the following distribution of farms and their areas according to size any tenure; distribution of the area of farms according to the main groups of utilisation; area and production of the principal crops; receipts from the sale of products of fruit gardens, nurseries, hot-houses, etc.; number of livestock, poultry, rearing of furred animals, etc.; quantities of livestock products obtained and/or sold; country of origin of the farmer; the period during which he has operated the farm; other occupations of the farmer; value of farms; farm expenses; value of certain products consumed on the farm.

The data, in general, refer to the year ended on 1 October 1929; those of the distribution of farms and their areas, of numbers of livestock, of the value of the farms, etc., refer to 1 October 1929.

The Institute has just received the publication containing the census results.

2. *Albania*.—An agricultural census has been taken and according to the information received by the Institute, its elaboration should have been finished in June 1931.

The questions considered in the questionnaire prepared for the purposes of the census—to be filled in with data relating to the various farms in each village—were the following: status of the farmer (proprietor or tenant farmer); distribution of farm area according to the main groups of utilisation; area and production of the principal crops; number of fruit trees; agricultural machinery; houses, number of livestock, poultry-farming and bee-keeping; number of families and number of persons living on the farm.

3. *Algeria*.—Because the larger part of the cultivated area belongs to the native population, the organisation of a complete agricultural census is practically impossible in numerous regions. On the occasion of the World Agricultural Census, however, the Government made a special inquiry designed to obtain a series of data complementary to those furnished by the annual agricultural statistics.

The information for this special inquiry was obtained by employing the same organisation responsible for the annual agricultural statistics, namely: the data have been collected in each commune by the communal commissions of agricultural statistics, then concentrated and checked for the district by the district commissions, at the departmental centre by the staff of the Prefecture and lastly at Algiers by the staff of the Government General.

The questions considered both in the annual agricultural statistics and in the special inquiry are as follows (the latter being indicated in special type): *distribution of private property according to area and nationality of the owner*; distribution of the territorial area by the main groups of utilisation; *area and number of isolated trees, bushes and nurseries*; *area and production of market-garden crop*; *agricultural machinery, etc.*; number of livestock, poultry, bee-keeping, sericulture; *quantities of the principal livestock products obtained*; *farm population*; *farm labour*. All of the data are furnished separately for Europeans and natives.

The data of the agricultural statistics refer to the year 1929 (those of livestock numbers were collected from March 1 to 15); those of the special inquiry were collected on 10 February 1930.

All of the data have been published but the publication of those resulting from the special inquiry is provisional, previous to the final, detailed report to be prepared subsequently by the staff of the General Bureau of Statistics.

4. *Argentina*.—The Government, on 1 July 1930, took a census of the numbers of livestock, the results of which have been transmitted to the Institute.

It has also transmitted to the Institute the figures for the agricultural year 1929-30 drawn from the annual agricultural statistics and referring to the distribution of the total cultivated area according to the different crops as well as to the area and production of the principal crops.

5. *Australia*.—In Australia an agricultural census is taken regularly each year. In 1929-30 certain complementary questions were added to the usual questionnaire in view of the world agricultural census. The questions for which the data have been elaborated are the following: distribution of the total area according to the legal situation of the land; distribution of the number and area of private farms according to size; distribution of the area of agricultural land by the main groups of utilisation; distribution of the area of cropped land according to the different crops; ensilage; use of fertilizers; irrigation; numbers of the different kinds of livestock; bee-keeping; quantities and values of livestock products.

The data in general refer to the agricultural season 1929-30; those for the use of fertilizers, to the calendar year 1929; those for the distribution of the total area according to the legal situation of the land, to 31 December 1929 (in New South Wales and in Western Australia), to 30 June 1930, those for the numbers of livestock, to 31 December 1929 (in New South Wales and the Federal Capital territory, to 30 June 1930).

The data were published at the end of September 1931.

(6) *Austria*.—The census of agricultural and forest farms was taken in 1930 by means of individual questionnaires.

The questions considered in the census are the following: distribution of farms and their area according to size, according to area of cultivated land and according to tenure; distribution of the total farm area by the main groups of utilisation; distribution of the area of arable land according to the principal crops; number of vine stocks and of fruit trees; area of forest and their composition; agricultural machinery and equipment for agricultural industries; numbers of livestock, poultry-rearing and bee-keeping; farm labour and number of days of work done; secondary professions of farmers; technical instruction imparted to the farmer and the members of the family; participation by the farmer in co-operative organisations; active and inactive farm employees.

The data of distribution of area, number of days of work done, and agricultural machines used refer to the year 1929; the other data refer to 14 June 1930.

Part of the preliminary census results have been published; the publication containing the complete and final results is in course of preparation.

(7) *Bahamas*.—For the purposes of the world agricultural census, the Government has transmitted data on the areas under the different crops and on the numbers of livestock in the different islands forming the colony.

(8) *Barbadoes*.—The census was taken in 1930.

The questions considered are as follows: number of farms; distribution of farm area by the main groups of utilisation; areas under the different crops and production of the principal crops; fertilizers; number of livestock and poultry-rearing; labour, wages, etc.

The data in general refer to the year 1929; those for livestock, etc., to 1 January 1930.

The census results relative to a total number of farms of over 10 acres in size, covering about 70 per cent. of the area of the colony, have been transmitted to the Institute.

(9) *Belgium*.—The general census of agriculture was effected between the end of 1929 and the beginning of 1930.

The questions considered in the individual questionnaires relating to farms are the following: distribution of farms according to size and tenure; distribution of the total farm area according to the main groups of utilisation; areas under the principal crops; green-houses; agricultural machinery and agricultural equipment; use of manures and artificial fertilizers; land improvements; numbers of livestock, poultry-rearing and bee-keeping; livestock reared; commercial feeding-stuffs fed to livestock; permanent farm labour; foreign labour; number of days of work done.

Contemporarily, data have been obtained in each commune or canton on the following questions: (a) uncultivated land belonging to the State, to the communes and to public bodies; (b) uncultivated land having been given an acquired value during the years 1911 to 1929 inclusive; (c) area of woodland property and water surfaces; (d) products of woodland property; (e) average yields of the principal crops; (f) cash and rent value of land; (g) cash wages of farm labourers; associations of agricultural interest.

The data in general refer to the year 1929; those on the area of woodland property and water surfaces, on agricultural machinery and equipment, on numbers of livestock, poultry-raising and bee-keeping and on permanent farm labour, refer to 31 December 1929; those on land improvements, to the period 1911 to 1929 inclusive and those on the products of woodland property, to the average for the years 1927, 1928 and 1929.

The work of revision and elaboration of the census results is in progress and according to a Government intimation, the data will not be available until the end of 1933.

(10) *Brazil*.—The agricultural census was to have been taken on 1 September 1930 and the General Direction of Statistics had prepared everything necessary for its organisation and execution but owing to the force of circumstances the realisation of the programme arranged was prevented.

(11) *British Islands in the Western Pacific*.—The High Commissioner for the Western Pacific has transmitted to the Institute the information collected for the world agricultural census on the British Solomon Is. Protectorate, Gilbert and Ellice Is. colony and the Tonga and New Hebrides Islands.

The data furnished for the first three groups of islands relate to areas cultivated and production of the most important crops, to numbers of livestock and to poultry-rearing; for New Hebrides, to production of the principal crops.

(12) *British Malaya*.—The Government has furnished the statistical data available regarding the area and production of the most important crops in the country (rubber, coconut trees and rice), and also data for a series of crops of minor importance and livestock.

The figures of area refer to 31 December 1929 and those of production to the year 1930.

(13) *Bulgaria*.—The agricultural census was to have taken place on 31 December 1930. The General Direction of Statistics had commenced the preparatory work but for financial reasons was obliged to postpone the execution of the census until the necessary financial means would be available.

(14) *Canada*.—The agricultural census was taken in June 1931, by means of individual questionnaires. As the census periods are fixed by law the Government could not change the date to make it coincide with that of the world census. It has kindly offered, however, to transmit to the Institute the data furnished by the agricultural returns for 1929, checked and, where necessary, revised on the basis of the results of the 1931 census. It should moreover, be observed that for many items the results of this census, despite the difference in date, may also fulfil the purpose of the world census.

The items considered in the questionnaire for the agricultural census of 1931 are the following: distribution of farms according to size and tenure; distribution of farm area according to the main groups of utilisation; area and production of the different crops; production of forest products; numbers of livestock and poultry-rearing; number of animals sold and slaughtered on farms; quantities of livestock products obtained and/or sold; total number of weeks of work done by labourers; value of farms; value of farm products.

The data in general refer to the year 1930; those of the distribution of farms and their area, numbers of livestock, etc., and the value of farms, to 1 June 1931.

Some of the preliminary results of the census have already been published.

(15) *Ceylon*.—The Government in 1929 carried out a census, using individual questionnaires for the European estates and, for native agriculture, questionnaires for each village filled in by the chief headmen and checked by the government staff.

The general census was limited to the area and yield per acre of rice and coconut trees and to numbers of livestock. The government held the opinion that the information furnished by the headmen on the tea and cocoa crops could not assure data more exact than those of the export statistics for these products and that it would have been equally difficult to obtain fairly exact data for the minor crops. In the questionnaires prepared for the European estates, however, data were also requested of the areas under tea, rubber and other crops. In addition to the results of the census taken specially in 1929 for rice, coconut trees and livestock numbers, the Government has been able to furnish the Institute with the results of the 1928 census for rubber, also with the figure for the area of the tea crop on European estates and an estimate of the total area of minor crops in 1929.

The data of areas and yields refer to the agricultural year 1 October 1928 to 30 September 1929; those of livestock numbers, to 30 September 1929.

(16) *Chile*.—The agricultural census was effected on 30 June 1930. The questions considered in the census are the following: distribution of farms according to size; distribution of farm area according to tenure; distribution of farm area by the main groups of utilisation; area and production of the different crops; production of wood; irrigation; agricultural machinery; number of stables and of silos; use of fertilizers; numbers of livestock, poultry-rearing and bee-keeping, number of animals slaughtered; quantities of the principal livestock products obtained; agricultural industries attached to the farms; labour.

Most of the data refer to the agricultural year 1 July 1929 to 30 June 1930; those of agricultural machinery, numbers of livestock, etc., and farm labour, to 30 June 1930.

The General Direction of Statistics has begun to publish some of the census results (numbers of livestock, livestock products, number of olive trees, area and production of the different crops).

(17) *Czechoslovakia*.—The agricultural census was taken on 27 May 1930 by means of individual questionnaires (principal questionnaire and special complementary questionnaires for forests, horticulture and pisciculture).

The following questions are examined: distribution of farms by size and tenure; distribution of the total farm area and the territorial area by the main groups of utilisation; areas under the different crops; commercial production of vegetables; nurseries; hot-houses; composition and production of forests; utilisation of water surfaces; irrigation; ensilage; agricultural machinery, etc.; numbers of livestock, wool production and poultry-rearing; farm labour; total days of work done by temporary labour; farm workers' lodgings; other professions and occupations of the operator; insurance; agricultural and forest industries attached to the farm; effects of agricultural reform on the farm.

The figures mostly refer to the date of the census; those relating to the commercial production of vegetables, production of fish from the water surfaces, and total days of work done by temporary labour, refer to the period 27 May 1929—26 May 1930; those of forest production, to the period 1 June 1929 to 31 May 1930.

The Government has published part of the preliminary results of the census.

(18) *Denmark*.—An agricultural census was taken in 1929 through the local authorities by means of questionnaires in which the data for each farm were inserted.

The items considered in the census are the following: distribution of estates according to area of agricultural land; distribution of the territorial area by the main groups of utilisation; distribution of farm area according to groups of crops; areas under the different crops and number of fruit trees; number and area of horticultural farms, area of the different horticultural cultivations, nurseries, hot-houses; improvements; use of liquid manure pits; numbers of livestock, poultry-rearing and bee-keeping.

The data in general refer to 15 July 1929; those regarding improvements, to improvements made in the period 1907 to 1929.

The census results were published in 1931.

(19) *Dutch East Indies*.—The Government has communicated in a very detailed memorandum, the reasons for which the special conditions of agricultural economy in tropical countries and especially in the Dutch Indies, in most cases render impossible the application of the methods recommended by the Institute for the world agricultural census.

The principal result of the participation of the Dutch Indies in the census might have been an attempt at counting the coconut trees and a certain number of the principal kinds of fruit trees. Owing to force of circumstances however, there was no chance of accomplishing with success the large amount of work involved in counting at this period as the staff at the time was occupied with the population census. It was therefore necessary to postpone the count until 1932.

The Government moreover observed that, particularly for the annual crops, it would have been possible to supply data covering many of the questions listed in the standard form by utilising the data of the annual agricultural statistics.

(20) *Egypt*.—The agricultural census was taken in 1929 by means of questionnaires in which the data for each agricultural holding were recorded by the village "sheikhs" under the direction of the provincial representatives of the Ministry of Agriculture. The data were collected at three different periods, namely, those of the winter, summer and autumn crops respectively. The items considered are the following: distribution of holdings according to size and tenure; distribution of the total area of holdings according to the main groups of utilisation; area under the different crops, area and number of fruit and other trees; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping.

The data concerning the different agricultural holdings have been completed by means of inquiries made for livestock, poultry and beehives other than those on the holdings, for fruit and other trees grown in public gardens and parks under the supervision of the administrative authorities or planted along the roadsides, and lastly, for nurseries.

In addition, the agricultural technical staff has collected information in each village on the yields of the principal crops and steps have been taken to ascertain the

average production of the principal livestock products in each district in order that it may be possible to calculate as accurately as possible the total production of the country.

Data on farm labour may be obtained from the results of the general census of population; as regards irrigation, data may be had from the Ministry of Public Works; it will also be possible to know the quantities of chemical fertilizers imported and produced in the country.

The crop data refer to the year 1929; the figures for livestock, etc., were collected at about the middle of July 1929; those for agricultural machinery, etc., in the autumn of 1929.

The results of the census have not yet been published.

(21) *Estonia*.—The agricultural census was taken in June 1929 by means of individual questionnaires.

The questions considered in the census are the following: distribution of farms according to area of agricultural land and to tenure; distribution of farm area according to the main groups of utilisation; areas under the different crops and number of fruit trees, etc.; agricultural machinery, etc.; fertilisers; buildings, etc.; improvements; numbers of livestock, poultry-rearing and bee-keeping; farm population and labour.

The data in general refer to the census period; those for fertilizers, to the quantities used from 1 July 1928 to 30 June 1929.

In addition, data of production of the different crops in 1929, of the quantities of the principal livestock products obtained from 1 May 1929 to 30 April 1930, of estimates of farm capital, and of farm indebtedness, etc., have been obtained by taking samples comprising 5 to 10 per cent. of the farms.

The results of the census have been transmitted to the Institute and published in a special Bulletin (No. 2) of the series to be published for the first world agricultural census.

(22) *Falkland Is.*—For the purposes of the world agricultural census, the Government has transmitted to the Institute data of the area cultivated, numbers of livestock, wool production and labour.

The data refer to the year 1930.

(23) *Finland*.—The agricultural census was taken in 1929-30 by means of individual questionnaires.

The questions considered are as follows: distribution of farms and their area according to area of agricultural land and tenure; distribution of farm area by the main groups of utilisation; area and production of the different crops; numbers of the principal kinds of fruit trees, etc.; forest plantations; clearings; drainage; manure; use of fertilizers, etc.; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; production of milk and eggs.

The data in general refer to the year 1929; those for forest plantations, to forests created respectively before 1918 and in or after 1918; those for clearings, to clearings effected in the period 1919-28 and in 1929 respectively; those on the use of fertilizers, etc., to fertilizers used in the spring of 1929 and autumn of 1928; those of agricultural machinery, etc., to 1 September 1929; those of the numbers of livestock, to 1 September 1929 and 1 January 1930.

The results of the census have just been published.

(24) *France*.—The census of agriculture and livestock was taken in 1929-1930 by means of questionnaires to be filled in in each commune by the Communal Commission of agricultural statistics.

The questions considered are the following: distribution of agricultural property according to the status of the owner; distribution of farms and their area according to size and tenure; distribution of territorial area by the main groups of utilisation; area, production, etc., of the different crops; plantations and their production; area and production of forests, improvements, replacements, etc.; buildings, manure pits in general; agricultural machinery, etc.; numbers of livestock, poultry-rearing, bee-keeping, sericulture; livestock bred, their losses and diseases; quantities of the different livestock products obtained; farm labour; lodging of farm employees; rural artisans; agricultural associations; agricultural industries.

The data in general refer to the year 1929; those for livestock, to 1 November 1929; those for buildings, to buildings constructed or abandoned since 1919; those for manure pits, to pits constructed before and after 1919 respectively; those for improvements, to improvements made since 1919.

The programme of the census includes, besides the statistical inquiry, an economic inquiry the results of which will be published in a series of monographs.

The results of the census have not yet been published.

(25) *French West Africa (Ivory Coast, Dahomey, French Guinèa, Upper Volta, Mauritania, Niger Territory, Senegal, Dakar, French Sudan).*—The conditions existing in this group of colonies, the penetration and organisation of which are relatively recent, do not permit the taking of a census. The Government General of French West Africa has, however, with the aid of a uniform general questionnaire applicable to the different colonies, obtained estimates covering most of the questions considered in the world agricultural census. These estimates reflect as closely as possible the actual state of affairs but contain some gaps and omissions.

The information collected furnishes estimates on the total area cultivated (and for many colonies also on the areas under the principal crops); on the production of foodstuffs, wild crops gathered, crops for industrial purposes or export; the area of forests and woods; forest products (local consumption and export); agricultural machinery; numbers of livestock and (for some colonies) poultry-farming; the most important livestock products (local consumption and export); and labour. For some colonies data have also been obtained on irrigation and the use of fertilizers.

The data refer to native crops; at the same time, separate information has been collected for farms under the heading of temporary or permanent land concession.

The latest date for the figures was fixed at 1 January 1930, for the year 1929. They have already been transmitted to the Institute.

(26) *Germany.*—A census of agricultural and forest farms was taken on 16 June 1925 by means of individual questionnaires. The questions considered are the following: distribution of farms according to the total area, agricultural area, tenure, the principal profession of the owner, the year, and the legal situation as regards the transference of the property; distribution of area according to the main groups of utilisation; area under the principal crops; number of fruit trees; agricultural machinery, etc.; soils; numbers of livestock and poultry-rearing; breeding of fresh water fish; farm labour; agricultural industries attached to the agricultural and forest farms.

The Government had the intention of repeating the farm census in 1930 along the lines of the plan of the International Institute of Agriculture, but for financial reasons this has not been possible. The Government has expressed its opinion however, that, owing to the relatively slow changes which take place in the composition of the farms, the difference of five years compared with the census effected in other countries should not be very large and that by using the results of the farm census of 1925 and those of the annual inquiry on land utilisation, crops and livestock numbers, it would be possible to construct the material required for the purposes of the world agricultural census.

(27) *Great Britain and Northern Ireland.*—In England and Wales, in Scotland and in Northern Ireland, an agricultural census is taken yearly of farms of one acre and over. The following data are obtained: distribution of farms according to size (England and Wales and Scotland) and tenure (Scotland); distribution of farm area according to the main groups of utilisation; areas under the different crops; numbers of livestock and poultry-rearing; farm labour.

The data refer to June 4.

The census returns have been completed with estimates of production of the principal crops and, in England and Wales, also with estimates of the quantities of the principal livestock products obtained.

For the purposes of the world agricultural census, besides the above-mentioned information for the year 1929, the following data has been compiled:

England and Wales.—Numbers of livestock on 11 January 1930.

Scotland.—Estimates of the quantities of the principal livestock products obtained during the twelve months from June 1929 to May 1930, also of the quantities and values of products sold by farmers or consumed on the farm.

In conjunction with the general census of production of 1930, a more complete agricultural census was subsequently executed including, besides the questions examined in the annual agricultural census, a series of complementary questions, namely: use of agricultural machinery, number of animals bred and of those lost, quantities of the principal livestock products produced or sold. The figures refer to the period 1 June 1930 to 31 May 1931.

The results of this more complete agricultural census are still being elaborated.

(28) *Greece*.—The agricultural census was taken in December 1929 by means of individual questionnaires.

The following items are examined in the census: distribution of farm area by the main groups of utilisation; area and production of the different crops, number of isolated trees and their production; irrigation; agricultural machinery; numbers of livestock, poultry-rearing and bee-keeping; livestock reared; quantities produced of the principal livestock products; labour, hours of work and wages; value of the products of the different crops and of livestock products.

The data in general refer to the year 1929 and those of areas cultivated, to the agricultural year 1928-29.

The Government has transmitted to the Institute part of the preliminary results of the census.

(29) *Guam*.—The agricultural census was effected in 1930 by means of individual questionnaires.

The questions examined in the census are as follows: area and production of the principal crops; numbers of livestock and poultry-rearing.

The data of area and production refer to the year 1929; those of livestock numbers, to 1 April 1930.

According to information received at the Institute, the elaboration of the census results has not yet been finished.

(30) *Guatemala*.—The agricultural census was taken in April 1930. The following questions are considered in the census: total farm area and that sown; area and production of the different crops; agricultural machinery; numbers of livestock, poultry-rearing and bee-keeping; quantities of the principal livestock products produced; farm population and labour; farm labourers' wages.

The larger part of the data refer to the agricultural year 1929-30; those of livestock, population and labour to the month of April 1930.

Part of the census returns (area and production of the different crops, numbers of livestock and quantities produced of the principal livestock products) have already been transmitted to the Institute by the Government.

(31) *Hawaii*.—The agricultural census was taken in 1930 by means of individual questionnaires.

The questions considered in the census are as follows: distribution of farms and their areas according to size and tenure; distribution of farm area according to the main groups of utilisation; area and production of the principal crops; number and production of fruit trees; receipts from the sale of the products of fruit gardens, nurseries and hot-houses, etc.; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; quantities of livestock products obtained and/or sold; country of origin of the farmer and the period during which he has operated his farm; value of farms; farm expenses; farm debts; value of certain products consumed on the farm.

The data in general refer to the year 1929; those of the distribution of farms and their area, of agricultural machinery, etc., of livestock numbers, of the value of farms and of farm debts, refer to 1 April 1930.

According to information received at the Institute, the elaboration of the census returns has not yet been finished.

(32) *Hungary*.—The Central Office of Statistics had prepared a plan for a very detailed agricultural census to be taken between February 15 and 18, 1930, but for financial reasons it could not be carried out at the period anticipated. The Government intends to realise its project as soon as the necessary means are available.

(33) *Iceland*.—The agricultural census was taken in April 1930 by means of individual questionnaires.

The following questions are considered in the census: distribution of farms according to size and tenure; distribution of farm area according to the main groups of utilisation; area and production of the principal crops; agricultural machinery, etc.; numbers of livestock and poultry-rearing; quantities of the principal livestock products obtained; farm population and labour.

The production figures refer to the year 1929; those of livestock to April 1930 and those regarding labour to the agricultural year 1929-30.

The census results are not yet available.

(34) *India*.—The Government considered that the local conditions of agriculture were not such as to assure the success of a census taken farm by farm. It has, however,

kindly participated in the world census by sending to the Institute the total figures (for the British Provinces and Native States respectively) which it was in a position to obtain by utilising the information furnished by the annual agricultural statistics and also the results of the census of livestock, ploughs and waggons taken in January 1930.

The data available cover a large number of the questions comprised in the Institute's standard form, namely: distribution of area according to tenure; distribution of area by the main groups of utilisation (area cultivated, in fallow, uncultivated but cultivable, uncultivated and unsuitable for cultivation and forest area); distribution of the cultivated area according to the different crops; area and production of the principal crops; irrigation; distribution of the forest area and forest production; numbers of ploughs and waggons; numbers of livestock.

The data in general refer to the agricultural year 1929-30; those of the numbers of livestock and numbers of ploughs and waggons, to January 1930; those of the distribution of area according to form of tenure, to the agricultural year 1929-30 for most of the British Provinces, to the agricultural year 1928-29 for Madras Presidency, to the agricultural year 1927-28 for Bengal and Coorg, to the agricultural year 1926-27 for the United Provinces and Bihar and Orissa and to the agricultural year 1925-26 for Bombay Presidency.

The data for the British Provinces were transmitted in March and in November 1931 and those for the Native States are being elaborated.

(35) *Italy*.—In March 1930 there were carried out, by means of individual questionnaires, a farm census, a general census of livestock, a census of businesses hiring out agricultural machinery and a farm population census.

The questions considered in these censuses are as follows: distribution of farms according to size and tenure; distribution of farm area according to the main groups of utilisation; area and production of the different crops, number and production of fruit trees; hot-houses and nurseries; area and production of forests; drainage and irrigation; agricultural machinery, etc.; numbers of livestock, poultry-rearing, bee-keeping and sericulture; quantities of the principal livestock products obtained; agricultural population; farm labour, number of days of work done; labourers' lodgings, etc.; rural industries attached to the farms.

The larger part of the figures refer to the date of the census (19 March 1930); those for crops and production to the agricultural year 1928-29; those for agricultural machines employed, for days of work and for rural industries, to the year 1929.

The Government has published some preliminary data on number of farms, number of livestock and agricultural population.

The elaboration of the livestock census and that of agricultural population is in progress.

For financial reasons it will probably be possible to elaborate the results of the farm census only as regards part of the questions considered.

(36) *Irish Free State*.—An agricultural census is taken yearly by collecting information at each farm; in 1929 certain supplementary questions were added to those normally included in the annual census.

The questions considered are the following: distribution of farms according to size and farm area according to tenure; distribution of the total farm area according to the main groups of utilisation; area under the different crops; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; farm labour and wages.

The data in general refer to 1 June 1929; those concerning the use of power machinery and power and tractor drawn machinery, to 1 June 1928.

Estimates have also been made of production of the different crops and of the quantities of the principal livestock products obtained in 1929 (for honey, from 1 June 1928 to 31 May 1929).

The results of the census and also the estimates of production of the different crops and of the quantities of the principal livestock products obtained, have been transmitted to the Institute and published in a special Bulletin (No. 1) of the series to be published for the first world agricultural census.

(37) *Japan*.—It was arranged that the agricultural census should be taken in two stages: firstly, a census of cultivated lands and their distribution (a) according to the principal groups of crops; (b) according to the status of the operator (owner or tenant farmer), followed by a census of farms, agricultural production and livestock. The first part of this programme was carried out on 1 September 1929. The second part was to have been accomplished in 1930 but this was prevented by financial difficulties.

As, however, the larger part of the questions considered in the programme arranged by the Institute for the world census are dealt with in the annual agricultural statistics of Japan and as other questions have formed the subject of special statistical investigations, the Japanese Government has been able to transmit to the Institute a series of data complementary to those obtained from the census of September 1929.

Information has been furnished on the following questions: distribution of farms according to tenure and area of agricultural land on the farm; distribution of the area of cultivated land according to form of tenure; area under crops, permanent meadows and pasture, crop producing bushes, forests, other productive land and unproductive land; area and production of the different crops; nurseries and flower cultivations; area and production of forests; use of fertilizers; agricultural machinery; numbers of livestock, poultry-rearing and sericulture; changes in the numbers of livestock during the year 1929; farm labour; farm wages.

The data of the distribution of the area of cultivated land according to form of tenure and of the chief groups of utilisation of area (except for meadows and pastures, forests and bamboos), refer to 1 September 1929; those of meadows and pastures, to the end of September 1927; those of forests and bamboos, to the end of 1927.

The data of area and production of the different crops refer to the production of 1929 (except for mulberries, 1927). The data of the distribution of farmers and of livestock refer to the end of 1929 (except for poultry, end of June 1929, and for rabbits and foxes, end of 1926); the data for agricultural machinery, to the end of September 1927; those for labour, to 1 October 1929. The figures for livestock products (except for eggs, 1 July 1928 to 30 June 1929) and those regarding the use of fertilizers, refer to the calendar year 1929.

(38) *Kenya*.—The Government in 1930 effected by means of individual questionnaires, a complete census of European estates. As regards native agriculture, estimates were at the same time made through the District Commissioners and agricultural staff, of area cultivated, of area and production of the principal crops and of numbers of livestock.

The questions considered in the census are the following: number of occupiers, total area occupied and total area cultivated; distribution of the area cultivated according to the different crops and production of the most important crops; farm forests. State forests and their production, agricultural machinery; numbers of livestock and poultry-rearing; number of animals lost; animals slaughtered for consumption on the farm; quantities of livestock products sold; farm labour; farm labourers' wages.

The data in general refer to the agricultural year 1 August 1929 to 31 July 1930; those of area, agricultural machinery and numbers of livestock, to 31 July 1930.

The census results have been published by the Government.

(39) *Latvia*.—The agricultural census was taken in July 1929, by means of individual questionnaires.

The questions considered in the census are as follows: distribution of estates according to area, kind of estate and tenure; distribution of farms according to area and kind of farm and of their area according to form of tenure; distribution of farm area by the main groups of utilisation; areas under the different crops and numbers of fruit trees, etc.; agricultural machinery, etc.; fertilizers; buildings, drainage; numbers of livestock, poultry-rearing and bee-keeping; farm population and labour; farm indebtedness.

The data in general refer to the period of the census; those for fertilizers, to the quantities used during the period 1 July 1928—30 June 1929.

In addition, data of production of the different crops in 1929 and the quantities of the principal livestock products produced from 1 May 1929 to 30 April 1930, have been obtained by means of samples comprising 5-10 per cent. of the farms.

The Government has already published most of the volumes containing the census results (number and operation of estates; number of farms; distribution of farm area and utilisation of arable land; utilisation of kitchen-gardens and orchards; farm livestock; operation of allotments; agricultural machinery and equipment; improvements and use of fertilizers; farm buildings).

(40) *Lebanon Republic*.—Along the lines of the standard form prepared for the world agricultural census the High Commissioner for the French Republic has transmitted estimates of the distribution of the total farm area according to the main groups of utilisation; area and production of the different crops; area and production of forests; numbers of livestock, poultry-rearing, bee-keeping and sericulture; and the quantities of the principal livestock products obtained.

The data refer to the year 1929.

(41) *Leeward Islands*.—The following data have been transmitted to the Institute for the purposes of the world agricultural census :

Antigua.—Distribution of farm area according to the main groups of utilisation; area and production of the principal crops; numbers of livestock; labour. (The figures are incomplete.)

Dominica.—Indication of the distribution of the total area according to the main groups of utilisation; estimates of the areas under the principal crops.

Virgin Islands.—Area and production of the principal crops, forest production, fertilizers, numbers of livestock.

Montserrat.—Distribution of the total area according to utilisation and production of cottonseed.

St. Christopher and Nevis.—Total area cultivated and area and production of the principal crops.

The Government, in communicating to the Institute the above information, referred to the difficulties encountered in obtaining complete and reliable data in this group of colonies.

(42) *Lithuania*.—The agricultural census was taken between the end of 1930 and the beginning of 1931 by means of individual questionnaires.

The questions considered in the census are the following: distribution of farms and their area according to size and tenure; distribution of the area of farms according to the main groups of utilisation; area and production of the different crops; fruit trees; agricultural machinery, etc.; fertilizers; buildings; numbers of livestock, poultry-rearing and bee-keeping; farm labour, information relating to agricultural reform.

The data relating to crops and fertilizers refer to the agricultural year 1929-30 and the others, to the data of the census (30 December 1930).

The results of the census have already been finally classified and will be published in four volumes, the first of which has already been received at the Institute.

(43) *Mauritius*.—In relation to the world agricultural census, an agricultural census was effected at the beginning of 1930.

The questions considered are as follows: distribution of estates and sugar cane plantations outside the estates, according to area; distribution of the area cultivated according to the different crops; production of sugar cane and of sugar; area of forests; farm equipment and machinery of sugar factories and of establishments for the preparation of fibre; numbers of livestock; number of sugar cane planters and other cultivators (native and non-native).

The census results have been transmitted to the Institute.

(44) *Mozambique*.—The Government in 1930 carried out a census of the farms of European and other assimilated non-native cultivators (that is, of all cultivators other than natives).

As regards native agriculture, it is possible to obtain only approximate estimates, which the Government has kindly promised to send to the Institute.

The census deals with the following questions: number of farmers and their distribution according to nationality; number and area of farms; distribution of farm area according to legal situation, tenure and size; distribution of the cultivated area by the main groups of utilisation; area and production of the different crops; quantities of the different products consumed on the farm; stocks of the different products; plantations of forest species and production of wood; irrigation and drainage; use of

fertilizers; agricultural machinery, silos, pumps, etc.; numbers of livestock; number of animals slaughtered, sold or lost; quantities of livestock products obtained, sold, consumed, etc., labour (native and non-native) employed and number of days of work done, labourers' wages (native and non-native); farm indebtedness; agricultural associations.

Most of the data refer to the agricultural year 1 November 1929 to 31 October 1930. The data concerning stocks of the different products, agricultural machinery, etc., numbers of livestock, labour, farm indebtedness and agricultural associations, refer to 31 October 1930.

The Government has already transmitted the census results to the Institute.

(45) *Mexico*.—The agricultural census was taken on 15 May 1930.

The following questions are examined in the census: distribution of farms according to size and tenure; distribution of farm area according to the main groups of utilisation; area and production of the different crops; forests and production of forest products; irrigation; agricultural machinery; numbers of livestock, poultry-rearing and bee-keeping; quantities of livestock products obtained; labour; value of the different classes of land; operating expenses; value of farms; farm indebtedness.

The data in general refer to the agricultural year May 1929—May 1930; the data of forest production and livestock products, to the year 1929; and those of numbers of livestock to 15 May 1930.

The elaboration of the census results is in progress.

(46) *Netherlands*.—The agricultural census was taken between 20 May and 20 June 1930 through the local authorities and using questionnaires in which data for each farm were inserted.

The questions considered in the census are the following: distribution of farms by area and tenure; distribution of area by the main groups of utilisation; numbers of livestock, poultry-rearing and bee-keeping.

The data refer to the period of the census.

In addition, the data of areas under the different crops and of average yield for each crop were estimated in 1930 with, as usual, the aid of information furnished in each commune by the mayor assisted by a commission for statistics composed of farmers in the commune.

The Government has published some preliminary results of the census.

(47) *New Zealand*.—In New Zealand an agricultural census is taken regularly each year. In 1929-30, certain complementary questions were added in the usual questionnaires with a view to the world agricultural census.

The questions for which data have been elaborated are as follows: distribution of the number and area of farms: (a) according to size; (b) according to the legal position as regards possession; (c) according to tenure; (d) according to type of farm; distribution of farm area by the main groups of soil utilisation; distribution of the area of arable land according to the different crops and quantities of products obtained; distribution of the area of market-garden crops, gardens, etc., according to purpose for which used and quantity of products obtained; distribution of plantations according to the principal kinds; quantity of wood cut; machinery; use of fertilizers; area irrigated; numbers of the different kinds of livestock; distribution of sheep according to size of flocks and strains; production of wool and butter and livestock slaughtered; farm population and number of persons working on farms.

The most important data have been classified according to size of farm and type of farm.

The data in general refer to the agricultural year 1929-30. Those of numbers of the different kinds of livestock relate to 31 January 1930 except for sheep for which the date is 30 April 1930. The data of quantities of wood cut, quantities of butter produced, number of animals slaughtered and use of fertilizers, refer to the 12 months ended on 31 January 1930; those for hives, to 16 February 1929.

Many of the figures were published in September 1930; but a series of complementary tables in great detail, were transmitted directly to the Institute in October 1931.

The Institute is preparing the Bulletin of these census returns.

(48) *Nigeria*.—The existing conditions in the country do not permit the execution of a proper agricultural census; the Government has, however, kindly prepared for the Institute a series of data based on the estimates made in the different provinces by the local authorities.

The data furnished deal with the following subjects: number and average area of farms (incomplete figures); total area cultivated; area and production of the principal crops; numbers of livestock; number of farmers.

(49) *Norway*.—The agricultural census was taken on 20 June 1929.

The questions considered in the census are the following: distribution of landed property according to area of the "innmark" (namely, of the land belonging to the farm with the exception of forests and non-contiguous mountain pastures) and area of cultivated land; distribution of area by the main groups of utilisation; area under the different crops, number of fruit trees, etc., drainage; purchases of fodder and fertilizers; agricultural machinery, etc.; use of electricity; numbers of livestock, poultry-rearing and bee-keeping; labour.

Most of the data refer to the date of the census; the figures of area, to the year 1929; those of purchases of fodder and fertilizers, to the period 21 June 1928—20 June 1929.

The first three volumes of the census have already been published; the fourth and last is in course of preparation.

(50) *Nyasaland*.—For the purposes of the world agricultural census the Government has transmitted a series of data regarding the distribution of farms according to size; the total area of arable land and plantations; area and production of the principal crops; numbers of livestock; and European labour.

The figures of area and production refer to the year 1929; those of livestock to 31 December 1929.

(51) *Peru*.—The Government has taken a census with the assistance of special commissioners who have obtained the data, as far as possible, directly from the farmers.

The information collected includes: the distribution of farm area by the main groups of utilisation; area and production of the different crops; numbers of livestock; quantities of the principal livestock products obtained; permanent farm labour.

The data refer to the calendar year 1929. A summary of the census results was transmitted to the Institute in August 1931.

(52) *Poland*.—The Government intended to carry out the agricultural census in June or July 1930 but due to financial difficulties the work had to be suspended. Data of land utilisation, crops and numbers of livestock are obtained yearly, by means of bulletins containing separate data for each farm, by the communal administrations controlling the general district administration.

(53) *Puerto Rico*.—The agricultural census was taken in 1930 by means of individual questionnaires.

The questions considered in the census are the following: distribution of farms and their area by size and tenure; distribution of farm area by the main groups of utilisation; area and production of the principal crops; receipts from the sale of market-garden and fruit-garden products; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; quantities of livestock products obtained and/or sold; country of origin of the farmer and the period for which he has operated the farm; value of farms; farm expenses; farm debts; value of certain products consumed on the farm.

The data in general refer to the year 1929; those concerning the distribution of farms and their area, agricultural machinery, etc., numbers of livestock, value of farms and farm debts, refer to 1 April 1930.

According to the information received at the Institute, the elaboration of the census results has not yet been finished.

(54) *Rumania*.—The general agricultural census was taken in March and April 1930 by means of communal questionnaires in which the data for each farm were inserted by the farmers themselves or by the mayor, notary or local councils and assemblies of the communes or villages on the basis of declarations made by the farmers.

The questions examined in the census are as follows: distribution of farms by size and tenure; distribution of farm area by the main groups of utilisation; area and production of the different crops and number of fruit trees; agricultural machinery, etc.; numbers of livestock, poultry-rearing, bee-keeping and sericulture; quantities of the principal livestock products obtained; permanent farm labour.

In addition there have been collected data, covering the whole territory of each commune or village, on the production of straw and waste vegetable products, on the area and production of forests and on the cultivation of flowers for sale.

The data in general refer to the year 1929; those of area, to the areas sown in autumn, 1928 and spring, 1929; and those of numbers of livestock, etc., to 31 December 1929.

The Government has stated that changes in the communal administrative staff effected at the beginning of 1930 in application of the law on administrative reform (law which modified the organisation and territorial area of departments and communes) have rendered the execution of the census difficult. A preliminary examination of the data collected has shown that only part of them could be used and that it would be necessary to be content with the answers to a restricted number of questions.

The work of analysing the questionnaires, owing to Budget economies, could only recently be commenced with a small staff. The preliminary results will consequently not be known until towards the end of the present year at the earliest.

(55) *Samoa (American)*.—The agricultural census was effected in 1930.

The questions examined are as follows: numbers of farms; area and production of the principal crops; number and production of fruit trees; numbers of livestock and bee-keeping.

The data refer to the year 1929; those of numbers of livestock, to 1 April 1930.

The census results have been published by the United States Government.

(56) *San Salvador*.—According to a communication of the General Direction of Statistics, the census was to be taken in 1930.

(57) *Sarawak*.—The Government has furnished approximate estimates as on 1 January 1930, of the area and production of the different crops and of numbers of livestock.

(58) *Seychelles*.—The census was taken in 1923.

The questions considered are as follows: distribution of farms and their area by size; distribution of farm area by tenure; distribution of farm area by the main groups of utilisation; area and production of the different crops; area and production of forests; drainage and irrigation; fertilizers; numbers of livestock, poultry-rearing and bee-keeping; quantities of livestock products obtained; labour, wages, etc.

The data in general refer to the year 1929; those of numbers of livestock, labour, etc., to the end of 1929.

The results of the census have been transmitted to the Institute.

(59) *Spain*.—By ministerial decree of 29 April 1927, reorganising the services of information on agricultural production, farmers must sign declaration forms containing the following data on holdings operated by them in each commune: areas under the different crops and number of fruit trees distributed; irrigation; use of fertilizers; agricultural machinery owned by the declarer; numbers of livestock, poultry-rearing, bee-keeping and sericulture; quantities of certain livestock products obtained.

The information furnished by these individual questionnaires has permitted detailed data to be obtained for 1929, the year of the world agricultural census; they have been completed with estimates of production of the different crops made by the agricultural bureaux.

(60) *Swaziland*.—The Government in 1930 carried out an agricultural census.

The questions considered are the following: total area and cultivated area of farms; area and production of the principal crops; number of fruit trees and quantities of the different kinds of dried fruit sold; forest plantations and their production; ensilage; irrigation; fertilizers; agricultural machinery; numbers of livestock and poultry-rearing; number of animals sold, slaughtered or lost; quantities of livestock products obtained and/or sold; labour.

Separate data on livestock and livestock products have been collected for natives living on European farms; as regards land occupied by the natives, the census has been limited to questions concerning livestock and livestock products, production of a few crops and certain agricultural machines, etc.

The data in general refer to the period 1 September 1929-31 August 1930; those relating to number of fruit trees, forest plantations, agricultural machinery, numbers of livestock, and labour refer to 31 August 1930.

The results of the census have been transmitted to the Institute.

(61) *Sweden*.—The general agricultural census was taken on 15 September 1927 by means of individual questionnaires. As on that date there was also to be taken for taxation purposes the general census of real estate and since the information to be collected for this object was partly of the same kind as that required in the agricultural census, the Government considered it opportune to combine the operations of the two censuses by taking the census of agriculture at an earlier date than that proposed by the Institute. In the preparation of the agricultural census, however, the Government followed, as far as possible, the plan outlined by the VIIIth General Assembly of the International Institute of Agriculture.

The following questions are examined in the census: distribution of farms by area of arable land and by tenure; distribution of area by the main groups of utilisation; areas under the different crops and number of fruit trees; drainage; manure pits and liquid manure pits; clearings; numbers of livestock, poultry-rearing and bee-keeping.

The data in general refer to 15 September 1927; those of area, to the areas sown during the summer of 1927; those of clearings, to clearings effected since 1922.

Information on production is regularly published in the annual statistics.

The results of the agricultural census of 1927 were published in 1930.

(62) *Switzerland*.—The agricultural census was taken on 22 August 1929 by means of individual questionnaires.

The questions considered are the following: distribution of farms by size, tenure and system of farming; allotments; distribution of area by the main groups of utilisation; areas under the different crops and number of fruit trees; hot-houses, etc.; forest production; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; labour; principal and secondary professions of the farm operator.

The data of area refer to the areas harvested in 1929; those of forest production, to the quantities of wood utilised from 1 July 1928 to 30 June 1929; and those for machinery, to machines used during 1929. The other figures refer to the date of the census.

Up to now only part of the final census results has been published in two volumes for crops and fruit trees respectively the other volumes are in course of preparation.

(63) *Union of South Africa*.—In the Union of South Africa a complete agricultural census is taken every five years and a more restricted one annually. The period originally anticipated for the former was the agricultural year 1930-31. In view of the world agricultural census, however, the Government decided to advance the period by one year and take a census in 1929-30.

The questions considered in the 1929-30 census are as follows: distribution of the number and area of farms: (a) by size; (b) by tenure; cropped areas and their distribution according to the principal crops; area of fruit-gardens, vineyards, pineapple plantations and banana plantations; number of fruit trees; areas of the different forest species; production of the principal crops; production of dried fruits; forest production; ensilage; irrigation; use of fertilizers; agricultural machinery; numbers of livestock and poultry-rearing; number of animals slaughtered; number of animals lost; quantities of livestock products; farm labour.

Most of the data refer to the agricultural year (1 September—31 August) 1929-30; those of the distribution of farms, area of fruit-gardens, etc., number of fruit trees, areas of forest species, number of irrigation wells, agricultural machinery, numbers of livestock and farm labour, refer to the situation as in August 1930.

According to the latest information available, the census results are about to be published.

(64) *United States*.—The agricultural census was taken in 1930 by means of individual questionnaires.

The questions considered in the census are the following: distribution of farms, of their total area and of their agricultural area by size and tenure; distribution of farm area by the main groups of utilisation; area and production of the principal crops; quantities of certain products sold or to be sold; production of forest products on farms; receipts from the sale of nursery and hot-house products, etc.; drainage, irrigation, etc.; quantities of fertilizers bought; agricultural machinery, etc.; numbers of livestock, poultry-rearing and bee-keeping; number of animals bought, sold and slaughtered; quantities of livestock products obtained and/or sold; movement of farm population; other occupations of farmers; total number of days of work done on the farm; value of farms; farm expenses; value of farm products; farm taxes; farm debts; participation in co-operative societies for purchase and sale.

In addition, data of farm population have been compiled for the population census which was taken at the same time as that of agriculture.

The data in general refer to the year 1929; those of the distribution of farms and their area, of the areas drained, etc., of agricultural machinery, of livestock numbers, etc., of the value of farms, etc., and of farm debts, refer to 1 April 1930.

Most of the results of the census have been elaborated and published for the different States but the general publication for the whole of the country has yet to appear.

(65) *Uruguay*.—The Government carried out a census in the period 30 April—30 May 1930 by means of individual questionnaires.

The questions included in the census questionnaires were the following: distribution of farms according to size, tenure and principal purpose (livestock-rearing, arable farming, mixed farming); distribution of area by the main groups of utilisation; area, production and consumption of the principal crops on each farm; production of wood; irrigation; agricultural machinery; numbers of livestock, poultry-rearing, bee-keeping and sericulture; quantities of the principal livestock products obtained; number of animals slaughtered for consumption on the farm; permanent farm labour; value of improvements, livestock, etc.

The data in general refer to the agricultural year 1929-30; those of numbers of livestock, to 30 April 1930.

The first results of the census for certain kinds of livestock have already been elaborated and published.

(66) *Virgin Islands (American)*.—The agricultural census was taken in 1930 by means of individual questionnaires.

The following questions are examined in the census: distribution of farms and their area according to size and tenure; distribution of farm area by the main groups of utilisation; area and production of the principal crops; numbers of livestock, poultry-rearing and bee-keeping; quantities of livestock products obtained and/or sold; country of origin of the farmer; period during which he has operated his farm, other occupations of the farmer; value of farms; farm expenses; value of certain products consumed on the farm.

The data in general refer to the year 1929; those of the distribution of farms and their area, of numbers of livestock, of the value of farms, etc., refer to 1 April 1930.

The census returns for numbers of livestock have been transmitted to the Institute.

(67) *Windward Islands*.—For the purposes of the world agricultural census there have been transmitted to the Institute, for the colonies Grenada and St. Vincent, data of the distribution of the number and area of farms according to size and estimates of the areas under the principal crops and of numbers of livestock.

APPENDIX XXI.

NOTE DATED THE 9TH JANUARY, 1934, BY SECRETARY, ON SUBJECT NO. 23 (i).—REPORT ON THE SCHEME OF RESEARCH WORK ON THE MOSAIC AND OTHER DISEASES OF SUGARCANE FOR THE PERIOD JUNE 1932 TO JUNE 1933.

Attention is invited to the enclosed note dated the 5th September 1933 (Annexure) on the subject mentioned above which was circulated to the Sugar Committee of the Council for consideration at its last meeting held in November 1933.

2. Dr. McRae explained the nature of the work covered by the report which was then adopted by the Sugar Committee.

3. The report is now for the consideration of the Advisory Board.

ANNEXURE.

NOTE FOR THE SUGAR COMMITTEE, DATED THE 5TH SEPTEMBER 1933, BY SECRETARY, ON REPORT ON THE SCHEME OF RESEARCH WORK ON THE MOSAIC AND OTHER DISEASES OF SUGARCANE, FOR THE PERIOD JUNE 1932 TO JUNE 1933.

At its meeting held in January 1930, the Sugar Committee considered a scheme of research work on the mosaic and other diseases of sugarcane submitted by the Imperial Mycologist and recommended it with certain modifications in cost. The scheme was further modified by the Imperial Mycologist and sanctioned in November 1930, for a period of five years. On account of financial stringency it was decided that this scheme should be started on a smaller scale for a period of three years in the first instance.

2. The first annual report (Enclosure) on the work done on the scheme during the period June 1932 to June 1933 has been received and is now for the consideration of the Sugar Committee.

ENCLOSURE.

SCHEME FOR RESEARCH ON MOSAIC AND OTHER DISEASES OF SUGARCANE.

(Financed by the Imperial Council of Agricultural Research.)

Report for the period 1st June 1932 to 30th June 1933.

I.—INTRODUCTION.

Though work on the diseases of sugarcane has formed a substantial amount of the activities of the Mycological Section at Pusa during the last several years, it was limited by the size of the staff available after giving due consideration to the claims of other crops. A five-year scheme providing for the appointment of a Class I officer, a Class II officer, and a Research Assistant and a Fieldman in the subordinate service whose whole time may be devoted to research on mosaic and other diseases of sugarcane was therefore submitted to be financed by the Imperial Council of Agricultural Research as soon as the Council was constituted. The scheme was accepted by the Council in 1930, but, owing to financial stringency which supervened, final orders sanctioning a non-recurring grant of Rs. 12,000 and a recurring grant of Rs. 53,000 to be spread over a period of three years, were not received until the second week of May 1932. The scheme was accordingly started with effect from the 1st June, 1932, and Dr. S. V. Desai, Second Assistant Agricultural Bacteriologist of this Institute, was appointed Sugarcane Mycologist, on the recommendation of the Public Service Commission, with effect from the 27th June 1932. Mr. S. A. Rafay was appointed Research Assistant from the 17th October, 1932, but the post of Assistant Sugarcane Mycologist was not filled until the 23rd June 1933, when Mr. L. S. Subramaniam, an Assistant in the Mycological Section, was appointed on the recommendation of the Public Service Commission, with the result that work on the fungus diseases of sugarcane did not receive as much attention during the period of the report as its importance demands.

Out of the non-recurring grant of Rs. 12,000 a sum of about Rs. 6,000 was spent during the financial year 1932-33, partly on laying out and equipment of an experimental area of 10 acres and partly on purchase of permanent apparatus such as microscope, incubators, autoclaves, etc. The experimental area, which is in a compact block protected by a pig-proof fence, has been divided into three plots of two and a quarter acres each for investigating the effect of mosaic disease on the yield of sugarcane, and three plots of about $\frac{1}{2}$ acre each for investigating the varietal resistance and spread of the disease under natural conditions. The remaining one acre is taken up

by roads, an insect-proof house, a tool shed and a brick platform with a water reservoir for keeping pots. The experimental area has also been provided with a hydrant and pipe lines for irrigational purposes.

An intensive study of the mosaic virus has been taken up, and a new line of attack has been developed to find out the nature of the mosaic diseases.

II.—MOSAIC DISEASE OF SUGARCANE.

Distribution.—In addition to the localities and varieties reported to be affected with mosaic in previous reports of the Mycological Section the following canes have been observed to have mosaic disease in the localities noted :—

Bihar.—Patna (Farm)—Co. 285, 300, 313, 331, A.ritsar Ponda and Sialkot Ponda, Mushari (Sugarcane Research Station)*—Hemja, Chynia, Yuba, Maneria, Mungo, Lewari, Ketari Barnkha, Co., 320, 325, 326, 330, 332, 333, 334, 335, 339, 342, 343, 346, 349, 352, 353, 357, 318, 319 and 317.

Bengal.—Dacca (Farm)—Co. 281 and 320. Mymensingh (Farm)—Co. 213.

Punjab.—Gurdaspur, Jullundur and Lyallpur (Farms)†—Co. 203, 318, 213, 281, 300, 301, 312, 343, 344, 346, 347, 349, 350, P. O. J. 2878, Saretha, Katha and Naba.

Central Provinces‡—Co. 210 and Red Mauritius.

Madras§—Central Farm, Coimbatore.—Co. 360, 361, 408, H. M. 320, 332, and 544. Nellikupum.—Co. 205.

Bombay.—Padegaon (Farm)—H. M. 213 (Java Hebbal).

The Imperial Cattle-breeding Farm at Karnal was believed to be free from mosaic disease until last year, but in June, 1933 two local varieties in the block allotted to the sugarcane sub-station were found to be badly affected with mosaic, viz., Dhault of Batala and Katha. The percentage of attack was 8 and 63 respectively.

Artificial Transmission of mosaic

Season plays an important part in producing the disease by artificial inoculation, the period before the setting in of rains (from April to June) being the most suitable for successful artificial transmission. It is curious that sunshine facilitates the artificial transmission of the disease.

A series of experiments were carried out to find out the optimum conditions for successful artificial inoculation of the mosaic disease. The following four methods of inoculation were tried to find out their efficiency in producing the disease under three atmospheric conditions, viz., humid, shade and sunshine :—

Method A.—Hypodermic needle injection (finest possible needle). ●

Method B.—Insertion of fragments of mosaic infected tissue into healthy plants.

Method C.—Wrapping tightly a sugarcane leaf showing mosaic infection round the spindle of a cane stalk to be inoculated and rapidly pricking with fine pin (insect) through the mosaic leaf and spindle, 15 times.

Method D.—Gentle rubbing over a large leaf surface with a cloth soaked in juice from mosaic plants.

1. Humid condition was created by placing the pots in a shady place which was surrounded by water.

2. Shade condition was maintained by keeping the inoculated pots in such a position that sunlight did not fall directly on the plants throughout the day.

● Reported by Sugarcane Specialist, Bihar.

† Reported by Associate Prof. of Bot., Lyallpur.

‡ Reported by Government Mycologist, C. P.

§ Reported by Government Mycologist, Madras.

3. Sunlight condition was maintained by putting the inoculated pots in such a position in the open that sunlight fell direct on the plants throughout the day.

Out of these methods, C was found to be the most efficient one for producing the disease in a series of experiments.

When this method was used the period of incubation was the shortest and cent. per cent. infection of plants occurred under favourable natural conditions.

Sunlight condition has been found to be favourable in visible transmission of mosaic in a short time in the inoculated plants in contrast with the humid and shade conditions as tabulated below :—

No. of shoots showing mosaic in different weeks.

Experimental condition.	Date of inoculation.	Method.	No. of shoots inoculated.	15th to 21st April.	22nd to 28th April.	29th April to 5th May.	6th to 12th May.	13th to 19th May.	20th to 26th May.	27th May to 2nd June.	3rd to 9th June.	Total No. of infection.	Incubation period.	
														Maxi- mum weeks.	Mini- mum weeks.
I. Humid	15th April 1933	(a)	20	..	..	..	1	2	2	1	..	6	7	4
		(b)	21	..	..	..	2	5	2	..	..	10	6	4
		(c)	18	..	..	12	1	1	..	..	..	18	5	3
		(d)	31	..	..	1	4	5	3	2	..	15	7	3
II. Shade	..	(a)	32	..	..	1	3	2	1	..	..	7	6	3
		(b)	20	..	..	..	..	5	1	..	..	6	6	5
		(c)	19	..	..	7	4	..	..	..	..	11	4	3
		(d)	25	..	..	1	..	1	2	..	..	4	6	3
III. Sunshine	..	(a)	20	..	7	6	..	1	2	..	..	16	6	2
		(b)	21	..	..	..	3	4	2	..	..	9	6	4
		(c)	22	..	17	4	..	1	..	..	..	22	5	3
		(d)	17	..	..	4	1	1	..	..	..	6	5	3
<i>Series II.</i>														
I. Humid	3rd May 1933	(a)	10	2	..	..	..	..	5	7	5	2	5	2
		(c)	10	2	6	..	..	2	10	5	2	5	2	
III. Sunshine	..	(a)	10	1	1	..	..	3	5	5	2	5	5	2
		(d)	10	4	5	..	..	2	5	5	2	5	5	2
		(c)	10	..	2	..	..	2	5	5	2	5	5	2

* 1 killed by white ants.

Cultivation of mosaic virus in vitro

Experiments were devised to induce the multiplication of the virus in vitro, but so far no conclusive evidence has been adduced. Tissue culture and other methods have failed to give a culture which reproduces the disease. This should not be taken as an evidence of non-multiplication in vitro because the sugarcane mosaic virus is very susceptible to ageing and Chamberland candle filtrates have invariably failed in reproducing the disease. The virulence of the virus is destroyed by so many factors that it is advisable to keep the question open.

While carrying on cultivation experiments it was found that the transfers of the mosaic virus in series in alkaline broth induce a capricious pleomorphic growth. The juice of healthy tissues failed to give similar phenomenon. As this phenomenon was observed in repeated series of duplicated experiments, the detailed procedure is given below :—

Juice of mosaic infected as well as healthy leave was obtained by crushing them in a mortar with a small amount of water. The juice was successively filtered through a cloth, a filter paper and a sterile Chamberland filter candle L3 or L5; 0.5 cc. of the filtrate was inoculated into 10 cc. of sterile broth having a reaction of p H 7.8. The broth best suited for the purpose had the following composition :—

Peptone	5 gms.	} Broth was adjusted to p H 7.8 and was sterilized at 120° c for 30 minutes.
Marmite	..	..	..	3 gms.
Lithium chloride	..	..	..	2.5 gms.
K ₂ HPO ₄	..	..	..	0.2 gms.
Mg SO ₄	..	..	..	0.2 gms.
Sucrose	..	..	..	2.0 gms.
H ₂ O	1,000 cc.	

The inoculated broth tubes were incubated at 30°—37°c for three to five days

No visible growth developed during the incubation of first transfers. The broth was then filtered through sterile Chamberland filter candle and 0.5 cc. of this filtrate was inoculated into a series of fresh broth tubes, generally in duplicate and triplicate and incubated. After five days' incubation, transfers from these cultures were made into fresh tubes after filtration. One set was set aside for prolonged incubation to see if any growth developed thereby.

In this way a series of transfers were carried out both with mosaic and healthy juice. It was observed that after 10 transfers a slight haziness developed in transfers started from the juice of mosaic infected leaves. The broth was spread on nutrient agar and various other stock agar media but no growth could be discerned on the surface. The haziness increased in the next transfer and spreading of the broth on nutrient agar gave very minute colonies on the agar surface. Most of these colonies failed to give growth on transfer and some gave discontinuous growth with innumerable minute separate colonies.

Further cultivations in broth as well as on agar ultimately gave a heavy continuous growth with small clear depressed areas, similar to bacteriophagic plaques.

The biochemical reactions of the organisms were studied. The growth of the organisms in these culture media was meagre and the characteristics varied unaccountably. Repeated plating and other culture methods failed to separate the culture into organisms with well established different characteristics. The organisms obtained differed in biochemical reactions from those obtained from tomato mosaic but the growth characteristics and other cultural behaviour were found to be similar.

Attempts to produce the mosaic disease by inoculating the cultures and filtrate of the organisms have so far been unsuccessful. Mosaic free stock of very susceptible varieties is being multiplied as material for inoculation with these cultures. As long as the conditions which adversely affect the virulence of the sugarcane mosaic virus are not understood the artificial inoculations with material kept in vitro are likely to be unsuccessful.

Effect of mosaic virus on algae.—The effect of mosaic virus on unicellular chlorophyll bearing organisms were studied. It was observed that the juice of the mosaic infected leaves filtered through sterile Chamberland filter candle, stimulated the growth of a widely distributed unicellular Coccoid Algae of the Pleurococcus order belonging to the genus *Chlorella*. The juice of healthy leaves under similar conditions had no effect on the growth.

Only 0.2 cc. of the filtered juice was added to 10 cc. of Kleb's solution in which the alga was inoculated.

These effects were confirmed in several series of experiments.

Effect of mosaic on chlorophyll content.—The estimation of chlorophyll in the mosaic infected and healthy leaves has been taken up. Badly affected mosaic leaves of Co. 213 contained 20% less chlorophyll than the healthy ones. The comparative distribution of chlorophyll leaf by leaf in Co. 213 is given below:—

1st youngest open leaf 47% of similar leaf of healthy plant.

2nd youngest open leaf 75% of similar leaf of healthy plant.

3rd youngest open leaf 84% of similar leaf of healthy plant.

4th youngest open leaf 95% of similar leaf of healthy plant.

Tonnage experiments in co-operation with Provincial Departments of Agriculture.

In order to study the effect of mosaic on the yield and juice of sugarcane under different climatic conditions and under irrigation, two experiments have been started at Patna and Cawnpore Farms in collaboration with the Deputy Director of Agriculture, Patna, and the Plant Pathologist, U. P.

In Patna Farm mosaic-free plots of the tonnage experiment and the adjoining non-experimental plots were found to be affected with smut, the infection varying from 1.2 to 2.1%. Control measures were carried out.

III.—RED STRIPE DISEASE OF SUGARCANE.

The occurrence of the red stripe disease of sugarcane has been established for the first time in India. Red stripe disease is characterised by two definite types of lesions, (1) that caused by infection of the leaves and (2) that caused by the infection of the growing point. Long needlelike red stripes may be formed in any portion of the leaf blade but generally they appear at or near the base of the leaf blade. They are bright red and follow the course of the vessels. They often coalesce and form a broad lesion. As the leaf matures these lesions assume chocolate-brown colour. Lesions on the growing point bring about top-rot conditions. On splitting open fine needle-like red lines could be traced in the unfurled leaves reaching the growing point. The disease is caused by bacterial infection. The causative organism has been isolated. The bio-chemical reactions differ slightly from those of *Phytomonas rubrilineans* and *Phytomonas rubrisubalbicans*, which are known to cause the red stripe in other sugarcane growing countries.

The organism is usually associated with a species of *Fusarium* in the diseased tissues but inoculations with *Fusarium* alone failed to reproduce the typical red stripe condition.

The organism alone is able to induce the red stripe and top-rot but rather slowly. The *Fusarium* alone also produces a kind of top-rot and local lesions are usually produced. These lesions are blotchy and quite distinct in appearance from typical red stripe lesions.

Artificial production of red stripe and top-rot condition is induced very quickly by inoculation of the organism and *Fusarium* together.

The disease occurs in young canes before the break of the monsoon, and decreases with the progress of the monsoon. It was observed to occur on the following varieties in different localities:—

Pusa.—Co. 315, 316, 321, 333, 334, 335, 336, Uba, Chunnee, 210, 322, 312, 214, 213, 382, 386, 387, 397, 348, 299, 303, 304, 322, 331, 344, 339, 337, 385, 213, 213, 343, 210, 313.

Sepaya.—Red stripe—Co. 213, 210, 300, 301, 312, 313, 326, 331, 335, 341, 342, 385, 281, 320, 343, 297, 298, 299, 303, 321, 322, 338, 345, 346, 318, 347, 329, 332, 333, 334, 336, 337, 339, 348, 349, 350, 353, 354, 356, B. S. 7, 10 and P. O. J. 2696. Red stripe mixed with top-rot—Co. 213, 300, 301, 312, 210, 313, 318, 326, 331, 335, 341, 265, 261, 297, 298, 299, 303, 321, 322, 338, 344, 345, 346, 347, 317, 319, 323, 325, 327, 328, 329, 330, 332, 333, 334, 337, 339, 340, 348, 349, 350, 351, 352, 353, 342, 343, 336.

Dacca.—P. O. J. 2727, Co. 361, 347, 368, 370, 384, 377, 382, 373, 372, 204, 372, 223, 213, 300, 343, 349, 351, 360, 364, 378, 379, 384, 391, 404, 407, 410, 411, 412, 413, H. M. 544 striped, P. O. J. 2714, 2725, 2878, and Fiji B.

At Dacca and Sepaya the disease has assumed serious proportions, the incidence being as much as 80% in some varieties. The disease does not kill the cane outright but the growth is checked and in cases where the top shoot is affected it causes appreciable loss.

IV.—SYSTEMATIC WORK.

During the year under report, 17 bundles of specimens of diseased sugarcane were received from various Government farms for examination and report. Cultures of red stripe disease organisms were received from the Fibre Expert to the Government of Bengal, Dacca, for comparison with Pusa strains. It was found that one of his strains was similar to the organisms causing the red stripe disease at Pusa and Sepaya. The virulence of the organisms was lost by long cultivation on agar.

V.—PROGRAMME OF WORK FOR 1933-34.

I. *Mosaic disease*—

- (1) Survey of the mosaic disease in India.
- (2) Artificial transmission of sugarcane mosaic to hosts other than sugarcane.
- (3) Cultivation of mosaic virus in vitro, identification of the culture obtained from mosaic tissues. Study of the serological reactions of mosaic virus and the organisms obtained from diseased tissues.
- (4) The study of the physiological and histological changes brought about by mosaic disease in sugarcane.
- (5) Effect of various physical and chemical factors on the virulence of the sugarcane mosaic.
- (6) Tonnage experiments to see the effect of mosaic on the yield and juice of canes.
- (7) Varietal test experiments to see the natural spread and resistance of different varieties.

II. The study of the red stripe disease and its control measures.

III. *Sugarcane fungus diseases*—

- (1) Comparative study of different isolates of *Colletotrichum falcatum* from thick and thin canes, to see if there are physiological strains.
- (2) Study of *Fusarium moniliforme* causing top-rot and control measures.
- (3) Survey of fungus diseases in India.
- (4) Isolation of various fungi from different localities and various varieties in order to see whether Indian strains are identical with those in other countries.

APPENDIX XXII.

NOTE DATED THE 10TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 23 (ii).—REPORT ON THE WORKING OF THE SUGARCANE RESEARCH STATION IN THE BOMBAY-DECCAN, PADEGAON FOR THE PERIOD ENDING 30TH JUNE 1933.

The first progress report (annexure) on the working of the scheme of sugarcane research in the Bombay-Deccan Padegaon for the period ending 30th June 1933, has been received and is for the consideration of the Advisory Board. The scheme was sanctioned in June 1931 and started with effect from the 6th June 1932.

2. The progress report was placed before the Sugar Committee at its sixth meeting held at Coimbatore in November last, but as the members had not sufficient time to study the report there was no discussion on the Report.

ANNEXURE.

ANNUAL REPORT OF THE SUGARCANE RESEARCH SCHEME FOR DECCAN, PADEGAON, POST NIRA, R. S., DISTRICT POONA, FOR THE YEAR 1932-33.

CONTENTS.

- (1) Introduction.
- (2) Location.
- (3) Possession of land and P. W. D. Buildings.
- (4) Appointments—
 - (I) Officers.
 - (II) Subordinate Staff.
- (5) Equipment.
- (6) Educational Tour.
- (7) Programme.
- (8) Miscellaneous—
 - (a) Visitors.
 - (b) Opening Ceremony.
 - (c) Help.

ENCLOSURES.

- (I) Annual Report of the Soil Physics Section.
- (II) Annual Report of the Crop Physiology Section.
- (III) Annual Report of the Agricultural Management Section.
- (IV) Programme.

1. INTRODUCTION.

The origin of this scheme has been fully described in the printed copy—Enclosure II. The Sugar Committee which met in Poona in August 1930, passed the following resolution :—

“That the Committee recommends that arrangements be made, which can be expanded and fitted into a general scheme of Agricultural Research as proposed by the Director of Agriculture, Bombay, for an immediate and co-ordinated attack under unified control on the main problems connected with sugarcane plant and to await detailed proposals from the Bombay Government.”

The Sugar Committee further expressed the view that sugarcane research should be located at a place which is representative of the environmental conditions obtaining in the Deccan Canal Zone, and considered that a site more representative than Manjri Experimental Station should be selected.

As a result of the above resolution a full scheme was submitted by the Director of Agriculture. The Provincial Council of Agricultural Research, Bombay, recommended it to the Governing Body and consequently this scheme was sanctioned (reference No. 1241/Agri., dated the 8th June 1931, from the Imperial Council of Agricultural Research, to Bombay Government) for a period of five years.

2. LOCATION.

A few months before the final sanction of the scheme was received, to avoid delay, a survey of the site required for the scheme was undertaken by the then Deputy Director of Agriculture, South Central Division, Poona (Rao Saheb B. P. Vagholkar, L.Ag.). To fulfil the requirements of the scheme, the following was essential :—

- (1) The land should fully represent the tract of the whole canal area in the Deccan.
- (2) In the close proximity of the said piece of land, there should be sufficient residential accommodation for the staff.

Mr. T. F. Main, then Director of Agriculture, Bombay Presidency, inspected several selected sites in July and August 1931 on all the canals in the Deccan and rejected all except the present, as they did not fulfil both the conditions mentioned above. The present site of the scheme has got the land for the farm situated at Padegaon in Phaltan State on the Nira Right Bank Canal at mile No. 12 of Canal Road and the buildings which were meant for offices and residence were available owing to the abolition of the P. W. D. division of the Executive Engineer for construction, about 2½ miles from the Farm site in Padegaon Village of Satara District on the old Poona Satara Road at 43½ miles from Poona. The nearest Railway Station is Nira on M. & S. M. Railway.

3. POSSESSION OF LAND AND P. W. D. BUILDINGS.

As the scheme was sanctioned in June 1931 and as it was meant to work only for five years, every possible effort was made soon after the selection of site, to acquire the site and get the possession of the buildings, without which the scheme could not be launched. The land (104 acres and 10 guntas in area) was taken possession of in October 1931 on lease. Government sanctioned the handing over of the buildings in March as per G. R. No. 5875/27, dated 30th March 1932, and possession was taken from June 1932, soon after the appointment of the officers and staff.

The following statement will give an idea of the property of the scheme:—

Serial No.	Description.	Constructed.	Lent or hired by	Taken on lease.	Remarks.
1	2	3	4	5	6
I	(1) Area of the Farm .	..	..	On lease.	
	(2) (a) Extra area for threshing yard and Latrines . . .	..	On hire.	..	
	(b) Extra area for channel and service road	Acquired .	..	..
II	Buildings—				
	<i>A.—Farm Buildings—</i>				
	(1) Laboratory .	Constructed Departmentally.	..	..
	(2) Implements and Store shed . . .	Do. .	..	..
	(3) Cattle shed .	Do. .	..	..
	(4) Gurhal and Machinery shed .	Do. .	..	..
	(5) Pot-culture house	Do. .	..	..
	<i>B.—Residential Buildings</i>	Do. .	..	..
	<i>C.—Buildings for office—</i>				
	(P. W. D. Building)—				
	(1) Office Building .	..	..	..	Taken from P. W. D. free of rent.
	(2) Laboratory Building . . . . .	..	..	..	Ditto.
	(3) Residential Buildings . . . . .	• ..	..	..	Usual rent is paid to P. W. D. by the occupants.
	(4) Gas shed . . .	Constructed Departmentally.	..	..
	(5) Engine shed .	Do. .	..	..

4. APPOINTMENTS.

I.—OFFICERS.

The following is an abstract from the printed copy of the scheme page 9 :—

"Hence it is proposed to organise this Research Scheme on the basis of one highly qualified officer assisted by two colleagues. These three officers will deal with Soil Physics, Sugarcane Physiology and Agriculture proper respectively."

This shows how the scheme was to be manned. Out of the three posts the two posts of Soil Physicist and Crop Physiologist were advertised in January 1932 and for the third post of Agriculturist, a senior officer from the department was intended to be selected. The selection committee composed of—

- (1) The Chief Secretary to Government of Bombay.
 - (2) The Director of Agriculture, Bombay Presidency, Poona.
 - (3) Principal, Agricultural College, Poona.
 - (4) Vice-Chairman of the Imperial Council of Agricultural Research,
- selected the two candidates for the advertised posts :—

- (1) Dr. J. K. Basu, as Soil Physicist,
 - and
 - (2) Dr. R. D. Rege, as Crop Physiologist,
- and also considered the composition of the staff as a team, and unanimously agreed to the following as a suitable team for the scheme as a whole :—

- | | | | | |
|-------------------------------|---|---|---|--|
| (1) Rao Saheb B. P. Vagholkar | . | . | . | Deputy Director of Agriculture, S. C. D., Poona, to be Principal Agricultural Officer. |
| (2) Dr. R. D. Rege | . | . | . | Crop Physiologist. |
| (3) Dr. J. K. Basu | . | . | . | Soil Physicist. |

These appointments were declared by the end of May 1932 and the officers joined their posts on the following dates :—

Name of Officer.	Date of Joining.	Remarks.
(1) Rao Saheb B. P. Vagholkar, Principal Agricultural Officer.	6th June 1932	..
(2) Dr. R. D. Rege, Crop Physiologist	6th July 1932	Was relieved late by Sind Department of Agriculture.
(3) Dr. J. K. Basu, Soil Physicist	18th June 1932	..

II.—SUBORDINATE STAFF.

As regards appointments in different sections of subordinate staff, it was already decided that the Manjri Farm staff was to be merged in the Agricultural Section and new selections were to be made for the rest of the sections.

The staff joined in June 1932, except the staff under the Soil Physics and Crop Physiology Sections, who joined in August 1932.

The following statement shows the superior staff working in the scheme :-

Serial No.	Section.	Name of Officer.	University qualifications.	Designation.	Remarks.
<i>Officers.</i>					
1	Agriculture .	Rao Saheb B. P. Vagholkar.	L.Ag. (Bom.).	Principal Agricultural Officer.	
2	Crop Physiology.	Dr. R. D. Rege .	M.Sc. (Bom.), Ph.D. (Lond.)	Crop Physiologist.	
3	Soil Physics .	Dr. J. K. Basu .	M.Sc. (Cal.), Ph.D. (Lond.)	Soil Physicist.	
<i>Graduate Assistants.</i>					
1	Agriculture .	Mr. V. N. Apte .	B.Ag. (Bom.)	Superintendent, Padegaon Farm.	
(1)	Agriculture .	Mr. N. B. Patwardhan.	B.Ag. (Bom.)	Assistant.	
		Mr. P. S. Kulkarni	B.Ag. (Bom.)	Do.	
(2)	Crop Physiology.	Mr. P. V. Wagle .	M.Ag. (Bom.)	Senior Assistant.	
		Mr. B. H. Ghatikar	M.Ag. (Bom.)	Assistant.	
(3)	Soil Physics .	Mr. S. S. Sirur .	B.Ag. (Bom.)	Senior Assistant.	
		Mr. V. D. Tagare	B.Sc. (Bom.), B.Ag. (Bom.)	Assistant.	
(4)	Office .	Mr. V. R. Utgi .	..	Head Clerk and Accountant.	

5. EQUIPMENT.

By the time the officers joined in June, the following works were done and purchases were made by the Director of Agriculture. The Engineering Section was supervised by the Assistant Agricultural Engineer to Government, Bombay Presidency, and the Farm Section by the Deputy Director of Agriculture, S. C. D., Poona. The main object, in undertaking these, was not to lose the time of planting and consequently the year of work, as the scheme was for a short period :-

- (1) The Farm land was acquired in October 1931 and the whole area was ploughed with a Tractor plough.
- (2) As the Manjri Farm was to be closed from 1932 April, the seed of cane varieties for trial was transferred to Padegaon and an area of three acres was planted in January 1932 under cane.

- (3) Farm buildings and fencing the whole farm area was almost completed.
- (4) Machinery such as Power Crushers, Oil Engines, Weigh-bridge were ordered and received.

Soon after the joining of the officers, the needs of each officer's section as well as those required to fulfil the object of the scheme were discussed amongst officers as well as with the Director of Agriculture. As a result of this some of the budget heads required re-adjustment and some new ones were needed, with additional grants from other sources, without which it was not possible to start the scheme for what it was designed for. The revised budget was prepared and submitted for Government sanction in July 1932. Even though it took a good deal of time to receive final sanction, the works were started, and mostly completed in time, as otherwise one complete year would have been lost.

The following is a list of works that were decided on after the re-adjustment of the budget :—

- (1) Outlet and special supply channel from main canal, constructed by P. W. D.
- (2) Gurhal and machinery shed and fixing of machinery.
- (3) Structural modifications and fittings to the laboratory.
- (4) Water measuring devices, consisting of meters, tanks, etc.
- (5) Levelling land and making pucca channels.
- (6) Internal distributories in the Farm area.
- (7) Meteorological Observatory.
- (8) Pot-culture house.
- (9) Construction of latrines and baths for staff at the Farm.
- (10) Water and feeding troughs for cattle.

The plans and estimates for all the above works were prepared by the Executive Engineer, Mutha Canals Division, Poona (who was specially asked by Mr. Baxter, Superintending Engineer, Deccan Irrigation and Research Circle, to help) and the Assistant Agricultural Engineer to Government, Bombay Presidency, Poona. The former prepared plans, etc., of Nos. 1 and 6 and the latter for the rest. Even in spite of all possible expedition this did take two to three months' time.

In the Deccan the usual planting season of cane commences from January and naturally the work in all sections should commence from that time. As it was thought extremely essential that all works except Nos. 2 and 9 should be complete by the time it was decided to do all works departmentally except No. 1 which was entrusted to the Executive Engineer, Mutha Canals Division, Poona.

The works Nos. 2 to 10 were executed under the direct supervision of the Principal Agricultural Officer. The Assistant Agricultural Engineer to Government of Bombay had deputed for these works his senior Assistant Mr. V. Y. Chitale, from December 1932 to 15th February. Thus with the help of Dr. Rege, Dr. Basu, Mr. V. N. Apte and Mr. V. Y. Chitale, all the works were completed in time. Dr. Rege and Dr. Basu specially supervised items Nos. 3, 7 and 8.

The Assistant Agricultural Engineer occasionally supervised the works of machinery and water measuring devices, which were designed by him. The following statement shows the dates of starting and date of completion of works :—

Serial No.	Description of work.	Date of Starting.	Date of Completion.
(1)	Outlet and special supply channel from main canal, constructed by P. W. D.	July 1932	9th Jan. 1933.
(2)	Gurhal and engine shed with fixation of machinery	1st Oct. 1932	30th Mar. 1933.
(3)	Structural modifications and fittings in the laboratory	17th Sep. 1932	9th Jan. 1933.
(4)	Water measuring devices consisting of meters, tanks, etc.	1st Dec. 1932	10th Feb. 1933.
(5)	Levelling land and making pucca channels	1st Mar. 1932	10th Feb. 1933.
(6)	Internal distributory in Farm area	7th Oct. 1932	9th Jan. 1933.
(7)	Meteorological Observatory	17th Feb. 1933	31st Mar. 1933.
(8)	Pot-culture house	18th Feb. 1933	15th Mar. 1933.
(9)	Construction of latrines and baths for staff at the Farm	2nd Nov. 1932	18th Mar. 1933.
(10)	Water and feeding troughs for cattle	22nd Dec. 1932	22nd Jan. 1933.

The following statements show the amounts spent on different items for equipping the whole scheme :—

BUILDINGS.

The work of constructing the farm buildings was already started in 1932 January by the Director of Agriculture and the same was completed by June 1932. A map showing the buildings constructed is attached herewith as Enclosure No. 1. The work of gurchal and machinery shed was started in October and completed before the end of March. The statement below gives the list of buildings and the cost incurred :—

Serial No.	Description.	Amount required to complete the work. Rs.
1	3 Graduate Assistants quarters	2,301
2	8 Non-graduate assistants' quarters	4,148
3	Coolie lines, 15	2,967
4	Farm office and laboratory	7,012
5	Burhal and engine shed	3,248
6	Catt'e shed for 10 pairs	1,742
7	Implement and store shed	1,392
8	Latrines	218

The following statement shows the purchases made for equipment :—

EQUIPMENT.

I.—Live Stock and Dead Stock :—		Amount spent.
Item.		Rs.
1. Power crushing mills, oil engine and accessories		9,944
(1) Black stone cold start crude oil engine 32 B. H. P. complete from Messrs. Marshall Sons and Co. Ltd., Bombay	4,996	
(2) Chattanooga No. 192 sugarcane mill fitted with 3 rollers complete with pulley 28" and Bagasse carrier, less juice pump	1,475	
(3) Chattanooga No. 145 sugarcane mill fitted with 3 rollers complete with pulley 28" and Bagasse carrier, less juice pump	990	
(4) Fixing charges of the above three machines and accessories	2,483	
2. Water-measuring devices consisting of meters, tanks, etc.		6,438
3. Pairs of cattle		2,066
4. Implements		1,559
5. Weigh-bridge and two weighing machines.		1,669
6. Office furniture		609
7. Reference books		967
II.—Land Improvement :—		
(1) Fencing the farm area (104 acres and 10 gunthas)		3,518
(2) Levelling land and making pucca channels		3,505
III.—Laboratory Fittings and Apparatus		10,455
Outlet and special supply channel from main canal, constructed by P. W. D.		4,163

6. EDUCATIONAL TOUR.

Before a regular programme of work was drafted Mr. T. F. Main, then Director of Agriculture, suggested a tour on all the canals for the new officers, with the object of getting first-hand information. The officers were taken for 16 days in the whole canal area and by coming in contact with progressive cultivators, first-hand information was obtained.

7. PROGRAMME OF WORK.

The programme of work was drafted after the tour and a programme for 1933-34 has been attached as Enclosure IV. The programme of 1933-34 is preliminary and it is expected that a more thorough programme will be drafted for 1934-35.

8. MISCELLANEOUS.

(a) *Visitors.*—In the early stages the scheme was visited by—

- (1) Dewan Bahadur T. S. Kamblī, Hon'ble Minister for Education, Bombay, on 8th July 1932.
- (2) Sir T. Vijayaraghavacharya, Vice-Chairman, Imperial Council of Agricultural Research, on 5th August 1932.
- (3) Mr. G. K. Deodhar, M.A., C.I.E., on 2nd February 1933.

Besides Mr. N. L. Dutt visited in December 1932 and the members of the Crop Research Committee of the Bombay Department of Agriculture visited on 29th April 1933.

(b) *Opening Ceremony.*—Soon after the laboratory apparatus was received and fitted, on 9th January 1933 the opening ceremony was performed by Dr. W. B. N. S. The function was attended by several members of the Legislative Council and progressive cultivators of canal area and officers of the Bombay Department of Agriculture.

(c) *Help.*—The Superintending Engineer, Deccan Irrigation and Research Circle, Poona; Executive Engineer, Mutha Canals Division, Poona; Mr. V. K. Majgaonkar, Assistant Engineer, Bhatghar; Assistant Agricultural Engineer to Government, Bombay Presidency, Poona; The Chief of Phaltan and the Dewan of Phaltan deserve to be thanked for rendering help to the scheme.

The reports of the work done in 1932-33 in the three sections,—

- (1) Soil Physics,
- (2) Crop Physiology,
- (3) Agricultural,

are enclosed herewith as enclosures I, II and III respectively.

The office of the scheme which was quite new in organisation and had to deal with large amounts, was efficiently managed by the Head Clerk-Accountant Mr. Utgi.

B. P. VAGHOLKAR,

*Principal Agricultural Officer,
Sugarcane Research Scheme, Padegaon.*

ENCLOSURE I.

THE WORK OF THE SOIL PHYSICS SECTION, SUGARCANE RESEARCH SCHEME FOR DECCAN, PADGAON, 1932-33.

I took charge of the Soil Physics Section on the 18th of June 1932. During the year 1932-33 the work of the Section was mostly of a preliminary nature. The first and foremost work was the designing and fitting up of the laboratory. The general plan of the laboratories (i.e., of the Soil Physics and Crop Physiology Sections) was submitted by myself and the Crop Physiologist by the middle of July and the work was undertaken within a short time.

The tentative programme of work was drawn up in September, after touring in the main canal tracts of the Bombay-Deccan, studying the needs of cultivators as well as the factory people in the successful growing of sugarcane. The outstanding problems from the point of view of soil studies are (a) to trace the causes which lead the cultivators to use an increasing dose of manure every year to keep up the same crop yield under perennial irrigation, and (b) to evolve methods to counteract these harmful effects in order to maintain a high level of soil fertility for a number of years.

Accordingly a programme was arranged under the following headings:—

- I. Different soil colloids and how they modify the properties of the soil.
- II. Effect of agricultural operations such as irrigation, manuring, cultivation, cropping and fallowing on the soil colloids and other physical properties of the soil.
- III. Studies of the absorbing complex and the absorbed cations in the soil profile as a basis of genetic classification.

The details of the above programme are given in Enclosure IV, page 159.

The laboratory fittings were completed by January but it was not possible to start regular work until March. During this time the graduate assistants (*viz.*, Messrs. S. S. Sirur and V. D. Tagare, who were appointed on August 5th and 13th respectively) were engaged in the following preliminary work:—

- (1) Sampling of farm Soils.
- (2) Laying out of the experimental plots.
- (3) Soil survey work (A) and (B). Three tours were undertaken by me with Mr. Sirur and three with Mr. Tagare during the winter months.
- (4) From March onwards the laboratory work was started and after preliminary trial of methods the analysis of the composite samples of the light, medium and *chopan* (heavy) soils of the farm were undertaken together with other routine determinations of the periodic samples from the experimental plots. A concise chart of the most important data is given in Tables I and II.

At present the work of the laboratory includes most of the standard physical and chemical determinations of soil. With the ensuing electric installation of the station it is hoped that we shall be able to fit up a more up-to-date laboratory.

(1) *Sampling of Farm Soils.*—To start with, samples of soil from the whole of the Farm area were collected according to the grid system with a two-fold view (1) to study the soil heterogeneity, and (2) to collect soil samples at the commencement of the life of the station so as to afford a useful reference at a later date. According to this system, soil samples were collected 200 ft. apart from one another, by dividing the whole area into squares with sides of 200 ft. and taking soil samples at one of the corners of each square. Each sample was made up of 3 sub-samples drawn near about each other to eliminate sporadic variation. The samples were taken in 3 depths, 0–6", 6–12" and 12–24". Altogether 330 samples from 113 places was collected, dried immediately and stored in galvanized iron tins. The sampling was started on 15th August and finished on 22nd September, there being considerable interruption due to rain.

(2) *Farm Experimental Plots.*—The experimental plots laid out on the farm are mainly connected with soil fertility studies in order to find the effect of various agricultural operations such as irrigation, manuring, cropping and fallowing on the soil colloids and physical properties of the soil. These plots will be maintained permanently to study the effects of the long-continued operation of each treatment.

There are three series of experiments and they are repeated in three types of soil.

Series I deals with the effect of irrigation on the soil, three duties of water being chosen for this purpose, namely 70, 95 and 120 acre-inches per year inclusive of local rainfall.

Series II deals with the effect of manure on the soil. The availability of different manures to plant at different times of the year, their interaction with the soil colloids and how they affect the physical and chemical properties of the soil will be studied in this connection. The medium soil has been made the subject of intensive study, being the most common type of soil in this part. The experiment is laid out in randomised blocks of 18.15 x 12' size (or 1/200th of an acre) in duplicate. There are

six nitrogenous, three phosphatic and two potassic manures, doses being chosen to supply 200 lbs. of N, 100 lbs. of K_2O and 80 lbs. of P_2O_5 per acre, an approximation of the average weights of these ingredients in a 40-ton cane crop.

In the light and *chopan* (heavy) soils, only three nitrogenous, two potassic and one-phosphatic manure have been selected. Measured quantities of water (95" acre-inches) are given to these plots every ten days by means of a standing-wave flume. Irrigation is given in flat beds in these experiments.

Series III deals with the effect on the soil of (a) crops without manure, (b) crops with manure and (c) fallows.

The idea of this experiment is to investigate the effect of crops on the soil deficiency is not in question. The question of fallows will also be studied in this connection in detail in order to find out the recuperative power of different systems of fallows.

The different treatments are:—

- (1) Cane grown in a three-year rotation of sann-hemp (*Crotalaria juncea*) cane and *Nilua* jowar (a fodder variety).
- (2) Continuous plant cane, year after year, (a) with and (b) without manure.
- (3) Continuous ratoon cane (a) with and (b) without manure.
- (4) Continuous "adsali" cane, i.e., July-August planted cane maintained for 18 months and harvested in November next year. It is however, intended to try and maintain adsali for two years so as to avoid leaving the land fallow between November and July as is the case in the ordinary adsali.
- (5) Four kinds of fallows with all possible combinations of irrigation and cultivation, viz.:—
 - (i) Uncultivated and Unirrigated.
 - (ii) Uncultivated and Irrigated.
 - (iii) Cultivated and Irrigated, and
 - (iv) Cultivated and Unirrigated.

The land is laid out in ridges and furrows, 4 ft. apart, the fallow plots also being laid out similarly to serve as corresponding controls.

The plots are irrigated every 10 days in the usual way as in ordinarily cultivated cane, the amount of water not being measured by any special device. It is however, computed, considering the size of the furrows that the irrigation given this way comes to about 2½ acre-inches per irrigation and at this rate 90 acre-inches during the life of the crop, each irrigation being fairly accurately given to the same intensity by a practised farm-hand.

The size of each plot in this series is 1 guntha or 1/40th acre, being 45·37 ft. × 24', the length being the most suitable considering the comparatively sharp gradient obtaining in the Deccan, which are very difficult to level down even to 3 in 500.

There are no randomised replications of the treatments as only vector studies, i.e., the direction which certain changes in the soil will follow being contemplated. However, duplicate samples in each treatment are taken from sub-plots of the same plot so as to get an independent estimate of error for interaction studies.

(3) (A) *Soil Fertility Survey*.—The object of this survey is to study the long-continued effect of irrigation, manuring, cropping and other agricultural operations on the soil development. The Nira Left Bank Canal afforded an excellent field of such investigations, the areas watered by it having been under irrigation for over forty years. Three tours were taken during the year round about Baramati, Wadgaon and Sansar and thirty places were selected whose complete history was known for a number of years. Six-inch samples were collected up to a depth of two feet in all cases, i.e., 120 samples in all. These may be classified as under:—

- (i) Plots under 8 months irrigation for the last 40 years.
- (ii) Plots under perennial irrigation for the last 40 years.
- (iii) Plots which are untouched and uncultivated.
- (iv) Plots which are unirrigated but on which dry crops are grown.
- (v) Plots under perennial irrigation for only 5 to 10 years.
- (vi) Salt-affected and water-logged soils.

The following information about the soils was collected in this connection:—

- (i) Manurial history, past and present.
- (ii) Cultural operations,
- (iii) Irrigation,
- (iv) Rotations,
- (v) Yields,
- (vi) Weeds, etc.

The analyses of these soils are in progress and it is hoped that some useful soil data will be soon forthcoming from this investigation.

(B) *Genetic Soil Survey*.—The subject of a survey of the soils of the Deccan Canal tract has been mentioned under section III of the short programme submitted in the introduction to this Report.

It is necessary to know the types of soils that have to be dealt with before undertaking any systematic study of these soils. According to the latest ideas of soil science a true soil type is one which shows a characteristic "profile development", the geological origin and climatic factors acting on the soil having contributed to the formation of the profile. And it is the view that similar soil types react similarly to agricultural practice.

With this idea in mind, soil profiles in typical places along the Nira Right Bank Canal were examined and described. For this purpose land which had never been cultivated or irrigated was selected. If this was not available, land which had been used for dry farming was selected. To compare with this, a soil profile in adjacent land which had been cultivated and irrigated for reasonably long periods was also taken to find out the changes effected on the original profiles by cultivation, irrigation, etc. Soil samples were collected from different 'horizons' in each case for further analysis at the laboratory for the determination of the depth distribution of bases and acid radicles. The natural vegetation relief, drainage condition, subsoil water and details of cultivation were noted in each case.

Three tours were undertaken during the year 1932-33, two to Malairas and one to Dharmapuri around which 13 profiles were examined. Three more profiles were taken on the farm, making up 16 altogether, from which 92 samples have been collected.

So far the general impression from the morphological examination of the profiles goes to show the following:—

(1) There is no sharp demarcation of zones in the profiles which may be ascribed to the dryness of the climate.

(2) Three different types of profiles have been found to occur, viz.—

(i) Deep black soil overlying "murum" or weather trap, with no colour horizon but giving heavier and more compact structure with increasing depth. The surface soil is crumbly and loose and interspersed with roots.

(ii) Dark grey horizon rich in clay up to a depth of about 2 ft. overlying a layer with lighter texture interspersed with patches of brown material extending upto about 4 ft. Below this is a brownish red horizon with similar texture with concretions of calcium carbonate and silicates. This layer varies in depth and usually goes up to the 'murum'.

(iii) Deep black soil becoming lighter in colour and texture with increasing depth, with no sharp line of demarcation, extending upto 3½—4 ft. Below this there is a white sandy material with good drainage. Black concretions of lime are usually met with just above the sandy substratum.

(4) *Farm Soils*.—The nature of the three types of soils mentioned in the preceding section will be understood from the Tables I and II given below:—

TABLE I.

Mechanical Analysis.

—	Heavy.		Medium.		Light.	
Depth:—			0—12"			
	I	II	I	II	I	II
Coarse Sand . . .	6.49	7.73	8.51	10.89	1.71	1.89
Fine Sand . . .	8.74	10.52	11.72	14.99	27.83	30.93
Silt . . .	19.75	23.52	27.59	35.15	33.00	36.65
Clay . . .	49.00	58.23	30.50	38.98	27.50	39.53
	} Clay Soil.		} Clay Soil.		} Clay Loam.	

TABLE I—contd.
Mechanical Analysis—contd.

— —	Heavy.		Medium.		Light.	
	I	II	I	II	I	II
Depth:—			12—24".			
Coarse Sand	10.60	11.91	2.88	3.45	1.91	2.06
Fine Sand	11.33	12.62	5.68	6.67	21.45	23.10
Silt	21.50	23.95	30.25	36.21	29.75	32.04
Clay	46.25	51.52	44.75	53.67	39.75	42.80

I and II give the percentages on the air-dry soil and on the total mineral constituents respectively.

TABLE II.
Chemical Analysis.

— —	Heavy.		Medium.		Light.	
	0—12".	12—24".	0—12".	12—24".	0—12".	12—24".
	%	%	%	%	%	%
Insoluble residue in HCl.	49.11	50.69	50.20	50.58	60.87	59.06
Soluble silica	13.84	14.98	14.74	15.79	15.25	15.74
Iron (Fe ₂ O ₃)	9.80	9.60	10.40	9.80	9.60	11.80
Alumina (Al ₂ O ₃)	14.20	14.35	14.55	14.15	13.50	11.20
Lime (CaO)	8.50	6.72	7.14	7.49	3.57	4.90
Magnesia (MgO)	1.52	1.83	1.48	1.19	1.68	1.99
Nitrogen	0.044	0.041	0.043	0.034	0.062	0.051
Available K ₂ O	0.041	0.043	0.031	0.036	0.019	0.022
Available P ₂ O ₅	0.035	0.036	0.035	0.034	0.042	0.047
Loss on ignition	16.40	16.26	15.88	15.62	16.90	16.52
PH. values	8.24	8.47	8.24	8.41	8.38	8.51
Total soluble salts	0.23	0.35	0.25	0.29	0.20	0.21

J. K. BASU,

Soil Physicist,

Sugarcane Research Scheme
for Deccan, Padegaon.

ENCLOSURE II.

ANNUAL REPORT OF THE CROP PHYSIOLOGY SECTION FOR THE YEAR ENDING JUNE 1933.

I took charge of the post of the Crop Physiologist on 6th July 1932. My senior assistant Mr. P. V. Wagle was already working on the Manjri Farm whence he was transferred here with all the other staff. He joined his duties on 1st March 1932 and was working in the Agricultural Section till my arrival. According to the printed scheme only one graduate Assistant and two non-graduate assistants were assigned for my section. It was, however, found that it would not be possible to carry out the physiological programme with one graduate assistant only and accordingly the Director of Agriculture made a recommendation to convert one of the non-graduate posts to that of a graduate which proposal was approved by the Bombay Government in their resolution No. 9678/28, dated 17th November 1932. Mr. B. H. Ghatikar who was deputed to this post from the Bombay Agricultural Department joined on 6th February 1933.

This being the first year of the Scheme, much of the period has to be utilised in (1) framing the programme of work (2) setting up of the laboratory and (3) arranging the field experiments. The programme has been settled after studying the conditions of the Deccan Canal Tract under the guidance of the Principal Agricultural Officer who had arranged to bring us in contact with the cultivators and the factory people throughout this tour. I also paid a visit to the Kolhapur tract which is well known throughout India for the best type of gul. Some very important physiological problems besides those mentioned in the printed scheme were suggested during this tour all of which cannot be taken on hand immediately. It is therefore proposed to tackle only the following problems at present:—

- (1) Bioclimatic study.
- (2) Water requirements of sugarcane.
- (3) Manuring requirements of sugarcane.
- (4) Relation of water to manure.

A detailed description of these can be found in Enclosure IV. In addition some minor problems such as the decomposition of Sann (*Crotalaria juncea*) and compost-making are also being studied.

In order to tackle the problems in all their aspects, this section is at present equipped with a meteorological observatory and a pot culture shed. An open space 66' x 66' has been enclosed in a central position in the farm and the meteorological instruments have been installed as shown in the accompanying* photograph, in the remote corner of which the pot culture house can also be seen. This is meant to accommodate fifty pots with an open extension for use in fine weather and is intended for the experiments of both the physiological and physical sections. With the development of the problems it is however felt necessary to have at least a few lysimeters which it is hoped to build in the near future. It is also expected to complete the laboratory equipment during the current financial year as some special physiological apparatus still remains to be ordered out.

The first consideration on my taking over charge was the fitting and equipment of the laboratory which was newly to be started. Though the general fittings of the tables could be completed within a few months, the regular working could not however be started till about the middle of January due to late arrival of the gas machine as well as much of the apparatus from abroad. Advantage was however taken of the last season's crop which was mainly planted for seed purposes (1) in standardising morphological methods (2) in fixing the minimum number of these observations necessary to get an idea of the variation in treatment as well as environmental conditions (3) in the investigation of the optimum favourable conditions for the germination of sets and (4) in getting a general idea of the mineral requirement of the crop by the chemical analysis of harvest-time samples.

Though it is rather too early to draw any definite conclusions from the varied data which are being accumulated, some of the results have given the following important indications which will have to be corroborated on a large scale:—

(i) Application of sulphate of ammonia at the time of planting instead of 3 weeks later as followed in the Standard Manjri Method not only accelerates germination but also leads to increased percentage success as shown in the following table:—

TABLE No. I.

Percentage germination of Pundia.

Period.	With Sulphate of Ammonia.	Without Sulphate of Ammonia.
3 weeks	13	3
6 weeks	37	26
8 weeks	40	29

(ii) Table No. II gives the mineral requirements of crop for two prominent varieties of cane. It clearly indicates that not only the total demand varies with the yield obtained, but there is also a varietal difference in the intake of various constituents, P. O. J. requires for instance more nitrogen per ton of crop while Pundia has got a higher partiality for phosphates and potash.

TABLE No. II.

Mineral intake of Sugarcane Varieties.

	P. O. J., 2878 (40 tons stripped cane) per acre.		Pundia (29 tons stripped cane) per acre.	
	Calculated per acre basis in lbs.	Calculated per ton of crop in lbs.	Calculated per acre basis in lbs.	Calculated per ton of crop in lbs.
Nitrogen	125	2.3	50	1.4
Ash	1500	27.7	951	27.6
Ca O	104	1.9	71	2.0
P ₂ O ₅	133	2.4	108	3.1
K ₂ O	158	2.9	164	4.8

NOTE.—The mineral constituents are calculated on the whole plant including leaves, stem and roots on the basis of the yield of stripped cane actually obtained per acre in year 1932-33.

The normal cane season in the Deccan Canal tract is from 11 to 13 months' duration starting generally from the middle of January. Regular physiological experiments can be therefore started with the season of 1933-34 only. Special field and pot experiments are laid out in three types of soils—light, medium and heavy. Observations are also taken in some of the experiments in the general cropping scheme of the farm. For the intelligent anticipation of the scheme of work as well as for future reference, the layout of the field experiments is given below:

*Layout of the Field Experiments.***I.—Bio-climatic study—**

A well equipped meteorological observatory has been set up here to correlate the climatic factors with the morphological and physiological behaviour of the plant. In addition, thanks to the co-operation of the Deputy Directors of Agriculture, S. C. D. and also of S. D., some of these observations are being taken on the Kopergaon, Gokak and Kumta Farms.

II.—Water Requirement of Sugarcane—

(i) *Pot-culture experiments.*—Galvanised iron pots 3' high x 22" diameter are used for this purpose.

Total Water.—75", 95" and 130 acre inches applied on acre basis; Interval every ten days.

Manuring.—Standard Manjri dose of 150 lbs. N.

Variety.—Pundia.

Replications.—8 per each water treatment, four of which are covered and four exposed to the sun.

Observations.—(1) Botanical (2) analysis of leachates removed before every irrigation for important mineral constituents.

(ii) *Field Experiments.*—Observations are taken in experiment No. III of the general cropping scheme in only two of the six replications from the following water treatments—75, 95 and 130 acre inches with 150 lbs. Nitrogen. In addition there is one plot for each of three water variations which while receiving the same treatment will be without a crop. Total number of plots $12+3=15$.

Observations.—Botanical, soil moisture before and after every irrigation.

(iii) Wilting co-efficient experiments.

(a) Plots $20' \times 12'$ with 5 rows of cane 4' apart.

Treatments of manuring, irrigation, etc., according to the Standard Manjri Method, *Varieties.*—Pundia and P. O. J. 2878.

Stoppage of water.—April, May, August, October, December till permanent wilting when regular irrigation is applied till harvest time.

These experiments are conducted in heavy, medium and light soils.

Total number of plots including those for control=72.

Observations.—(1) Botanical (2) Soil Moisture (3) Root Studies.

(b) *Pipes.*—2' high \times 15" diameter are buried without disturbing the soil. The main experiment with both the varieties is laid in the heavy soil while in the light and medium soil only, Pundia is grown. Treatment is exactly the same as in the plots except that watering is not continued after permanent wilting. Replications 4 per each treatment. Total number of pipes=70.

Nos. (i) and (ii) give an idea of the optimum as well as maximum water requirements of the crop while Nos. (ii) and (iii) its periodical distribution to get the maximum yield from a fixed quantity of manure.

III.—*Manurial requirement of sugarcane*—

(1) *Field Experiments.*—The size of each plot is $48' \times 38'$ with 12 rows of cane 4' apart.

Variety.—Pundia and P. O. J. 2878.

Manuring.—50, 150, 300 lbs. N. (Pundia gets only 150 lbs. N. while P. O. J. all three treatments). All other treatments similar in all the plots. Replication I, total number of plots 4.

Observations.—(1) Botanical (ii) periodical plant sampling for chemical analysis (iii) periodical root studies.

IV.—*Relation of water to manure*—

(i) *Rings.*—Galvanised iron rings 6" high \times 22" diameter are hammered in the soil to 3" depth, leaving 3" above ground to prevent water spreading on the surface.

Total water.—75, 95, 120 and 130 acre inches, applied on acre basis.

Manuring.—50, 150 and 300 lbs. N.

Variety.—Pundia.

Replications.—4 per each treatment—variations 12, total rings, 48. In addition there are two rings receiving 95 acre inches in irrigation with no manure at all.

Observations.—(i) Botanical (ii) soil samples for lateral and downward movement of manure.

(ii) *Field Experiments*—

(a) Experiment III of the general cropping scheme.

Total water.—95 and 130 acre inches.

Manuring.—50 and 150 lbs. N.

Varieties.—Pundia and P. O. J. 2878.

Replications.—Two of each possible combination.

Total number of plots.—16.

(b) III of the physiological experiments.

Observations.—(i) botanical (ii) periodical soil sampling both for downward and lateral movement of mineral constituents.

Experiment III will give an idea of the periodical intake of mineral constituents while Experiments III and IV together the optimum as well as maximum food requirement of Sugarcane under different water treatments.

Planting of the special physiological experiments was done on 23rd January in all the three types of soils. Pots could not however be planted till late in April when the main construction of the pot culture house was completed.

In conclusion, I am very glad to thank all the members of the staff for the complete co-operation they have given me. I may specially make a mention here of Mr. P. V. Wagle who has shown a very keen industry in the discharge of his duties.

R: D. REGE,
*Crop Physiologist,
Sugarcane Research Scheme
for Deccan, Padegaon.*

ENCLOSURE III.

ANNUAL REPORT OF THE AGRICULTURAL MANAGEMENT SECTION FOR THE YEAR 1932-33.

- (1) Administration and Staff.
- (2) Tour.
- (3) Farm and Farm Development.
- (4) Crops grown in 1932-33.
- (5) Layout of Experiments.
- (6) Programme for 1933-34.
- (7) New plantation.
- (8) Miscellaneous.

I took charge of the duties on 6th June 1932 and remained in charge throughout the whole year.

The subordinate staff allotted to this section as per printed scheme, was the Manjri Farm staff, which formed a strength of three graduates. Thus this section is manned with three graduates only. The increased acreage under cane and the new layout of experimentation methods involve a very large number of plots under observation as compared to Manjri Farm. The Manjri Farm staff is therefore found to be quite inadequate to cope with all the problems in the scheme. This was brought to the notice of the Director of Agriculture and as a result it has been decided to curtail the work.

The graduates working in this section are :—

- (1) Mr. V. N. Apte.
- (2) Mr. N. B. Patwardhan.
- (3) Mr. P. S. Kulkarni.

Owing to the retirement of the permanent Superintendent of the Manjri Farm, who was in the grade of Rs. 220—10—300, Mr. V. N. Apte was specially selected by the then Director of Agriculture (Mr. T. F. Main) to fill up the post of the Superintendent, Padegaon Farm. He was transferred from the Southern Division, and joined the post in December 1931. The actual working of Manjri Farm continued till June 1932, as it took a good deal of time after the harvest of the cane crop to wind up and transfer all materials to Padegaon. Mr. N. S. Joshi, B. Ag. worked with Mr. V. N. Apte till the joining of the Manjri Staff in June 1932. In the year under report the following graduates went on privilege leave :—

Name	Period
(1) Mr. V. N. Apte	21 Days
(2) Mr. N. B. Patwardhan	1 Month

and in their vacancies substitutes were engaged for the said periods as without substitutes work was unmanageable.

As per printed scheme and G. R., No. 6061/28, dated 27th May 1932, I being a senior officer was considered responsible for the whole scheme. It was essential to

start work in all the sections at least in January 1933, which is the starting time of the cane season in the Deccan. It was therefore not possible to leave anything incomplete in any section, as it would have delayed the work for some time. Hence most of my time during the year was taken up for fitting up and equipping the other sections, and as a result, I had to leave the development of farm area solely to my senior assistant Mr. V. N. Apte who worked strenuously throughout the year and completed all the farm arrangements in time.

Tour.—A special tour was undertaken to Hebhal and Coimbatore from 3rd to 18th November 1932 at the suggestion of the then Director of Agriculture, Mr. T. F. Main, to study the progress of H. M. 320 cane variety in Mysore and sugarcane-sorghum hybrid in Coimbatore. Mr. N. L. Dutt, Rao Bahadur T. S. Venkataraman and Dr. Badami were kind enough to render me all help.

Farm and Farm Development.—As stated above in General Report page 2 an area of 104 acres and 10 gunthas has been taken on lease for the experimental farm of the scheme. The location of the farm is about 1,804 to 1,825 ft. above the mean sea level with an average rain fall of 18", with climatic conditions approximating to those of the canal zone of the Deccan.

The area comprises of 3 types of soil as per classification of irrigation development and research circle which is mainly based on (1) the depth of the soil and (2) the drainage. The acreage under each type is as under :—

	Areas.
I.—Medium soil passed as fit for cane	95 acres; 10 gunthas.
II.—Light soil not passed for cane but for only seasonal crops	4 acres, 10 gunthas.
III.—Heavy soil unfit for cane but fit for seasonal crops	4 acres and 30 gunthas.

Before the final selection of the site the preliminary survey for soil and murum depth was made by the Deputy Director of Agriculture, S. C. D., Poona. It gave a rough idea as to the nature of the soil. It seems however necessary to undertake a regular survey of the area, under the supervision of the Soil Physicist, with a view to study the effects of soil depths and types coupled with the previous or impervious nature of the substrata on crop production. The soils have been analysed and the idea of the composition, both mechanical and chemical can be had from the results (recorded on pages 19 and 20 Soil Physicist's Report attached herewith).

The area was entirely under rain-fed crops in previous years and hence was not levelled and developed for irrigation. In order to make it suitable for irrigation the following important operations were done :—

- (1) Eradication of deep-rooted weeds.
- (2) Levelling.
- (3) Arrangement for laying out main and subsidiary water channels.
- (4) Construction of a drain for removal of surplus irrigation or rain water.

(1) *Eradication of Deep-rooted Weeds.*—The operation of ploughing the land with a Tractor and Gallows ploughs (working to a depth of 10"—11") was commenced soon after taking possession of the land in October 1931. 67 Acres and 26 gunthas of area was ploughed with the Tractor and the remaining 36 Acres and 30 gunthas with Gallows plough. The cost of Tractor Plough came to Ra. 830-1-6, i.e., Ra. 13-0-7 per acre.

(2) *Levelling*—In the canal zone of the Bombay Deccan the lands are extremely undulating and exceptionally few extensive pieces of land are found of uniform slopes, such as would form a suitable piece of land for experimental purpose. The present piece of land which was till now never developed for irrigation has uniform slopes on both sides West to East and South to North, but it is not very badly cut by ravines. In the main block of medium soil which comprises of 95½ acres the slopes vary from 0.5 to 1 per cent. on both the sides. Owing to these steep gradients in some portions of the area, it was found essential to level them to a certain extent in dividing the land for experimental blocks, which would facilitate uniform irrigation. Thus levelling had to be done in some portions by scraping and depositing layers from 3" to 9" in depth. The levelled portions will naturally take a year or two to come into normal condition for crop growth. However, every attempt has been made not to disturb the soil in most of the places except in places where it could not be avoided. The probable depth, to which a soil can be scraped for purposes of levelling without affecting the soil fertility and the probable time taken by the soil to regain its fertility in case it is affected by scraping, are problems that are as yet unknown, and the same are being studied by the Soil Physicist.

In the year 1932-33 only a limited acreage was levelled which was required for cane planting and the remaining work was postponed for the next year.

Drainage.—Even though the land is well drained having a murum substratum to varying depths, yet to carry off excess rain, water, it was essential to have a drain and the same of 2340' length has been opened at a suitable place in the middle.

(3) *Laying out of main and subsidiary water channels.*—As the whole area was to be laid out in small-sized plots, it required an efficient water distribution system, which was intended to cover the maximum area with irrigation without any erosion of soil and consequent vitiation of experimental blocks. Hence the layout of main channels as well as distributing ones needed intelligent designing. With the help of the Executive Engineer, Mutha Canals Division, the whole system was designed and planned to suit these conditions. The construction work was started departmentally on 1st October 1932 and completed in March 1933 with the exception of few small road crossings and tail outlets. The total length of channels for joining the areas with underground connections has come to 11,892 ft. in length distributed over the whole area. Out of these main channel length is 7812' having a capacity of carrying water from 1 to 2 cusecs.

The water distribution has been found to work well. The map of the Farm area showing the blocks, channels, etc., is attached as enclosure No. 3.

Crops grown in 1932-33.

I.—Cane Crop—

It was decided to close the Manjri Experimental Farm on 31st March 1932 after the cane crop was harvested. As the land at Padegaon was taken in October 1931, it was thought advisable to prepare some area and transfer all important varieties of cane from Manjri Farm to Padegaon, which would supply planting material for the 1933 season. About six acres of land was prepared and the 8 selected varieties mentioned below were planted into six replicates in plots having a size of 6 cents.

(1) Pundia (2) E. K. 28 (3) P. O. J. 2878 (4) H. M. 89 (5) Co. 290 (6) J. 213 (7) H. 109 (8) Str. D. 109.

In addition to this, a surplus area was planted with E. K. 28 and Pundia for seed purposes together with a second batch of Coimbatore selections, received from Mr. N. L. Dutt, Second Cane Breeder. The old museum collection at Manjri Farm which consisted of old long standing varieties was also planted. Thus the total acreage planted under cane was 6 3/5 acres. Planting of the crop was done in the last week of January 1932 and harvesting was commenced in February 1933. The crop was manured with 40 cart-loads of farm yard manure together with subsequent dose of 150 lbs. N. per acre in the form of Sulphate of ammonia top oil cake dressing. The season was abnormal in that the rainfall was almost cent. per cent. higher than the normal for the tract. The following statement gives the mean yield and Brix obtained per acre from the varieties :—

Serial No.	Name of Variety.	Mean Yield in tons of cane per acre.	Mean Brix.	Remarks.
1	Pundia	28.76	19.19	As most of the crop was used for planting, results in gull yield are not available.
2	E. K. 28	42.79	21.74	
3	P. O. J. 2878	40.35	22.58	
4	H. M. 89	39.39	22.02	
5	Co. 290	41.72	21.32	
6	J. 213	33.13	20.04	
7	H. 109	42.23	20.14	
8	Str. D. 109	28.95	20.36	

Coimbatore seedling canes.—Sixteen seedling canes serially numbered from Co. 400 to 415 were received in March 1932 and the whole crop was utilised for planting for seed multiplication during 1933.

II.—*Sann Crop*—

The remaining area of about 50 acres was grown with sann. The sowings had to be done from 15th May till 7th July 1932 as the water distribution system was not organised. Owing to the defective irrigation system and the uneven nature of the soil the crop could not be grown uniformly. After the blocks were marked out for next year's work harvesting was commenced from 16th August 1932 and extended up to 7th October 1932 as the operation was badly retarded by continuous heavy rains. The average yield of green matter obtained was 15,000 lbs. Yields up to 27,000 to 29,000 lbs. green matter were secured with early sowings in some of the areas.

Layout of Experiments.

It had been already decided to have all experiments laid out as per Fisher's thod of randomisation.

Plot Size.—In fixing the size of the plot the following things had to be taken into consideration :—

- (1) The availability of the land for accommodating the number of plots required for conducting the experiments proposed to be undertaken.
- (2) The adoption of a convenient plot unit for proper handling.
- (3) The dimensions that would suit the slope of the land for the even distribution of irrigation water.

It was found that method adopted in some places was not applicable to the conditions at Padegaon. However the cane that was grown in plots of 81·6' x 32' supplied very useful information for the permanent layout. Finally the size of the plot decided on is 54·44' x 32' as the most suitable from the view points referred to above. The plot accommodates 8 rows 4 feet apart. The entire plot gives an area of 4 cents. of an acre and after excluding a ring of 4' lengthwise and 4·5' breadthwise to eliminate border effects it leaves a net area of 2·5 cents of an acre or 1 guntha. The number of individual canes on such an area vary from 1,000 to 1,100 according to the variety, thick, medium, or thin and weigh from 1,800 to 2,000 lbs.

In a special experiment like the one where the quantities of water are being tested, in addition to the ring a space of 8' is left fallow all round the plots. The sketch showing the plot with a ring is attached herewith as enclosure No. 4.

Method of Experimentation and Number of Replicates.—To ascertain the fertility of the land, Sann was grown over the whole area, and even though it had grown unevenly owing to want of regular water distribution on account of the uneven nature of the soil surface, it did supply a provisional data as regards fertility and a guide for the ensuing year, the following two methods are adopted for major experiments :—

- (1) Complex experiment with six replicates.
- (2) Randomised Blocks. Replications varying from 6 to 8.

In minor experiments 4 replicates have been arranged.

Programme for 1933-34.—The programme as laid down for the year is attached as an Enclosure. It is tentative in so far as the experiments of manure and water are concerned. After the study of fundamentals by the Crop Physiologist this year, the same will have to be modified.

New Plantation of Cane.—The abnormal rains which continued till the middle of November, badly checked the progress of the work of constructing channels and distributories. However by 15th February the area planted with cane in all sections, i.e., Agricultural, Soil Physics and Crop Physiology sections was 19 acres and 27·61 Gunthas.

Every member of the staff in this section put in strenuous work during the year.

B. P. VAGHOLKAR,

*Principal Agricultural Officer,
Sugarcane Research Scheme, Padegaon.*

ENCLOSURE IV.

PROGRAMME, IN OUTLINE, OF DECCAN SUGARCANE RESEARCH SCHEME, PADEGAON.

The principal object of this research scheme is to ascertain the most economical method of producing a ton of cane, over a series of years, under the canal conditions of the Bombay Deccan which may be regarded as broadly typical of Peninsular India. The problems involved fall into three main categories, namely—

- (1) Soil problems.
- (2) Plant problems.
- (3) Management problems.

The research programme has accordingly been organized under these three sections with a highly qualified officer in charge of each.

(1) *Soil Problems.*

It is a common experience that irrigation damages the soil to a greater or less extent, especially black-cotton-soil. There is a loss of "heart" reflected in such conditions as—

- (1) More work being required to produce the tilth demanded for a good seed bed,
- (2) A falling off in crop-yields, apart from such causes as a deficiency of plant food.

With regard to cane in particular, the land becomes either unable or less able to produce a ratoon crop or even an *adsali* crop.

An extreme example of damaged soil is the case where the field has become water-logged.

Some useful practical methods have been evolved for counteracting this damage to soil texture, such as manuring with organic manures like cattle-dung or green manure.

It is, however, the object of Dr. Basu, Soil Physicist, to study the actual reactions going on in the soil which, step by step, transform a good soil-texture into a bad soil-texture, and to evolve treatments which will prevent these reactions.

From this standpoint the most important constituents of the soil are colloidal in nature. The dimensions of these particles, in suspension, are usually very small (0.25 "u" or less) and owing to their great interfacial surface they exhibit remarkable power of absorption. They are electronegative and can therefore combine with bases giving rise to colloids having fundamentally different properties. Soils containing sodium colloids are very sticky, impermeable and show "swelling" in a high degree, whereas when sodium is replaced with calcium the resulting calcium colloids show physical properties eminently suitable for plant growth and cultivation. These and other important properties of the soil colloids have given a great impetus to soil scientists to make an intensive study of soil colloids when soil management is in question. The programme of the Soil Physicist will be arranged under the following headings:—

- (I) Different soil colloids and how they modify the properties of the soil.
- (II) Effect of agricultural operations such as irrigation, manuring, cultivation, cropping and fallowing, on the soil colloids and other physical properties of the soil.
- (III) Studies of the absorbing complex (soil colloids) and the absorbed cations in the soil profile as a basis of genetic soil classification.

(1) *Different soil colloids and how they modify the properties of the soil.*—Different soil colloids and their behaviour will be the subject of study under this section. Effect of addition of organic colloids on the physical properties of soils as well as their effects on the availability of soil potash, phosphate and nitrogen to plants will be investigated. Actual amounts of organic colloids supplied by farmyard manure and green manure will also be worked out in lysimeter experiments. Similarly inorganic soil colloids will be separated and the properties of the same with different absorbed bases will be studied. Properties of a mixture of differently saturated colloids will also be investigated from the view points of cultivation and soil management.

(II) *Effect of irrigation, manuring, cultivation, cropping and fallowing, on soil colloids and physical properties of the soil.*—A statistical survey of the canal tracts under irrigation agriculture will be undertaken with a view to correlate the data of yields of various rotational crops and the rates of watering, manuring, cultivation and cropping. Soil samples will be analysed from the representative plots (both from the dry and the irrigated tracts) in order to study the changes undergone by the soil under perennial irrigation and statistical relationships will be worked out between various soil factors and soil treatments. This will further be corroborated by laboratory and field experimentation.

Effect of growing plant-cane, ratoon and *adsali* on the soil will also be investigated. It is generally observed that continuous cropping (growing the same crop every year), has a deleterious effect on the crops themselves. Whether this is due to (i) actual deficiency of plant food materials, (ii) liberation of toxic substances, (iii) soil acidity produced by the evolution of CO_2 by the roots, (iv) deterioration of the soil colloids, will be studied and modification in soil management accordingly suggested. Summer fallow has been found very efficient in most cases to recuperate the soil, and it is proposed to study the different systems of fallows and their influence on the soil.

(III) *Studies of the absorbing complex (soil colloids) and the absorbed cations in the soil profile as a basis of genetic soil classification.*—Study of soil profiles will be undertaken with a view to elucidating the distribution of different bases and acid radicles in the complete horizon and the determination of the effect of perennial irrigation upon the soil reaction and upon other physico-chemical characteristics of the soil. This will entail the following lines of work :—

- (i) Depth distribution of soluble salts and the degree of alkalisation.
- (ii) Genetic soil classification on the basis of the absorbing complex of soil and the absorbed soil cations in the different horizons.
- (iii) The study of the morphology of these soils by Gedroiz's method.
- (iv) Evolution of methods to prevent soil deterioration.

(2) *Plant Problems.*

In the life of a plant, the normal manifestations of its activities are mainly dependent on three factors, viz., climate, water supply and food supply, and any physiological study must embrace these conditions and must distinguish their effect on the three stages of plant life, germination, active growth and maturation.

Climate is perhaps the most important factor in determining the distribution of crops. The Deccan Canal tract is found for instance to be very favourable to cane specially for the superior thick soft canes. Climate also controls the "critical periods" of water and food requirements of the plant and bioclimatic study is therefore essential for the true understanding of the various plant activities.

Due to the insufficiency of rainfall over large areas of the world no other factor is found to control crop production so much as water and recourse is therefore had to irrigation. The irrigation farmer thus gets a water supply at his command and due to the general tendency to over-water the crop, there is a great waste of water which is obtained as in the Deccan canal tract under a very high cost. The exact water requirement of the crop is therefore a very important problem and such physiological work has to be carried out before definite findings can be laid down.

Irrigation brings in its trail the necessity of manuring specially for sugarcane which both from the standpoint of the cultivator and the Government is found to be the most paying crop in the Deccan canal tract. It is however a great feeder and thus the chief obstacle in the way of this crop is the high cost of production incurred by the average cultivator specially during periods of economic depression. It has been demonstrated that a large proportion of the total expenditure on sugarcane is incurred upon manure and its application and it is widely held that the agriculturist overmanures his cane. It has also been suggested that heavy manuring leads to greater consumption of water and also to low quality of gum. The manuring problem thus requires fundamental investigation on the interrelation of water and manure in the soil and also on the demand of the crop for different ions and their periodical intake.

The physiological programme will thus include the following major problems :—

- I. Climatological behaviour of sugarcane and rotational crops.
- II. Water requirements of sugarcane and rotational crops.
- III. Manurial requirements of sugarcane.
- IV. Relation of water to manure.

I.—*Climatological behaviour of sugarcane and rotational crops.*—It is proposed to set up a well-equipped meteorological observatory at the station. Daily climatic records will be kept and their effect on the plant activities will be observed.

II.—*Water requirement of sugarcane and rotational crops.*—Both field and pot-culture experiments will be arranged to find out (i) the minimum and well as the optimum total water requirement of the plant and (ii) their periodical distribution to get a maximum yield from a fixed quantity of manure. Field studies will include (i) Botanical observations both morphological and physiological, (ii) soil moisture determinations and (iii) wilting coefficient. A critical study of the absolute water requirement of plants will be carried out by pot culture experiments in which both loss by evaporation as well as percolation will be eliminated. This will be further supplemented with lysimeter experiments in which water removed in percolation will be accurately determined. It should thus be possible to differentiate between the three main systems—evaporation, transpiration and percolation which control the disposal of water applied in irrigation.

III.—*Manurial requirement of sugarcane.*—A very critical study will be carried out by detailed chemical analysis of the plant as regards (i) the normal as well as the maximum demand of the crop for important mineral constituents and (ii) the intake of these constituents at different stages of plant growth. Further both pot culture and field experiments will be arranged to study the effect of the important manurial ingredients, i.e., N. P. K. on the physiological behaviour of the plant and its yield. Special attention will be also directed to their influence on the quality of gul.

IV.—*Relation of water to manure.*—This investigation is mainly intended to get an idea of (i) the ultimate destination of the manure applied to the land under varying irrigation treatments, in other words to determine (a) what ingredients are taken up by the crop, (b) what are drained away in the water and (c) what remain over in the soil and (ii) the relative effects of water and manure on the physiological behaviour of the plant and yield. This study will include both field and lysimeter experiments and soil and plant samples will be analysed for important constituents.

(3) *Management Problems.*

The farmer wants to know what is the most economic crop-yield under Deccan canal conditions. Does a 30-ton crop pay better or worse than a 40-ton crop of cane? The Agricultural or Management Section will conduct a careful economic investigation into the cost of producing a ton of sugarcane at different pitches of yield within the range of 30 to 50 tons of cane per acre, with due consideration for preserving the soil-texture.

This broad problem will involve a number of incidental problems all having an ultimate bearing upon the cost of production. These include—

- A. Sugarcane Varietal Investigations.
- B. Cultural Investigations.
- C. Manurial Investigations.
- D. Irrigational Investigations.

It is anticipated that the varietal investigations will have a very important bearing upon the economics of cane farming in the Deccan. Hitherto it has proved difficult to find a cane superior to pundia, but during the last few years certain Java varieties, notably E. K. 28 and P. O. J. 2878 have done very well in the Deccan. The Imperial Sugarcane Breeding Station at Coimbatore has also turned its attention to thick or "noble" canes and there are 15 Coimbatore varieties already under investigation at Padegaon, and more will be tried. Similarly the sugarcane-breeding work undertaken by the Mysore Government with the aid of a grant from the Imperial Council of Agricultural Research is likely to give the Deccan some good canes and a selection of these will be added to those already under trial. All these varieties will be subjected to intensive study with special reference to—

- (1) the efficiency of the root system from the standpoint of securing maximum value from fertilisers applied to the land,
- (2) maturity factors such as (a) maturing within 12 months and (b) the stability of the composition of the juice over a long period at harvest time,
- (3) suitability for *adsali* and ratoon purposes,
- (4) tonnage performance in terms of cane, sucrose and gul.

As regards the cultural, manurial and irrigational problems the work undertaken will be largely complementary to that of the Crop Physiologist.

In addition, certain special problems will be investigated such as—

- (1) Cultivation of sann and other green-manure crops.
- (2) Green manuring problems.
- (3) Manufacture of synthetic organic manure and its uses.
- (4) Bare fallows *versus* rotation crops in cane-farming.
- (5) Testing of machinery for varying economic circumstances.
- (6) Improvement of gul-furnaces and gul-manufacture.
- (7) Management of land not considered ideal for sugarcane.

In addition to the programme of work to be conducted at Padegaon it is contemplated to supplement it at suitable centres in the canal zone with special reference to testing under village conditions indications and conclusions obtained at the Research Station.

AGRICULTURAL MANAGEMENT SECTION.

CROPPING SCHEME OF THE PADEGAON SUGARCANE RESEARCH STATION, FOR THE YEAR 1933-34.

Index of Experiments to be conducted in 1933-34.

Serial No.	Description of Experiments.	Block Nos.	Remarks.
<i>A.—Major Experiments.</i>			
I	Requirements of nitrogenous top dressing with sann as basic manure for the cane crop	III-A, B, C, and IV-A, B, C.	
II	Requirements of organic manure (F. Y. M.) and nitrogenous top dressings for the cane crop	II-A, B, C, D, E, F.	
III	Requirements of water and the effect of different doses and quantities of manure and water on the cane crop	I-A, B, C.	
IV	(A) Final trial of promising cane varieties	VII-A. VII-B. VII-C.	
	(B) Preliminary trial of cane varieties	Irregular space—7.	
	(C) Intermediate trial No. 2 of varieties of cane	X-A.	
	(D) Intermediate trial No. 1 of varieties of cane	Irregular space—7.	
	(E) Varieties in museum block	IX-A.	
<i>B.—Minor Experiments.</i>			
V	Comparison of different doses of nitrogenous top dressings with sann, cake and farm-yard manure as basic manures on the cane crop	VI-A, B, C.	
VI	Trial of different nitrogenous fertilizers with sann as basic manure on the cane crop	V-A, B, C.	
VII	Seasonal planting of cane	Irregular space—16.	
VIII	Work on green-manure crops	IX-B.	
	(A) Seasonal planting of sann.		
	(B) Trial of varieties of green manure crops other than sann, e.g., <i>dhaincha</i> , <i>udid</i> , black <i>kulthi</i> and <i>shevri</i> .		
IX	Study of response of different cane varieties in heavy soil	Heavy soil.	

Major Experiment—A.

Experiment No. I.—"Requirements of Nitrogenous Top Dressings with Sann as Basic Manure for cane crop".

(1) *Object.*—The experiment is laid down with a view to see with two varieties Pundia and P. O. J. 2378 whether higher and economic yields could be secured with a heavier or lighter dose of Nitrogenous Top Dressing than 150 lbs. N. per acre, the optimum dose found on the Manjri Farm.

(2) *Layout.*—The experiment is laid down as per Fisher's Complex "Experimentation" method with two varieties and treatments replicated six times and randomised.

(3) *Rotations.*—The rotation is a 3-year one as under :—

Block No.	III-C & IV-C.	III-B & IV-B.	III-A & IV-A.
Crop.	Cane.	Nilawa.	Sann.

(4) *Treatments.*—The treatments are four.

Serial No.	Organic Manure +	Nitrogenous top dressing in the form of cake and Sulphate of Ammonia.	
1	Sann.	200 lbs. N.	} Per Acre.
2	"	150 lbs. N.	
3	"	100 lbs. N.	
4	"	75 lbs. N.	

(5) *Time of applications.*—(1) Basic manure—

Sann is grown in the previous year of cane in June and buried about August. An average crop of sann with 25,000 lbs. of green matter will supply about 100 lbs. N. per acre.

6) *Nitrogenous top dressing* :—

Sources of Nitrogen { A=Sulphate of Ammonia.
 { B=Safflower Cake.

N=Total quantity of Nitrogen per acre in lbs.

The total quantity of Nitrogen is applied in three doses as shown in the following statement :—

Dose.	Time of application.	Quantity of Nitrogen to be applied at each dose.	Source from which nitrogen is derived.
1	Three weeks after planting . . .	1/3 N.	From A alone.
2	Eight weeks after planting . . .	1/3 N.	Equal quantities of Nitrogen from A and B
3	At earthing up of the crop . . .	1/3 N.	From B alone.

NOTE.—Rotation crops receive no manures.

Experiment No. II.—"Requirements of Organic Manure (F. Y. M.) and Nitrogenous Top Dressing for cane crop".

(1) *Object.*—The object is to investigate with two varieties of cane—(1) Pundia, (2) P. O. J. 2378 which combination of quantities of both the manures would give higher economic yield.

(2) *Layout.*—The experiment is laid down as per Fisher's Complex Experimentation method with two varieties and nine treatments replicated six times and randomised.

(3) *Rotation.*—The rotation is a 3-year one as under :—

Block No. Rotation.	II-A & II-B. Cane.	II-E & II-F. Nilawa.	II-C & II-D. Cotton.
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(4) *Treatments.*—The treatments are 9 as under :—

Serial No.	Organic Manure (F. Y. M.)	Nitrogenous top dressing in cake + and Sulphate of Ammonia.	
1	10 Carts	50	} Quantities are per acre.
2	10 Carts	100	
3	10 Carts	150	
4	20 Carts	50	
5	20 Carts	100	
6	20 Carts	150	
7	30 Carts	50	
8	30 Carts	100	
9	30 Carts	150	

(5) *Time of application*—

(1) Basic manure :—Farm Yard Manure is applied before planting cane.

(2) Nitrogenous Top Dressing :—

Sources of Nitrogen { A=Sulphate of Ammonia.
B=Safflower Cake.

N=Total quantity of Nitrogen per acre in lbs.

The total quantity of Nitrogen is applied in three doses as shown in the following statement :—

Dose.	Time of application.	Quantity of Nitrogen to be applied at each dose.	Source from which nitrogen derived.
1	Three weeks after planting	1/3 N.	From A alone.
2	Eight weeks after planting	1/3 N.	Equal quantities of Nitrogen from A and B.
3	At earthing up of the crop	1/3 N.	From B alone.

NOTE.—Rotation crops receive no manures.

Experiment No. III.—Requirements of water and the effect of different doses and quantities of manure and water on the cane crop.

(1) *Object.*—The experiment is laid down with a view to investigate with two cane varieties Pundia and P. O. J. 2878 (1) the actual quantities of water required to obtain the maximum cane crop, with the standard dose of nitrogenous top-dressing and standard Manjri Method of growing cane and (2) to compare whether the increased quantities of water require correspondingly increased doses of manure or otherwise.

(2) *Layout.*—The experiment is laid out as per Fisher's complex experimentation method with two varieties and treatments replicated six times and randomised.

(3) *Rotation.*—The rotation is a 3-year one as under :—

Block Nos. Crop.	I-A. Cane.	I-C. Nilawa.	I-B. Sann.
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(4) *Treatments.*—The treatments are six as under :—

Serial No.	Quantities of water inclusive of average rainfall in acre—Inches.	Nitrogenous top and dressing dose of manure.	
1	70	150 lbs. N.	} Per acre.
2	95	150 lbs. N.	
3	120	150 lbs. N.	
4	130	150 lbs. N.	
5	70	50 lbs. N.	
6	130	50 lbs. N.	

(5) *Irrigation*.—Irrigation in each case is applied every ten days and the total quantities are meant for 12 months according to which it is distributed for each turn. The average rainfall is taken at 18 inches and deductions made for effective rain fall during the interval between two irrigation turns from next irrigation.

(6) *Time of application*—

(1) *Basic Manure* :— Sann which is grown in the previous year forms as organic manure and the same is grown in June and buried in August.

(2) *Nitrogenous Top Dressing* :—

Sources of Nitrogen $\left\{ \begin{array}{l} \text{A} = \text{Sulphate of Ammonia.} \\ \text{B} = \text{Safflower Cake.} \end{array} \right.$
 N = Total quantity of Nitrogen per acre in lbs.

The total quantity of Nitrogen is applied in three doses as shown in the following statement :—

Dose.	Time of application.	Quantity of Nitrogen to be applied at each dose.	Source from which nitrogen is derived.
1	Three weeks after planting . . .	1/3 N.	From A alone.
2	Eight weeks after planting . . .	1/3 N.	Equal quantities of Nitrogen from A and B
3	At earthing up of the crop . . .	1/3 N.	From B alone

NOTE.—Rotation crops are grown as usual without any special manure and irrigation treatments.

Experiment No. IV-A.—Final trial of promising cane varieties. . . .

(1) *Objects*.—The objects in testing different cane varieties are to find out—

- The variety or varieties with a good root system to enable them to take the maximum advantage of soil, water and manure and to prevent lodging.
- The variety or varieties with a tendency to mature within 12 months with a character of no bud-shooting habit and having power of retaining stable composition of juice for a fairly long period during the harvest time.
- The variety or varieties that would be most suitable for *adali* or Ratoon.
- The variety or varieties that should give a higher economic tonnage of cane, sucrose, and gul than Pundia. The ultimate goal is at least 15-25 per cent. more yield than Pundia.

(2) *Layout*.—The experiment is laid down in 8 randomised blocks.

(3) *Rotation*.—The rotation is a 3-year one as under :—

Block No. Crop.	VII-B. Cane.	VII-A. Nilawa.	VII-C. Sann.
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(4) *Varieties*.—The varieties under trial are ten in number.

Serial No.	Name of Variety.
1	P. O. J. 2878.
2	E. K. 28.
3	Str. D. 109.
4	H. 109.
5	Co. 290.
6	H. M. 89.
7	Pundia.
8	C. 360.
9	Co 402.
10	H. M. 320

(5) *Manurial Treatment*.—Manurial treatment is as per Manjri standard method.

NOTE.—In the varieties, seed of Co. 402 has been received from Coimbatore for planting and H. M. 320 from Mandya Farm in Mysore State.

Experiment No. IV-B.—Preliminary trial of cane varieties.

This trial will consist of—

- (1) New strains from Coimbatore specially bred by the Second Cane Breeder and also by the Sugarcane Expert.
- (2) New strains and selections from Hebbal and Mandya Farm in Mysore State.
- (3) Other promising varieties traced out in museum collection.

(1) *Object.*—The object is to see which shows better growth, higher sucrose and earliness. If the above characters are visible in any one or two varieties, they will be taken in the Final Tests.

(2) *Layout.*—There is no special layout but the planting will be done in two to four rows of 27' length according to the seed supply.

(3) *Varieties.*—The following shows the list of varieties under trial :—

Main head.	Serial No.	Name of Variety.	Remarks.
I-A	1	Co. 416	} From the Second Cane Breeder, Coimbatore.
	2	Co. 417	
	3	Co. 418	
	4	Co. 419	
B	1	Co. 351	} Sugarcane Sorghum Hybrids from the Sugarcane Expert, Coimbatore.
	2	Co. 352	
	3	Co. 353	
	4	Co. 355	
	5	Co. 356	
	6	Co. 357	
	7	Co. 281	} From Sugarcane Expert, Coimbatore.
	8	Co. 349	
II	1	H. M. 606	} From Dr. Badami of Mysore.
	2	H. M. 608	
	3	H. M. 607	
	4	H. M. 609	
III	1	P. O. J. 2725.	
	2	B. 6308.	

In addition to the above, Pundia, P. O. J. 2878, Co. 290 and E. K. 28 are grown.

(4) *Treatment of Manure and Water.*—Treatment is the same as per Final Test trial.

Experiment No. IV-C.—Intermediate trial of cane varieties No. II.

This trial will consist of those varieties that have been found promising to a second degree in the preliminary varietal trial.

(1) *Object.*—The object is to test them fully from all the points described under final varietal test.

(2) *Layout.*—They would be grown in a strip system, duplicated. Each variety occupying 4 lines of 54'44" in each strip.

(3) *Rotation.*—The rotation is a 3-year one as under :—

Block No.	X-A.	X-C.	X-B.
Crop.	Cane.	Nilwa.	Sann.

(4) *Varieties*.—The following shows the list of varieties:—

Serial No.	Name of Variety.	Remarks.
1	Co. 358	} Received from the Second Cane Breeder, Coimbatore, in 1930. 1st Trial 1930-31, Manjri Farm. 2nd Trial 1931-32, Padegaon Farm.
2	Co. 361	
3	Co. 363	
4	Co. 364	
5	Co. 365	
6	Co. 400	} Received from the Second Cane Breeder, Coimbatore, in 1931. 1st Trial in 1931-32 at Padegaon Farm.
7	Co. 401	
8	Co. 407	
9	Co. 408	
10	Co. 410	
11	Co. 411	
12	Co. 412	
13	Co. 413	
14	Co. 414	
15	Co. 415	
16	Pundia.	
17	E. K. 28.	
18	Co. 290.	
19	P. O. J. 2878.	

(5) *Treatment for Manure and Water*.—It is the same as in the Final Test trial. *Experiment No. IV-D*.—Intermediate trial of cane varieties No. I.

This will consist of trials of cane varieties specially received from Coimbatore which have stood third in selection.

(1) *Object*.—The object is to test them for one more year to see their performances and if any of these do not come up to standard they will be rejected and if any show better performance they will be selected for final test.

(2) *Layout*.—The same as per preliminary varietal trial.

(3) *Varieties*.—The following list shows the varieties grown in this trial:—

Serial No.	Name of Variety.	Remarks.
1	Co. 403	} Received from the Second Cane Breeder, Coimbatore. 1st Trial at Padegaon Farm in 1931-32.
2	Co. 404	
3	Co. 405	
4	Co. 406	
5	Co. 409	
6	Pundia.	
7	E. K. 28.	
8	P. O. J. 2878.	
9	Co. 290.	

(4) *Treatment of Manure and Water*.—The same as per preliminary varietal trial. *Experiment No. IV-E*.—Cane varieties in museum block.

This will consist of all varieties received from Manjri Farm and those rejected from selections received from Coimbatore, Mysore, etc.

The object is simply to have a collection for general observations.

Each variety is grown as per number of sets available.

The following shows a list of these varieties:—

Block No.	Serial No.	Name of Variety.
IX-A.	1	P. O. J. 2727.
	2	P. O. J. 2725.
	3	P. O. J. 2883.
	4	Co. 281.
	5	Co. 362.
	6	Co. 213.
	7	Str. Co. 290.
	8	H. M. 165.
	9	H. M. 303.
	10	H. M. 500.
	11	H. M. 553.
	12	H. M. 337.

Block No.	Serial No.	Name of Variety.
IX-A.—contd.	13	H. M. 310.
	14	H. M. 210.
	15	H. M. 14.
	16	H. M. 320.
	17	H. M. 544.
	18	H. M. 600.
	19	H. M. 542.
	20	Str. H. M. 544.
	21	Str. H. M. 89.
	22	B. 1528.
	23	B. 6346.
	24	B. 6308.
	25	B. 208.
	26	B. 376.
	27	B. 6388.
	28	Q. 813.
	29	Q. 116.
	30	D. 109.
	31	D. 1135.
		Str. D. 1135.
	32	Red Sport.
	33	Java.
	34	J. 213.
	35	Str. J. 213.
	36	E. K. 2.
	37	Manjav.
	38	Sealy Seedlings.
	39	Kabbu white.
	40	Cavangerie.
	41	Black Cane Nasik.
	42	Khajurya.
	43	Khandya.
	44	White Transparent.
	45	Yellow Mauritius.
	46	Ashy Mauritius.
	47	Manjri Red.
	48	Waxy Red.
	49	Str. Mauritius.
	50	Elephant Cane.
	51	Arrowed Pundia.
	52	Pundia U. P.
	53	Kabirya.
	54	Sacharum Spontaneum.
	55	Green sport.
	56	P. O. J. 2878 X Sealy seedling.
	57	P. O. J. 2878 X Str. D. 109.
	58	P. O. J. 2725 X Nilwa.
	59	P. O. J. 2878 X E. K. 28.
	60	Pundia X Str. 109.
	61	P. O. J. 2725 X Kalbondi.

Minor Experiment—B.

Experiment No. V.—Comparison of different doses of Nitrogenous Top Dressing with Sann, ground nut cake and Farm Yard Manure as basic manures on Cane Crop.

(1) *Object.*—The object of the Experiment is to see with Pundia, the relative advantages of the three principle basic manures along with the standard and reduced doses of Nitrogen Top Dressings.

(2) *Layout.*—The experiment is laid down in four replications with treatments randomised.

(3) *Rotation.*—The rotation is as under :—

Block No.	VI-A.	VI-C.	VI-B.	Remarks.
Crop	1. Cane	1. Nilwa	1. Sann	} Where F. Y. M. and groundnut cake are to come.
	2. Cane	2. Nilwa	2. Fallow	

(4) *Treatments.*—The treatments are six as under :—

S. No.	Basic manure.	Nitrogenous top dressing	Remarks.
1	Sann	75 lbs. N.	} Nitrogenous top dressing in the form of $\frac{1}{3}$ N from safflower cake and $\frac{2}{3}$ N from sulphate of ammonia.
2	Sann	150 lbs. N.	
3	15 Carts F. Y. M.	75 lbs. N.	} Ditto.
4	Ditto	150 lbs. N.	
5	Groundnut cake 1 ton	75 lbs. N.	} Nitrogenous top dressings in the form of $\frac{1}{3}$ N from groundnut cake and $\frac{2}{3}$ N from sulphate of ammonia.
6	Ditto	150 lbs. N.	

(5) *Time of application.*—Basic manures :—

As regards (1) Sann, the system is the same as described under previous experiments.

(2) *Farm yard manure.*—This is applied before planting cane.

(3) *Groundnut cake.*—This is applied before planting cane.

(6) *Nitrogenous top dressing.*—

Sources of nitrogen :—
 } A = Sulphate of Ammonia,
 } B = Oil Cake.

N = Total quantity of nitrogen per acre in lbs.

The total quantity of nitrogen is applied in three doses as shown in the following statement :—

Dose.	Time of application.	Quantity of nitrogen to be applied at each dose.	Source from which nitrogen is derived.
1	Three weeks after planting.	$\frac{1}{3}$ N.	From A alone.
2	Eight weeks after planting	$\frac{1}{3}$ N.	Equal quantities of nitrogen from A and B.
3	At earthing up of the crop.	$\frac{1}{3}$ N.	From B alone.

Experiment No. VI.—"Trial of different nitrogenous fertilizers with sann as basic manure on cane crop".

(1) *Object.*—The object of the experiment is to compare other nitrogenous fertilizers with sulphate of ammonia used in the standard dose with safflower cake with sann being the basic manure. Pundia variety of cane to be grown.

(2) *Layout.*—The experiment is laid out in four replicates with the treatments randomised.

(3) *Rotation.*—The rotation is as under :—

Block No. Crop.	V.A. Cane.	V.C. Nilwa.	V.B. Sann.
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(4) *Treatments.*—The treatments are five as under :—

S. No.	Basic manure.	Quantity of nitrogenous top dressing.	Fertilisers used to supply the N in top dressing.
1	Sann	150 lbs. N.	$\left\{ \begin{array}{l} \frac{1}{4}N \text{ from cake} + \frac{1}{4}N \text{ from calcium cyanamide.} \\ \frac{1}{4}N \text{ from cake} + \frac{1}{4}N \text{ from nitrate of potash.} \\ \frac{1}{4}N \text{ from cake} + \frac{1}{4}N \text{ from sulphate of ammonia.} \\ \frac{1}{4}N \text{ from cake} + \frac{1}{4}N \text{ from nitrate of soda.} \\ \text{From Sulphate of Ammonia alone.} \end{array} \right.$
2			
3			
4			
5			

(5) *Time of application.*—(1) Basic manure :—

Sann is grown in the previous year of cane in June and buried about August. An average crop of sann with 25,000 lbs. of green matter will supply about 100 lbs. N. per acre.

(6) *Nitrogenous top dressing*—

Sources of Nitrogen	$\left\{ \begin{array}{l} A = \text{Sulphate of Ammonia.} \\ A_1 = \text{Calcium cyanamide.} \\ A_2 = \text{Nitrate of soda.} \\ A_3 = \text{Nitrate of potash.} \\ B = \text{Safflower cake.} \end{array} \right.$
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N = Total quantity of nitrogen to be applied per acre in lbs.

The total quantity of nitrogen is applied in three doses as shown in the following statement :—

Dose.	Time of application.	Quantity of nitrogen to be applied at each dose.	Source from which the nitrogen is derived.	Remarks.
1	Three weeks after planting of the crop.	1/3 N.	$\left\{ \begin{array}{l} (a) \text{ From A alone.} \\ (b) \text{ From } A_1 \text{ alone.} \\ (c) \text{ From } A_2 \text{ alone.} \\ (d) \text{ From } A_3 \text{ alone.} \\ (e) \text{ From A alone.} \end{array} \right.$	
2	Eight weeks after planting of the crop.	1/3 N.	$\left\{ \begin{array}{l} (a) \text{ Equal quantity from A and B.} \\ (b) \text{ Equal quantity from } A_1 \text{ and B.} \\ (c) \text{ Equal quantity from } A_2 \text{ and B.} \\ (d) \text{ Equal quantity from } A_3 \text{ and B.} \\ (e) \text{ From } A_3 \text{ alone.} \end{array} \right.$	
3	At earthing up of the crop.	1/3 N.	From B alone in all treatments, except S. No. 5 above where it is from A alone.	

Experiment No. VII.—Seasonal planting of cane.

- (1) *Object.*—This experiment is undertaken to study how the three varieties of cane, Pundia, E. K. 28 and P. O. J. 2878 behave to extend the factory season from 120 to 180 days, if planted in different months.
- (2) *Layout.*—This is laid out in single plots.
- (3) *Rotation.*—Rotation will be fixed on the time of harvest of cane.
 (a) If harvested in March-April the rotation will be cane-cotton-sann.
 (b) If harvested in October-November and December the rotation will be cane-gram-sann.
- (4) *Time of planting.*—Three varieties are planted 8 times in a year as under :—
 (1) January.
 (2) February.
 (3) March.
 (4) April.
 (5) June.
 (6) July.
 (7) November.
 (8) December.
- (5) *Manurial treatment.*—The crop will receive treatment as in the Manjri standard method and the time of application of nitrogenous top dressings as designed for Experiment No. 1.

Experiment No. VIII.—Work on green manure crops.

- (A) Seasonal planting of sann.
 (B) Trial of other green-manure crops like *udid*, black *kulthi*, *dhaincha*, etc.
- (1) *Object.*—(A) seasonal planting of sann.

With varying times of cane planting it may be necessary to sow sann for green manure at different times during the year in order that the buried crop should get time enough to rot but should not remain unnecessarily too long in the soil without the cane crop. It is however likely that sann cannot be grown successfully throughout the year. In order to see at what times it can be successfully grown it will be sown in the following months :—

March.
 April.
 May.
 June.
 July.
 September.
 October.
 November.

Each time sowing will be done in duplicate plots of 4 cents, each.

B. The object is to see what other crops can be grown as green manure crops in the canal tract. The following crops will be tried :—

- (1) Dhaincha.
 (2) Sann.
 (3) Udid.
 (4) Black kulthi.

These will be tried in duplicate 4 cent. plots at two times in June and July to see the best time for planting.

Experiment No. IX.—Study of response of different cane varieties in heavy soil.

- (1) *Object.*—The object is to study how different Coimbatore strains both thick and thin including the sugarcane sorghum hybrids thrive in heavy soil and how they compare with those grown in medium soils.

(2) *Layout*.—These will be grown in two rows of 54.45' length without duplication.

(3) *Rotation*.—The rotation is—

Cane.	Cotton and berseem.	Wheat.	Tobacco.	Rabi jowar.	Big Japanese groundnut.
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(4) *Varieties*.—The following list shows the varieties:—

S. No.	Name of Variety.	Remarks.
1	Co. 281	
2	Co. 351	
3	Co. 352	
4	Co. 353	} Sugarcane sorghum hybrids
5	Co. 355	
6	Co. 356	
7	Co. 357	
8	Co. 360	
9	Co. 402	
10	Co. 408	
11	Co. 412	
12	Co. 290	
13	Co. 285	
14	Pandia.	
15	P. O. J. 2725	

(5) *Treatment of manure and application*.—The organic manure applied is farm yard manure at 30 cartloads per acre and the nitrogenous top dressing is as per Manjri standard method as described under Experiment No. 1.

Notes.

(1) *Plots and plot sizes*.—The size of the plot adopted in general is—

Entire plot = 54.44' x 32' = 4 cents = 1.6 gunthas.

Main plot = 45.37' x 24' = 2.5 cents = 1 guntha.

In water experiments a space of 8' is left all round the entire plots.

(2) *Methods of experimentation*.—The methods adopted are Fisher's—

(1) Randomised blocks,

(2) Complex experimentation,

with replicates varying from 6 to 8 in major experiments and 4 in minor experiments.

(3) *Method of growing cane*.—For cane growing, the Manjri standard method is adopted, which consists mainly of the following items:—

(1) Green manuring with sann in the previous year. (Sann is grown in June and buried in August. An average crop is 25,000 lbs. green matter which supplies 100 lbs. N.)

(2) Ploughing with a Gallows plough.

(3) 4' space between rows with 10,000 sets per acre.

(4) *Rotation*.—Sann-cane-nilwa.

(5) 150 lbs. N Nitrogenous top dressings in form of $\frac{1}{4}$ N, from Safflower cake and $\frac{1}{2}$ N from sulphate of ammonia to be applied in 3 doses as under:—

1st dose—50 lbs. N from sulphate of ammonia At 3 weeks.

2nd dose—50 lbs. N $\frac{1}{4}$ N from sulphate of ammonia and $\frac{1}{4}$ N from cake $\frac{1}{2}$ At 8 weeks.

3rd dose—50 lbs. N from safflower cake At earthing up.

In places where sann is going to be replaced by farm yard manure the rotation adopted is cane-nilwa-cotton.

(4) *Time of planting of cane*.—Planting of cane will be done between 15th January and 15th February.

(5) *Irrigation*.—Cane will receive irrigation every 10 days.

APPENDIX XXIII.

NOTE DATED THE 24TH JANUARY 1934, BY SECRETARY ON SUBJECT NO. 24, APPLICATION FROM THE GOVERNMENT OF BOMBAY FOR A GRANT OF RS. 56,795 SPREAD OVER A PERIOD OF FIVE YEARS FOR RESEARCH ON THE STUDY OF THE DECCAN WINGLESS GRASSHOPPER ("COLEMANIA SPHENARIOIDES").

Attention is invited to the enclosed extract from a letter from the Government of Bombay, No. 1762-A-33, dated the 11th January, 1934 (Annexure), forwarding a scheme (Enclosure to Annexure) for the study of the Deccan Wingless Grasshopper by Mr. T. N. Jhaveri, Assistant Professor of Entomology, Poona Agricultural College.

2. The cost of the scheme is estimated at Rs. 2,500 non-recurring and Rs. 54,295 recurring, spread over a period of 5 years. The Bombay Government's contribution will be limited to the provision of land and buildings which are already available at the Dharwar Farm.

3. The scheme has the support of the Bombay Provincial Agricultural Research Committee and is now for the consideration of the Advisory Board.

ANNEXURE.

EXTRACTS FROM A LETTER NO. 1762-A-33, DATED THE 11TH JANUARY, 1934, FROM THE SECRETARY TO THE GOVERNMENT OF BOMBAY, REVENUE DEPARTMENT, TO THE SECRETARY OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT :—*Research Schemes. Imperial Council of Agricultural Research Application for grants from, for—.*

I am directed by the Government of Bombay (Transferred Departments) to forward the following three schemes for grants-in-aid from the funds of the Imperial Council of Agricultural Research :—

- (i) Research scheme for the study of the Deccan Wingless Grasshopper by Mr. T. N. Jhaveri, Assistant Professor of Entomology, Poona Agricultural College.
- (ii) * * * * *
- (iii) * * * * *

I am to add that the schemes were approved by the Provincial Agricultural Research Committee at a meeting held on 13th December, 1933. The Government of Bombay recommend the schemes for the favourable consideration of the Imperial Council of Agricultural Research. Their contribution towards the cost of the schemes will be confined to the provision of land and buildings which are already available on the Dharwar Farm for work to be done under the first scheme and similar facilities on the Manjri Farm in respect of the work to be done under the third scheme.

* * * * *

(Enclosure to Annexure.)

No. 52/564 of 1933.

COLLEGE OF AGRICULTURE,
Poona, 6th November 1933.

From T. N. JHAVERI, Esq., L.A.,
Assistant Professor of Entomology, Poona;

To THE DIRECTOR OF AGRICULTURE,
Bombay Presidency, Poona.

Subject.—Research Scheme for the study of the Deccan Wingless Grasshopper ("Colemania Sphenarioides").

Sir,

As desired in the Bombay Provincial Agricultural Research Committee held in June last, I have the honour to resubmit my Scheme on the above subject duly recast in light of the discussion that took place in the meeting after incorporating all the details as desired in your letter No. S. 116-L-12742, dated 26th October 1933.

2. The item of the control propaganda has been altogether deleted from the scheme as the funds for the propaganda work are not allotted by the Imperial Council.

3. The scheme has been proposed for a period of 5 years in the first instance. As regards the expenditure for the same, the non-recurring amount is Rs. 2,500 and the recurring is Rs. 54,295. I have provided just the necessary staff to work the scheme. The scale proposed for the Chief Investigator is special and comparatively high as we want a really qualified man to take up the work and as such he should be given a higher remuneration.

4. After going through the scheme it will be noticed that the pest is a serious one and I beg to emphasise that this is a problem of the most vital importance causing an aggregate loss of several lakhs of rupees and covering vast tracts of Karnatak and the Deccan right from Dharwar up to Nasik, and it is quite essential that researches on this pest should be undertaken as early as possible.

5. The Headquarter of the Research Officer with his staff and Laboratory should be kept at or near Dharwar Government Farm, as Dharwar District seems to be the origin and the starting of this pest also appears in a serious form there.

I have etc.,

(Signed) T. N. JHAVERI,

Assistant Professor of Entomology,

College of Agriculture, Poona.

A RESEARCH SCHEME FOR THE STUDY OF THE DECCAN WINGLESS GRASSHOPPER
('COLEMANIA SPHENARIOIDES').

INTRODUCTION.

The Deccan wingless grasshopper is a typically South Indian species known mainly from the Southern part of the Bombay Presidency, Mysore State and a part of the Madras Presidency. Its original home appears to be somewhere on the border between Bombay, Madras and Mysore. The earliest appearance of this pest in this Presidency dates so far back as 1907-08 and it was reported as a pest till the year 1915. Then there comes a period of gap for nearly 7 to 9 years during which time the activity of the insect was not reported. But again from the year 1924 it has come into prominence and is steadily spreading and seriously affecting the principal cereal crops of the tract specially Bajri and Jowar. For a time it remained as a pest of local importance, when further emigration took place it assumed a serious form. The migrating bands of hoppers, whenever the pest appears, have been invading new areas and establishing themselves there and the year after year the pest is gaining more and more ground and extending northwards. At present the area of occupation by the pest extends from Dharwar to Nasik during the span of 23 years (1907 to 1931).

ECONOMIC IMPORTANCE.

This grasshopper is a swarming species and its ability to breed in cultivated lands and in their immediate vicinity makes it a dangerous pest. Although it shows much preference for grasses and cereals, crops of other orders are not exempt from the ravages of the pest. Since this grasshopper is a new genus of recent origin, it is in a decidedly adaptable stage in its evolution and it is therefore an open question whether it finally establishes itself as a specialised pest of Gramineaceous crops or embarks in a phytophagous career. The ravages done by this pest are often considerable, but sometimes they are so enormous that it makes it impossible to grow any particular crop in a locality. Leaving aside the damage in Madras and Mysore, the Bombay Presidency alone suffers a tremendous loss due to this pest. The area under Kharif Jowar and Bajri in the tract where this pest is prevalent is 10,00,000 and 20,00,000. Calculating the average damage at one rupee per acre of Jowar and Bajri each at its minimum the total loss in years of damage comes to several lakhs of rupees annually.

PAST WORK.

The work done on this pest so far is of two kinds : (1) Study of the Bionomics and seasonal history and (2) Control methods—Mechanical and Agricultural. The first has been done in a more or less detailed way in Mysore by Dr. Coleman, and the second has been done to some extent in Mysore and in the Bombay Presidency.

It gives some idea about the life, seasonal history of the pest under conditions obtained in Mysore (vide Bulletin No. 2 of the Mysore Department of Agriculture) and also about the possibility of the control of the pest in Mysore and in the Deccan and Karnatak.

OUR PROBLEM.

The study of this pest was done in 1910 under Mysore conditions. Since then, that is during the span of 23 years, the pest has changed its habits and habitat. Instead of being localised it has been generally spreading and so far as our Presidency is concerned, it has occupied an area from Dharwar up at Khandesh in a particular direction of soil and crops, but has not shown any such tendency in Mysore and Madras. Why this so, as well as what are the ecological influences that keep this in check in certain years and how it reappears or in other words what are the phenomena that help the periodicity of its appearance, all these things require to be investigated. In fact this is more a pest of the Deccan as can be seen from the map of the distribution of these grasshoppers given by Dr. Coleman in his Bulletin above referred to and attached herewith and as such, the pest has to be studied very thoroughly from all aspects under conditions obtained in the area where it is prevalent. After we have got complete knowledge about this pest, it is hoped that the pest could be combated in a more efficient way with a greater success.

The main points for research can be broadly given as under :—

1. Survey work.
2. Establishment of research centre for a detailed study of the pest with a view to evolve effective control measures.

I. Survey Work.

Survey work is absolutely essential if we are to get any inspiration for evolving any suitable line of control. If the origin of the pest has been from a non-pest, the following investigations are likely to throw some useful light. How this happened to be a pest? Was it not due to a change or changes in agricultural system such as replacement of one crop with another or extension of cultivation of favourable food plants, or (2) change from intensive system to extensive of certain crops or *vice versa*? Or was it due to (3) clearing of large forest or uncultivable area into cultivation? Or was it due to (4) eliminating certain factors which have acted adversely on these creatures such as destructions of specific parasites, predators, beneficial birds and other biotic or even meteorological factors; or (5) elimination of such crops which used to act deleteriously on insects, impairing their fertility or fecundity or keeping their multiplication down in some other way; or (6) was it due to abandoning any of the cultural or rotational methods which used to keep down the pest in check?

Now all these investigations are of pre-eminent importance if we want to trace the evolution of this insect from a non-pest to a pest, so that we may be able to retrace the stage of this insect in an opposite direction.

If this species or genus is of recent origin, it is possible to trace the route of variation by thorough survey of all the affected as well as non-affected adjacent areas, more especially the connecting lines—collecting and examining anatomically and physiologically all the variations of this pest and allied acridiids.

II. Detailed study of the pest.

It deals with the following point :—

- A. Bionomics.
- B. Behaviour.
- C. Ecology.
- D. Natural enemies.
- E. Control experiments.

A. Bionomics.—This will give all the information about the periods of the life history, life-cycles and seasonal history.

B. Behaviour.—Under this heading are studied the habits of this pest—principal host plants, alternate hosts, solitary phases, swarming phases, etc.

C. Ecology.—Study of the pest in relation to climate and soil.

D. Natural enemies.—Study of parasites, predators and diseases keeping it under check.

E. Control Experiments.—Trials of different control measures after having got the complete information about the pest.

The budget estimated for the scheme would be as under :—

Non-recurring Expenditure.

	Rs.
1. One dissecting Binocular Microscope	500
2. One Compound Microscope	500
3. Sprayers and Dusters and Jat apparatus	300
4. Equipment of field cages, etc.	1,200
Total	2,500

Recurring Expenditure.

Items.	1st year.	2nd year.	3rd year.	4th year.	5th year.
	Rs.	Rs.	Rs.	Rs.	Rs.
I. Establishment—					
Special Entomologist of the grade of Class II officer of Bombay Agricultural Service at Rs. 320 per mensem in the grade of Rs. 200—15—320—20—440—20—800.	3,840	4,080	4,320	4,560	4,800
Graduate Assistant (Rs. 110—8—150).	1,320	1,416	1,512	1,600	1,704
Non-graduate Assistant (35—5/2—60—4—100).	420	420	480	480	540
One Sotter (Rs. 20—1—40)	240	252	264	276	288
Peon at Rs. 16 per mensem	192	192	192	192	192
Clerk on Rs. 40 per mensem in the grade of Rs. 30—5/2—80.	480	480	540	540	600
II. Travelling allowance	1,500	1,000	1,000	1,000	1,000
III. Contingent charges	1,500	1,000	1,000	1,000	1,000
IV. Rent	600	600	600	600	600
V. Service stamps and Stationery.	75	75	75	75	75
VI. Labour and cultivation charges.	700	700	700	700	700
	10,867	10,215	10,683	11,031	11,499

	<i>Total Expenditure</i>	Rs.
Non-recurring		2,500
Recurring		54,295
	Total	56,795

(Signed) T. N. JHAVERI,
Assistant Professor of Entomology,
College of Agriculture, Poona.

APPENDIX XXIV.

NOTE, DATED THE 29TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 26, APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF RS. 37,580 (RS. 2,630 NON-RECURRING AND RS. 34,950 RECURRING) SPREAD OVER A PERIOD OF TEN YEARS FOR SHEEP BREEDING RESEARCH IN MADRAS.

Attention is invited to the attached letter from the Government of Madras, No. 2669-III/33, dated the 22nd January 1934 (Annexure), forwarding a scheme on sheep breeding at a cost of Rs. 37,580 (Rs. 2,630 non-recurring and Rs. 34,950 recurring) spread over a period of ten years. It has been estimated that a sum of Rs. 8,509 will be recovered by sale of stock during the ten years.

The scheme is now for the consideration of the Advisory Board.

ANNEXURE.

COPY OF LETTER FROM THE SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 2669-III/33, DATED THE 22ND JANUARY 1934.

Revised Scheme on sheep breeding.

In continuation of my letter No. 2669-III/33-2, dated 14th August 1933, I am directed to enclose a scheme on sheep breeding (Enclosure) revised in the light of the recommendations of the Sheep Breeding Committee of the Imperial Council of Agricultural Research.

2. The Provincial Research Committee recommends the scheme.
3. 150 printed copies of the scheme will be forwarded in due course.

(Enclosure.)

REVISED SCHEME ON SHEEP BREEDINGS.

In the Madras Presidency we find the woolly variety of sheep in the districts which have a good cold weather such as the North Salem, Coimbatore and Bellary. Most of these sheep are black and white in colour. At Hosur a flock of Bellary sheep have been maintained with the object of evolving a white breed of sheep. All the ewes we have are white with black on their faces and ears, when these are mated together, we get a fair number of black lambs and very few white lambs besides the white black face. The white lambs are delicate in constitution and cannot stand up to conditions as well as the white black face ones. Through very careful attention some white lambs have been reared but they are smaller, give a less wool yield and are not so robust in health. By mating white and white together, most of the progeny have died and personally I do not think we can raise a white flock without importing a new white ram. Clipping is carried out twice a year, in February and August and the wool yield has risen for the whole flock up to 2 lb. 12 oz. The ewes clip about 1-12 oz. to 2 lb. 4 oz. on the average in the year. The weight of a good white black face ram is about 120 to 125 lbs. At Hosur we have a flock of about 60 ewes. If we can raise a white flock of sheep which will give us about 4 to 5 lb. of wool per sheep, it will be of great help to the ryot. It is fairly hot on the plains; therefore we cannot expect to rear a flock of heavy wool bearing sheep.

It is proposed to use rams of the Bikanir breed in order to find out the effect of such cross-breeding with the Bellary breed and also to do careful selection in the same breed.

Some country ewes will be sold each year on account of age and irregular breeding.

The price of rams appears rather low but it will take time to convince the ryots to purchase them, therefore the price of ordinary country rams has been placed on these cross-bred rams for purposes of income.

The object—

- (1) To breed a type of white wool sheep as far as possible.
- (2) To produce a sheep which will give more and better wool and also a better carcase and one which will respond to feeding and fatten easily and be suitable for the climate of Southern India.
- (3) To ascertain if sheep can stand two lambing periods in one year if well fed without suffering in constitution and physique.
- (4) Best time for castration.
- (5) Teaching of better methods of shearing and wool classing.
- (6) To investigate diseases of sheep in collaboration with the Director of Veterinary Services.

It has been found that shearing twice a year, once in February and the other in August, we get a bigger wool yield in the year.

Buildings and lands.—There are enough buildings and pasture at H. war where the experiment is to be conducted.

Stocking the farm.—I suggest that 200 ewes of Bellary sheep be accepted as the foundation stock to be spread over a period of ten years for the two items of work proposed.

ESTIMATE FOR THE SCHEME.

SELECTED BELLARY FLOCK.

Capital Expenditure.

	Rs.	Rs.
Cost of 40 Bellary ewes at Rs. 10	400	
Railway freight	70	
Cost of one shearing machine and extra blades	120	
	<hr/>	
Total		590
		<hr/>

Recurring expenditure.

Labour—

One shepherd at Rs. 12	144
Three boys at Rs. 8	288
Extra for shearing and dipping	24
One night watchman at Rs. 12	144
	<hr/>
	600
	<hr/>

Maintenance, etc.

Feeding charges concentrates	320
Veterinary charges	30
Cost of dip, etc	20
Repairs to feeding troughs, shearing machines, etc	30
	<hr/>
	400
	<hr/>

Total—First year 1,000

SELECTED

Receipts.

	Rs.	Rs.
First year—		
By sale of wool at As. 5 per lb..	64	
By sale of 15 rams at Rs. 6	90	
By sale of 5 barren ewes at Rs. 6	30	
	<hr/>	184
Second year—		
By sale of wool	72	
By sale of 30 ewes at Rs. 6	180	
By sale of 30 rams at Rs. 6	180	
	<hr/>	432
Third year—		
By sale of wool	80	
By sale of 30 ewes at Rs. 6	180	
By sale of 30 rams at Rs. 6	180	
	<hr/>	440
Fourth year—		
By sale of wool	80	
By sale of 35 ewes at Rs. 6	210	
By sale of 35 rams at Rs. 6	210	
	<hr/>	500
Fifth year—		
By sale of wool	80	
By sale of 38 ewes at Rs. 6	228	
By sale of 38 rams at Rs. 6	228	
	<hr/>	536

GRADED BIKANIR-BELLARY SHEEP.

Capital expenditure.

Purchase of Livestock.

	Rs.	Rs.
First year—		
Hundred Bellary ewes at Rs. 10.	1,000	
Railway freight, etc.	140	
Cost of three Bikanir rams for Hosur	180	
	<hr/>	1,320
Third year—		
Cost of three Bikanir rams	180	180
Fifth year—		
Cost of three Bikanir rams	180	180
Seventh year—		
Cost of three Bikanir rams	180	180
Ninth year—		
Cost of three Bikanir rams	180	180
	<hr/>	<hr/>
Total		2,040

Recurring expenditure--
Maintenance, etc.--

Recurring expenses.

	I	II	III	IV	V	VI	VII	VIII	IX	X
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Staff and labour--										
One farm manager, Rs. 85-5-120 (average pay, Rs. 107-5/9.)	1,291	1,291	1,291	1,291	1,291	1,291	1,291	1,291	1,291	1,291
Leave contribution at 12½ per cent. . . .	161	161	161	161	161	161	161	161	161	161
Pensionary contribution at 8-1/8 per cent. of the maximum pay, i.e., Rs. 120.	111	111	111	111	111	111	111	111	111	111
One shepherd at Rs. 12 for first two years and at Rs. 13 for the succeeding years.	144	144	156	156	156	156	156	156	156	156
Three boys at Rs. 8 each	266	266	266	266	266	266	266	266	266	266
Extra for shearing and dipping, etc. . .	28	28	24	28	28	28	24	20	26	26
Maintenance--										
Feeding charges--Concentrates	320	430	480	500	400	320	320	370	320	370
Veterinary charges, cost of dip, etc. . .	50	50	50	50	50	50	50	50	50	50
Repairs to troughs, shearing machine, etc.	30	30	40	40	30	30	30	30	30	30
	2,430	2,540	2,618	2,640	2,523	2,443	2,426	2,440	2,440	2,440

Receipts.

	Rs.	Rs.
First year--		
Sale of 160 lb. wool at 4 annas	40	
Sale of 5 ewes at Rs. 5 each	25	
		65
Second year--		
Sale of 200 lb. wool	50	
Sale of 5 ewes at Rs. 5 each	25	
Sale of 37 ram lambs at Rs. 5 each	185	
		260
Third year--		
Sale of 250 lb. wool	62½	
Sale of 6 ewes at Rs. 5 each	30	
Sale of 35 ram lambs at Rs. 5 each	175	
		267½
Fourth year--		
Sale of 280 lb. wool	70	
Sale of 40 ewes at Rs. 5 each	200	
Sale of 44 ram lambs at Rs. 5 each	220	
		490

Receipts—contd.

	Rs.	Rs.
Fifth year		
Sale of 240 lb. wool	60	
Sale of 30 ewes at Rs. 5 each	150	
Sale of 45 ram lambs at Rs. 5 each	225	
	<hr/>	435
Sixth year—		
Sale of 220 lb. wool	55	
Sale of 38 ewes at Rs. 5 each	190	
Sale of 38 ram lambs at Rs. 5 each	190	
	<hr/>	435
Seventh year—		
Sale of 260 lb. wool	65	
Sale of 38 ewes at Rs. 5 each	190	
Sale of 38 ram lambs at Rs. 5 each	190	
	<hr/>	445
Eighth, ninth, and tenth years average income each year.	..	440

SUMMARY.*Selected Bellary Flock.*

	Rs.	Rs.
Capital expenditure . . . . .	..	590
Recurring expenditure—		
First year	1,000	.
For ten years . . . . .	..	10,000
		<hr/>
Estimate of income —		
First year	184	
Second year	432	
Third year	440	
Fourth year	500	
Fifth year	536	
Average for five years (sixth to tenth years) at Rs. 540	2,700	
	<hr/>	4,792
		<hr/>

Graded Bikanir Flock.

Capital expenditure—		
First year	1,320	
Third year	180	
Fifth year	180	
Seventh year	180	
Ninth year	180	
	<hr/>	
Total		2,040

Graded Bikanir Flock—contd.

Recurring expenditure—	Rs.	Rs.
First year	2,430	
Second year	2,540	
Third year	2,618	
Fourth year	2,640	
Fifth year	2,522	
Sixth year	2,442	
Seventh year	2,438	
Eighth year	2,440	
Ninth year	2,440	
Tenth year	2,440	
Total	<hr/>	24,950
 Estimate of income—		
First year	65	
Second year	260	
Third year	267	
Fourth year	490	
Fifth year	435	
Sixth year	435	
Seventh year	445	
Eighth year	440	
Ninth year	440	
Tenth year	440	
Total	<hr/>	3,717
 Grand total—Expenditure for ten years—		
Capital expenditure		2,630
Recurring expenditure		24,950
Total		<hr/>
Receipts		8,509
		<hr/>

APPENDIX XXV.

NOTE, DATED THE 2ND FEBRUARY, 1934, BY SECRETARY, ON SUBJECT NO. 15. PROCEEDINGS OF THE SIXTH MEETING OF THE SUGAR COMMITTEE HELD IN NOVEMBER 1933.

The proceedings of the Sixth Meeting of the Sugar Committee held in November 1933 are circulated for the information of the Advisory Board.

2. The recommendations made by the Sugar Committee on the various items of their Agenda have been summarised in the attached statement (Annexure). The action taken on the recommendations is shown in the last column of this statement (Annexure).

ANNEXURE.

Statement showing the recommendations contained in the proceedings of the Sixth Meeting of the Sugar Committee.

Item No. of Agenda.	Subject.	Recommendation of the Committee.	Action taken.
1	Decisions of the Governing Body on the recommendations of the Sugar Committee, Fifth Meeting.	Noted	No action required.
2	Utilisation of Molasses—Power alcohol.	The most important step is to carry out an experiment in the marketing and distribution of power alcohol in admixture with petrol as motor fuel. It is desirable to carry out a commercial experiment in the use of power alcohol in a limited area. Government should meet the cost of equipping two existing commercial distilleries with the special distilling plant required for the production of absolute alcohol and arrange for these to be worked by the owners of the distilleries. An experiment of this nature would afford the basic data on which Government could come to a decision on the question whether legislation would be justified requiring all petrol in India to be mixed with alcohol.	The question has been taken up with the other Departments of the Government of India.
3	Progress report on the experiments conducted by the Government of Bihar and Orissa in devising a satisfactory small-power sugarcane crushing mill.	Recorded. It was suggested that as most of the Provinces which had received grants from the Council for experiments in designing cane crushers had now completed their work, a pamphlet should be compiled summarising the results.	Necessary action will be taken in due course.
4	A test report on the "Phoenix" Cane Crusher by the Sugar Technologist, Imperial Council of Agricultural Research.	(i) The Sugar Technologist should be allowed to test private mills and that the test reports may be published at the discretion of the Council ; (ii) Test reports, whether central or provincial, should be first considered by the Sugar Committee which will decide regarding their publication.	Noted by S. T.

5	Interim report on the experiments conducted by the Sugar Technologist in the construction and testing of and improved juice-boiling <i>b.t.</i>	Certain suggestions were made by the Committee in regard to further experiments.	Communicated to the Sugar Technologist for necessary action.
6	Annual reports of the sugarcane seedling testing station, Dacca, for the years 1931-32 and 1932-33.	Rao Bahadur Venkataraman may be asked to draft a standard form for such reports.	He will be asked accordingly.
7	Annual report of the sugarcane station at Karnal for 1932-33.	Ditto	Ditto.
8	Report on the sugarcane research scheme, Bihar and Orissa, for the year 1932-33.	The Report was approved	No action required.
9	Report on the scheme of research work on the Mosaic and other diseases of sugarcane for the period June 1932 to June 1933.	Ditto	Ditto.
10	Note by the Sugar Technologist on certain proposed changes in the programme of work and equipment of the Research and Testing Station for indigenous systems of <i>Gur</i> and Sugar manufacture.	The Committee approved the proposals made by the Sugar Technologist and also recommended that he should study the economics of vacuum pan factories to suit the requirements of (a) Khandsaris of Northern India and (b) small agricultural sugar manufacturers such as those in South India, the plant in the latter case costing not more than Rs. 10,000.	The Sugar Technologist addressed accordingly.
11	Scheme for an Imperial Sugar Research Institute as revised by the sub-committee.	(i) That the H. B. T. I., Cawnpore, should be utilised for the proposed Research Institute if satisfactory arrangements can be made with the United Provinces Government. (ii) That the Imperial Sugarcane Breeding Station, Coimbatore, should be made a part of the proposed Sugar Research Institute.	Placed on the Agenda for the meeting of the Advisory Board to be held in February 1934, <i>vide</i> item 19.
12	Proposals for the initiation of future research into the insect pests of sugarcane.	The report of the special committee was adopted	Placed on the Agenda for the meeting of the Advisory Board to be held in February, 1934, <i>vide</i> item 19.

ANNEXURE—contd.

Statement showing the recommendations contained in the proceedings of the Sixth Meeting of the Sugar Committee—contd.

Item No. of Agenda.	Subject.	Recommendation of the Committee.	Action taken.
13	Application from the Government of Bihar and Orissa for a grant of Rs. 6,000 spread over a period of three years for a scheme of investigation on the possibilities of manufacturing Khandsari sugar by the single-pan method.	Recommended	Placed on the Agenda for the meeting of the Advisory Board to be held in February 1934, <i>vide</i> item 17.
14	Application from the Government of Madras for a grant of Rs. 45,000 spread over a period of five years for a scheme of research work on the chemistry of sugarcane.	Recommended subject to the condition that the question of leave contribution be further discussed with the Madras Government.	Placed on the Agenda for the meeting of the Advisory Board to be held in February 1934, <i>vide</i> item 16.
15	Scheme for research work on the development morphology and anatomy of sugarcane-sorghum hybrids and of the Indian sugarcane and wild saccharums—Note by Prof. Ekambaram of the Madras University.	Approved	Placed on the Agenda for the meeting of the Advisory Board to be held in February 1934, <i>vide</i> item 20.
16	Application from the Government of Baroda for a grant of about Rs. 25,000 spread over a period of five years for a Technological section to be attached to the Sugarcane Investigation Station at Vyara.	The present scheme may be dropped, and a revised scheme, modified in the light of the discussion which had taken place, be submitted later on.	The Government of Baroda informed accordingly.
17	Proposal by the Sugar Technologist, Imperial Council of Agricultural Research for an Indian Sugar Trade Information Service devoted exclusively to the Indian industry and the Indian markets.	Approved with slight modifications. It was desired that it should be brought into operation as early as possible.	Sanctioned by the Governing Body at its last meeting held in November, 1933.

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18	Note on the utilisation of bagasse for the paper and board industries by Mr. M. P. Bhargava.	The Forest Research Institute should be requested to undertake more extended experiments in the manufacture of paper, etc., from sugarcane bagasse.	Necessary action being taken accordingly.
19	Resolutions passed by the Board of Industries, United Provinces, relating to the sugar industry.	Noted	No action.
20	Minimum prices and sliding scale prices for sugarcane.	That in present circumstances and since protection has been granted to the sugar industry, it is necessary that steps should be taken to secure an equitable distribution of profits between the grower and the miller ; That the fairest way to insure an equitable distribution would be to link in some way the price for cane paid to the grower with the market price of sugar and preferably also with the quality of cane ; That legislation is necessary for securing such price regulation ; That the settlement of a suitable formula should be left to provincial Governments, provided that in the case of adjoining provinces, they should meet in a conference and then come to a mutually agreed decision.	The question is under the consideration of the Government of India.
21	Indian Sugar and Protection—an economic aspect of the question by Mr. Noel Deerr.	Recorded after further discussion	Recorded.
22	Levy of consultation fees for work done by the Sugar Technologist, Imperial Council of Agricultural Research, for Khandsari factories.	The scale of fees proposed by the Sugar Technologist was approved.	Sanction of the Governing Body is being obtained in circulation.
23-A	Report on the working of the Padgaon Sugarcane Research Station in the Bombay-Deccan for the year ending 30th June 1933.	As members had not had sufficient time to study the report, discussion was postponed to the next meeting.	Will be included in the Agenda for the next meeting of the committee. Also placed before the Advisory Board, <i>vide</i> item 23 (ii) of the Agenda, February 1934 meeting.

ANNEXURE—concl'd.

Statement showing the recommendations contained in the proceedings of the Sixth Meeting of the Sugar Committee--could.

Item No. of Agenda.	Subject.	Recommendation of the Committee.	Action taken.
23-B	Statement showing the grants received from the Government of India for sugar research and their allocation.	Recorded	Recorded.
23-C	Correspondence with the Indian Sugar Mills Association regarding their representation at the Sixth Meeting of the Sugar Committee.	The existing practice be maintained, namely that the co-opted members are appointed by name; if the Association wished to change its representatives, it might ask them to resign so that new members might then be co-opted by the Committee. This privilege should not be used too frequently.	The Association will be informed accordingly.

APPENDIX XXVI.

NOTE DATED THE 10TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 18, PROPOSALS FOR THE INITIATION OF FUTURE RESEARCH INTO THE INSECT PEST OF SUGARCANE.

Attention is invited to the attached extract (Annexure I) from the proceedings of the meeting of the Advisory Board held in January 1932 at which the Board, while rejecting the scheme for research work at Pusa on sugarcane insect pests including the carriers of mosaic, recommended, for the favourable consideration of the Governing Body, Mr. Milne's proposal for the initiation of future research into the insect pests of sugarcane, namely, the appointment of a Committee of Entomologists to deal with the problem and to draft a scheme for research. The Board's recommendation was accepted by the Governing Body.

2. At its meeting held in March 1933 the Sugar Committee considered the subject noted above and recommended that a Committee of Entomologists should be constituted to consider the matter, the personnel of the Committee being left to be settled by the Vice-Chairman to the Council. The undermentioned Committee was accordingly appointed by the Vice-Chairman :—

1. The Vice-Chairman, Imperial Council of Agricultural Research—Chairman, *ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. Mr. P. V. Isaac, Offg. Imperial Entomologist, Imperial Institute of Agricultural Research, Pusa.
4. Rao Bahadur C. S. Misra, Assistant Entomologist, Imperial Institute of Agricultural Research, Pusa.
5. Mr. M. Wynne Sayer, Offg. Imperial Agriculturist, Imperial Institute of Agricultural Research, Pusa.
6. Dr. T. V. Rama Krishna Ayyar, Ph. D., Government Entomologist, Madras.
7. Mr. P. B. Richards, Entomologist to Government, United Provinces.
8. Mr. M. Afzal Husain, M.A. (Cantab.), I.A.S., Entomologist to Government, Punjab.
9. Mr. T. V. Subramaniam, Offg. Entomologist, Mysore.
10. Khan Bahadur Maulvi Fateh-ud-din, B.A., I.A.S., Deputy Director of Agriculture, Jullundur.
11. Mr. C. A. MacLean, Deputy Director of Agriculture, Ranchi.
12. Mr. M. Carbery, Assistant Director of Agriculture, Bengal.
13. Rao Sahib B. P. Vagholkar, Officer-in-Charge, Sugarcane Research Station, Bombay-Deccan.

Secretary, Imperial Council of Agricultural Research—Secretary, *ex-officio*.

3. A copy of the report of the Sub-Committee (Annexure I-G) is attached together with copies of the technical notes presented to the Committee (Annexures I-A to F).

4. The report of the Sub-Committee (Annexure I-G) was adopted by the Sugar Committee at its last meeting held in November 1933, *vide* extracts from the proceedings of the Committee at Annexure I-H.

5. The report (Annexure I-G) is now for the consideration of the Advisory Board. If the Board agrees it is proposed to address the Governments concerned asking them to submit schemes on the lines of the report of the Sub-Committee.

ANNEXURE I.

EXTRACT FROM THE PROCEEDINGS OF THE ADVISORY BOARD, JANUARY 1932.

* * * * *

"Dr. McRae in introducing the subject stated that the work comprised under the scheme was of an important nature and he moved that the decision of the Sugar Committee be reversed. Mr. Hewlett seconded the motion.

Professor Gangulee enquired if any entomological work on sugarcane had been done at Pusa. Dr. McRae gave details of the work done and explained that if the present scheme was sanctioned, it will become possible to carry on more definite and intensive work. Dr. Coleman was of the opinion that the work was of an important nature and should be done. But as Mr. Fletcher was not in a position to accept alterations, the Sugar Committee may be asked to go into the matter once more and get a more modest scheme prepared. This was, however, objected to as beyond the scope of the Sugar Committee. Mr. Milne suggested that the work may be done on lines similar to those adopted by the Indian Central Cotton Committee by selecting scholars to work in those localities where the pests occur and to set up a co-ordinating committee for controlling the work of the scholars.

Dr. Gangulee considered the scheme too expensive and was against the expenditure being incurred. Mr. Finlow said that if the Board rejected the scheme it should at least add a rider that it recognised the importance of the borer so that perhaps another scheme more acceptable to the Board could be submitted in due course. Mr. Milne suggested that a Committee of Entomologists and Mycologists should be created to deal with this wide flung problem. Under the direction of such a committee a scheme for research should be framed which would then be submitted to the Council. In his opinion research scholars posted in areas where the diseases chosen for investigation are prevalent and working under the local entomologist would probably meet the needs of the case. If accepted, the scheme would be carried out under the direction of a small standing sub-committee which would act in concert with the Council's Sugar Committee. Dr. Subrahmanyam agreeing with Dr. Gangulee said that the rates of pay proposed were too high. The Council could get well qualified workers for Rs. 350—550 for the first post, Rs. 200 to 300 for the second and Rs. 120 to 220 for the third. Dr. Agharkar said that, in his opinion, an investigation was necessary but that the agency was not suitable in that it was too costly. He favoured Mr. Milne's idea. He also suggested that on such a committee the co-operation of the Forest Entomologist and the Zoological Entomologist should be obtained. In the result the Board rejected the scheme proposed by Mr. Fletcher and recommended Mr. Milne's proposal for the initiation of future research into the Insect Pests of sugarcane to the favourable consideration of the Governing Body."

ANNEXURE I-A.

A SCHEME OF RESEARCH WORK TO DEAL WITH THE PROBLEM OF SUGARCANE INSECT PESTS. *Note by P. V. Isaac, Esq., Offg., Imperial Entomologist, Pusa.*

There is no cure for insects as a whole. Insect damage is continuous and varied and when one insect is controlled others will still be found on the increase. There is the instance of certain insects which depend on cane for their breeding, not seriously injurious to cane but causing much inconvenience and loss to an industrial concern. Recently in a large cane area so many of these insects were produced that they sat on the insulators of high tension electric wires and caused frequent short circuiting that the electric supply company had to introduce specially devised insulators to get over this trouble. It is, therefore, necessary to have a permanent establishment for the study of all the insects that breed on cane.

Main Lines of Work.

The insects damaging cane include Termites, Crickets, Beetles, Shoot, stem and root-boring caterpillars and juice-sucking bugs and others. Among them those that cause most injury are: Termites and Shoot, stem and root-boring caterpillars.

1. *Termites*.—Termites (called white ants) live in the soil and attack newly planted setts, young shoots and roots. Very little is known of the species of termites present in India and their habits. Some time ago an Entomologist discovered that on a farm where termites were bad and much money was being spent in digging out termite colonies that the colonies dug out were those of a harmless species and that the nests of the really injurious species were overlooked. Termites will have to be collected and identified and their habits studied before control methods are devised and tried.

2. *The Shoot-borer*.—The well known Shoot-borer is *Scirpophaga nivella* Fabr. Another species, *Scirpophaga monostigma* Zell, also occurs as a shoot-borer. Further observations are required to learn the range of distribution of these insects and their habits.

3. *The stem-borers*.—At present we know of three important stem-borers: *Argyrotaenia sticticraepis* Hmp. *Chilo zonellus* Swinh. and *Diatraea venosata* Wlk. Before 1912 it was held by many that it was one insect the "Moth borer" that bored in cane, maize and juar (Sorghum). To protect sugarcane from borers, maize and juar were tried as trap crops in certain places and no results were noticed. Careful examination of the moths showed that they belonged to several species with different host plant preferences. Besides the three species mentioned above there are others which occur in small numbers or only in certain areas. Extensive collection and morphological studies alone will give definite information on the species, their distribution and food-plants and natural enemies.

4. *The root-borer*.—This pest *Emmalocera depressella* Swinh. is also said to occur on maize and juar. In 1917 this insect was not considered to be of great importance. Since then reports have been received leading to the conclusion that the insect is today to be estimated as a serious pest. Further study of the bionomics of this insect is also urgently required.

Above are instances of four pests which require immediate investigation. For any control of the damage done to sugarcane by insects it is necessary to make as complete an investigation as possible of the habits, seasons and areas of distribution of all the species that feed on cane in India. Predators and parasites which effect a natural control on the multiplication of these insects will also have to be closely studied. The object of these studies will be two-fold—one, the devising of artificial control methods against the important insect pests and two, the encouragement of natural enemies by breeding and liberating the parasites and predators of the pests.

Another line of work that is urgently required is the examination of new varieties of sugarcanes for their susceptibility to insect attacks. If the new canes that are distributed are not less prone to be attacked by insects than the old varieties which they are intended to displace the problem of insect injury and consequent financial loss will only increase.

Work on these cane insects could be started immediately as considerable information on cane pests has been gathered at Pusa and by the Entomologists in the various Indian Provinces.

LOCATION OF LABORATORIES.

Pusa could be made the headquarters as it can help:—(1) with laboratory and library facilities; (2) with the services of artists; (3) in the identification of insects and (4) in the proper housing of insect collections and other museum objects. There would be great saving in expenditure on buildings and laboratory fittings and Entomological publications if this is accepted. If Pusa is made the headquarters for work on sugarcane insects it would be desirable to have two sub-stations, one suitable for the rearing and study of the development of the insects found on cane and as a centre for the trial of control measures and another suitable for the rearing and distribution of parasitic and predaceous insects. The first sub-station could be Dehra Dun which (1) is a central place in the North Indian cane area, (2) is easy of access and (3) where probably housing and land would be easily available (4) work could be carried on without inconvenience during summer as it seldom gets very hot in Dehra Dun, and (5) the existence of a well-developed Entomological Section at the Forest Research Institute there is also an advantage. For the second sub-station it would be necessary to select a place where the summer is not so hot and the winter is not so cold as to send insects parasites and predators into aestivation or hibernation, or to kill them off when liberated in fields, and transport facilities by land and sea are also available. A place like Vizagapatam would perhaps meet these demands as (1) it is in a cane growing area, (2) is a port and a Railway centre and (3) is close to the Anakapalle and Samalkot Experimental Farms. It was from Samalkot that a Japanese Entomologist visiting India for collecting parasites to be exported to Japan for the control of some of their insect pests, collected the Chalcid parasite *Trichogramma minutum* Riley which it is believed could be used in India against sugarcane stem-borers. Mysore State and Ceylon are now using parasites of this genus and Vizagapatam is close to these areas.

STAFF REQUIRED.

The staff for the work of the kind I have suggested should include :—

- One Sugarcane Entomologist.
- Two Senior Assistants.
- Three Junior Assistants.
- Three Typist clerks.
- Three Fieldmen.
- Three Setters (Laboratory attendants) and
- Three Chaprassis.

The Sugarcane Entomologist will have his headquarters at Pusa. One Senior Assistant will be in charge of Dehra Dun and the other Senior Assistant will be in charge of Vizagapatam. Each of these three officers will have attached to him one Junior Assistant, one Typist Clerk, one Fieldman, one Setter and one Chaprassi.

EXPENSES.

The recurring expenditure is indicated in the table below, and amounts to roughly Rs. 40,000 a year.

Besides the amount for salaries about Rs. 30,000 will be required during the first year as a non-recurring expenditure for quarters and laboratories. Perhaps the Cane Entomologist could be housed in one of the Pusa vacant Class I bungalows, the staff at Dehra Dun and Vizagapatam could live in rented houses, and then there will be need for quarters for some of the staff at Pusa only. Money will also be required for building and equipping the two sub-station laboratories. The cost may be roughly estimated as follows :—

A. Recurring.

1. Salaries.

	Rs.
Pay of Sugarcane Entomologist at Rs. 1,000—50—1,250	12,000
Pay of two Senior Assistants at Rs. 150—20—350	3,600
Pay of three Junior Assistants at Rs. 100—10—150	3,600
Pay of three Typist clerks at Rs. 60—5—85	2,160
Pay of three Fieldmen at Rs. 60—5—85	2,160
Pay of three Setters (Laboratory attendants) at Rs. 40—5—65	1,440
Pay of three Chaprassis at Rs. 12 each	430

Total

25,390

2. Travelling Allowance	4,000
3. Apparatus and Experiments	3,000
4. Contingencies (Stationery, books, postage, etc.)	2,610

Total (First year)

35,000

Allowing for increments average annual expenditure would be roughly

40,000

B. Non-recurring.

	Rs.
1. Quarters for one Junior Assistant at Pusa	8,000
" for one Typist at Pusa	4,000
" for one Fieldman at Pusa	4,000
" for one Setter at Pusa	3,000
" for one Chaprassi at Pusa	1,000
2. Laboratories at Dehra Dun and Vizagapatam	6,000
3. Apparatus and laboratory equipment	4,000

Total Non-recurring Expenditure

30,000

ANNEXURE I-B.

THE PROBLEM OF INSECT DAMAGE TO CANE AND SOME LINES OF INVESTIGATION.

It is I think generally agreed among all those whose work lies with sugarcane that insect attack on the cane crop in the northern portion of British India does more damage than all the other known cane diseases put together.

In the course of the last twelve years I have had many opportunities of seeing the damage done by insects to standing cane and I have no hesitation in saying that 40 per cent. is not an excessive estimate of the damage done in a bad year and the insect menace is the greatest obstacle we are now faced with in the development of the Indian sugar industry on secure lines.

An organised plan of campaign to deal with the losses caused by insects in all its aspects is long overdue as not only are we totally unable to cope with the damage at present being done but we are never free from the liability of increased trouble in the future if some organised method of lessening the damage is not worked out. I attach herewith a list of sugarcane pests kindly furnished to me by the Entomological Section, Pusa.

The chief damage to the standing cane crop in my opinion is done by the borers, top, stem and root, leaf sucking insects and beetles. The corn aphid (A. M. Fitch) is linked up with the transmission of a most dangerous disease (mosaic) in other countries but its working hours in North India appear to be so few that I think we can leave it out of the category of destructive insects in Northern India at least until mosaic becomes more definitely harmful in that area.

Termites or white ants represent a type of insect attack which can be dealt with under ordinary conditions—as its spread is comparatively controllable and experiments connected with its destruction and control do not of necessity affect other cane work.

Termites or white ants. To use their more general name do a great deal of damage to newly planted cane.

There are three known ways of dealing with them :—

1. Deep and frequent cultivation of land.
2. The use of crude oil emulsion in the irrigation water
3. Stopping of cane sets.

1. The first has been adopted with great success in Pusa and we now have far less white ant attack than formerly and *our rotation* in which cane follows a thoroughly rotted green manure crop has assisted in lessening the incidence of the attack, *but any attempt to grow cane on light land out of the ordinary rotation is certain to produce an attack.* Growing cane on heavy low land is a certain solution for white ant trouble which really only occurs when cane is, in my opinion, grown on *unsuitable* land due to outside causes over which we have no control. Land which has held a regular white straw crop rotation is also liable to white ants but I consider that if land is properly worked and kept to a proper cane rotation, and such manures as half rotted Farm-yard manure, which attracts white ants, are avoided, the damage can be kept down.

2. Crude oil emulsion in the irrigation water is our standard treatment for nursery cane when attacked by white ants, it is cheap and efficient—but its use is limited to irrigated cane.

3. Stopping of sets.—This is the obvious way to deal with white ant attack and a well considered line of research investigation on this point should produce results. We have tried tar and oil on sets and neem cake sown in furrows with sets, but all to no effect. *Something* repels the white ant, as frequently a few sets are left untouched in rows which are otherwise completely eaten, but we have no knowledge of what this is or how it operates.

The white ant has apparently a preference for certain canes, mostly those of higher sucrose content, it would appear, but I am uncertain if this may not be linked, (as high sugar content almost always is) to weaker agricultural habit which possibly possesses less defence against the white ant.

Delayed germination apparently does not of necessity encourage white ants. Co. 205 which is notable for the above is not specially liable to attack. Any injury—long cabbage on sets, dead eyes, seems to attract, but this is not a general rule in my experience.

Work on this part of the insect pests problem could be conducted anywhere as control is easy and there is no fear of damage to other cane experiments.

Leaf Sucking Insects.

Leaf sucking insects do not in my opinion constitute a serious danger in Northern India at present. The four months' period during which the cane makes its chief growth is so short and leaf formation and growth so fast that the cumulative effect of partial leaf destruction does not seem to have the same effect on the growing cane crop as in other countries where the crop is on the land for two years or so. I consider in this case we can be said to be definitely protected by our exceptional climatic conditions.

Beetles.

Two outbreaks of the *Alissonotum* beetle have been reported from Kamrup and Shamaw and considerable damage has been done by this pest. The increase of the pest at Sahmaw is constituting a serious menace to the cane industry there. Last year over two millions of the beetles were caught and destroyed but still it is on the increase.

Cane Borers.

In my experience by far the greatest damage is done by the cane borers, top stem and root and the damage they do to a cane crop is increased by the fact that not only is the mill cane ruined but in cases where a subsequent crop has to be planted from this seed owing to isolation the risk of a cumulative attack is always present if the greatest care is not taken in selecting the seed and much extra expense is thereby involved.

The Entomological methods of dealing with the borer are, I believe:—

1. Traps (light) collection of egg masses and other minor methods which appear to be unsuitable over large areas.
2. Parasitism.—This line of work which appears to offer by far the greatest opportunities for controlling borer attack is at present under a distinct cloud and the Porto Rico Technological Conference passed a resolution in March, 1932:—

"In view of the great publicity which has been given to costly attempts in various parts of the world to control the cane moth borer (*Diatraea*) by mass breeding and liberation of *Trichogramma* and in view of the fact that Entomologists who have been engaged in this work on a comprehensive scale are in wide disagreement as to the practical results, if any, of this method, this conference after examination of all published evidence cannot endorse the plan until unanswerable statistical evidence of its efficacy is forthcoming." This authoritative pronouncement can hardly be said to inspire confidence. Nevertheless, there can be no doubt that if a solution along these lines can be found it will go far to deal with the problem of borer control on cheap, effective and permanent lines against these pests.

Other Entomological lines of work may be in progress but I am not in a position to deal with them as a layman nor to comment on their efficiency.

I now pass to the lines of research which are in a certain sense outside the work of pure Entomologists and which in my opinion offer the most promising means of leading us to methods which will radically assist us in our insect campaign.

The Survey Problem.

What is the proportion of borer attack on different canes and how can we estimate it—is it increasing or decreasing on our new canes?

It is of the greatest importance that we should know with the least possible delay if the new canes we are now giving out are more susceptible to borer attack than the canes they are replacing. There is no doubt that Co. 214, Co. 210 and Co. 213 have proved less vulnerable to borer than the Hemja cane they replaced and in the course of my tours during the last twelve years I have obtained considerable data on this matter and have always kept a very careful eye on this aspect of the cane question and the damage involved. I do not however find this point kept in mind regarding the new canes now being given out elsewhere. I find they are judged usually in small plots—on sucrose and tonnage and other mill and agricultural points only. *I do not find the Entomological side of the question is receiving the consideration it deserves*

considering the damage involved. One of the chief cane provinces does not even possess an Entomologist which is a lurid example of the attitude towards this most important problem. Small isolated plots of a particular variety are not a means of judging borer damage on a large scale and never will be, and their use appears to have been replaced by large scale surveys in most countries where the borer is being systematically dealt with.

It may be news to many people here but it is an undoubted fact that due to the failure of cane breeders to recognize the borer menace in the past many countries are having to discard their new high sucrose canes and revert to the canes these new canes superseded. In Java in 1920 borer was practically negligible. In Java in 1930 borer was a very big item and the damage sustained by the new canes such as P. O. J. 2878 was 3 to 5 times as much as that in the canes they superseded *and the damage is on the increase.*

Porto Rico, Louisiana and the West Indies have this problem already before them and have already obtained data which enables them to show clearly that their new canes will have to be discarded and replaced by the originals as they are heading for disaster.

Antigua and St. Kitts find P. O. J. 2715 and 2878 more attacked than B. H. 10/12 and S. C. 12/4.

In St. Kitts the P. O. J. canes were being discarded.

B. H. 10/12 is 25 per cent. to 30 per cent. more affected than S. C. 12/4.

Plant cane is invariably more affected than ratoons.

In Porto Rico B. H. 10/12 and S. C. 12/4 are more heavily attacked than the original variety Crystallina.

Dr. Hazellhof states that in Java P. O. J. 2878 and P. O. J. 2883 are 3—5 times more infested than E. K. 28. D. I. 52 also remains little damaged.

The above few reports show that the industry is in danger of receiving a definite setback, from this one cause alone.

We have in India no such information and it is essential—as a first line of research work—that we obtain it throughout the cane growing tracts without delay.

New Canes.

Observations must be made on a proper basis as to whether new varieties of cane suitable in all other respects are being or likely to be attacked by borer to a greater extent than those already existing in general cultivation. If this is so progress is not being made.

Standardisation of methods of estimation.

A committee has lately been set up to standardise methods of estimating borer attack on different canes. I consider we should without delay obtain their considered opinion and act upon it as far more work has been done on this subject in other countries which have larger staffs and more experience.

The following standing Committee to standardise methods for determining borer infestation was appointed in March, 1932, at Porto Rico :—

Dr. M. D. Leonard, Porto Rico (Chair).

Dr. G. N. Walcott, Porto Rico.

Dr. W. E. Hinds, Louisiana.

Mr. H. E. Box, Antigua.

Mr. T. E. Holloway, Louisiana.

Mr. R. W. E. Tucker, Barbados.

Mr. D. L. Van Dine, Cuba,

and might with advantage be communicated with.

Once we are in possession of this data we shall know whether we are proceeding on right lines with our new cane distributions or whether we are merely increasing our liability to borer losses.

The Cane Breeding Side.

The second line of work which appears profitable in this connection is the breeding of a "borer proof" or perhaps I should say more accurately a "borer resistant" cane.

Recent work in Java by Dr. Hazelloof has proved that a variation in leaf spindle thickness is directly correlated with resistance to top borer attack and a very potent factor in reducing the damage to a crop.

It would not appear beyond our powers—other things being equal—to select and experiment with a number of canes of this type against the normal type with a view to testing out the validity of this discovery and its relation to our own Co. canes in general cultivation.

Work on such lines would be provided with data from the standardised methods for determining borer infestation and would form in my opinion a very fruitful source of research on the main problem.

It is quite unnecessary to stress the point that India with its enormous acreage mostly in small plots and under no united control is totally unable to adopt any of the borer control methods found useful in islands or countries with a small controlled acreage of cane.

I now pass to problems which are more linked with the agricultural side. These are the effect on borer attack of :

- Times of planting,
- Depths of planting,
- Manuring, burning of trash,
- Rotations and ratooning.

All such research work pre-supposes and requires considerable borer attack to enable its experiments to be brought to a definite conclusion. For this reason hardly any work on borer has been able to be carried on in the New Area as the damage to our other experiments would nullify such a large range of work that much time and money would be wasted. *It has got to be primarily and clearly realised that any scheme of research work on borers pre-supposes a long period of careful investigation on the damage done by an insect which we have at present no means of controlling and which is therefore free to damage all other cane plots and experiments. For this reason the work on cane pests of this kind must be carried on at a station set apart absolutely for insect pest research and no other scheme can be supported with safety.*

We have a certain amount of evidence that manuring assists cane pest borer attack but this may be linked up with the rainfall which we cannot control.

Trash burning is held in India to lessen borer attack but other countries do not agree. This may be due to certain fundamental differences in cane cultivation and the handling of the crop and requires investigation. Similarly a long rotation and no ratoons is said to keep down borer, but here again we have no actual data and the statement is made in other countries that plant cane is always more attacked than ratoons.

The efficacy of burning or non-burning of trash can only be definitely tested by a long series of experiments culminating in a bad borer outbreak on one side of the experiment. Trap crops also for testing their efficiency require a borer outbreak and the effect of ratooning on borer infestation is likely to infest all neighbouring cane experiments with the moth.

I have left any questions of staff and laboratory equipment for the above schemes to those more fitted to deal with the matter and have merely in this note outlined the more pressing problems for investigation.

(Sd.) WYNNE SAYER,

Offg. Imperial Agriculturist.

Dated 8th July 1933.

List of sugarcane pests with a short account of the damage caused by them :

- I. Boreas—**
1. *Scirpophaga nevelia*, F. In young canes it causes "dead—hearts". In old canes when shoots are formed it continues to attack and top shoots are damaged. The effect of the attack by the larvae is always disastrous to the plant further growth is stopped in every case. Only very vigorous plants whether young or old can give out side shoots or branches.
 - (Top shoot borer).
(*Scripophaga Kanthogastralla ariflua*).
 2. *Scripophaga monostigma* They are also found boring the tops like *S. nivella* but are less common. A minor pest.
 3. *Emmalocera depressella* Root Borer. It is a specific pest of sugarcane and causes the greatest damage of all internal borers. The caterpillar usually enters the base of the shoot through the side near or below the soil surface. The entire shoot when pulled sideways is dislodged easily at the base.
(— *Pepua depressella* ;) (Palyocha saccharolla)
 4. *Chilo Zonellus*—(—*Chilo simplex*). Less common.
 5. *Diatraea venosata* Bore the stem. A well known cane pest of Java.
 6. *Diatraea auricilia* Bore down from the top of the cane.
 7. *Argoria ticticraspis* Bore the stem.
 8. *Argoria tumidocostalis* Occurs in Bengal, and Assam as a stem borer.
 9. *Sesamia inferens* A minor pest. Bore down from the top but more often they enter from the side.
 10. *Sesamia uniformis* Ditto.
 11. *Xyloborus perforans*, Wlk. The larvae of this beetle was reported from Bengal. Chinsura farm, and in some districts of Behar.
- II. Sucking Insects—**
1. *Pyrilla aberrans* They suck the juice of plants. They lay their egg masses on the underside of the leaves, and are more common in broad-leaved varieties. When present in large numbers they may cause considerable damage.
 2. *P. Pusana*.
 3. *P. Porpusilla*.
 4. *Alourolobus barodensis* Popularly known as cane mealy wing, and is destructive to sugarcane in some years, especially to broad-leaved varieties. The insect is found on its food plant in all its stages from June to the following March but is usually bad from July to November.
 5. *Noonaskollia bergii* This mealy wing is not a serious pest of cane but appears sporadically. The adults are abundant in some years though not so in others. It may be found on the leaves along with *A. barodensis*.
 6. *Ripersia secchari* It has been found occurring on sugarcane in Coimbatore, Gorakhpur and Pusa. It occurs under the sheathing leaves and difficult to detect.
 7. *Pseudococcus sacchari* It is found under the sheathing leaves, and is not very common.
 8. *Pseudococcus saccharifolia* It is found on both surfaces of the leaves and not under the sheathing leaves.
 9. *Aclerde japonica* Has been found occurring in Jabbulpur, Partabgarh and Poona. The scales occur at the nodes below the sheathing leaves.
- III. Leaf eating insects—**
1. *Phidodonta modesta* This beetle occurs in most parts of India as a minor pest. The grubs mine into the leaves producing white irregular oblong patches and pupate inside. The adult beetles also feed on the leaves.
 2. *Hieroglyphus banian*. It is a major pest in U. P. and reported from Azamgarh district.

3. *Oxya velox* It is a minor pest in mature canes. It eats the leaves.
4. *Desychira securis* It is not much of a pest but at times it occurs in numbers.
5. *Telicota augias* It is a minor pest. The larvae roll the leaves.

IV. External agents—

1. Termites.
2. *Gryllotalpa africana*.
3. Beetle grubs Melolonthid, Curculionid, Chrysomelid and Elatrid.
4. Beetles.
5. Red ants Doryhus.

(1) Termites or white ants Damage the base of the stem and roots, causing the young plant to dry up. Usually they avoid wet and muddy places. The nature of the soil is an important factor for the occurrence of termites sandy soil being more infested with them than the clayey soil. The setts are usually eaten up by them.

(2) *Gryllotalpa africana* It gnaws the shoots from the side at a point above their junction, with the setts and causes dead hearts. It is not a major pest.

(3) Beetle grubs—

1. *Anomala bengalensis*
2. *Anomala beharensis*.
3. *Adoretus caliginosus*
4. *Autoserica inaequalis*
5. *Myllocerus discolor*
6. *Monoplecta signata* These are found in their grub stage at the roots of sugarcane. The damage does not seem to be much. Of these *Anomala bengalensis* has been definitely observed at Pusa and Dacca to gnaw the new sugarcane shoots under soil surface much in the same way as the mole-crickets.
7. *Myllocerus blandus*
8. *Formicomus caeruleipennis*
9. *Pachnephorus* spp.
10. *Alissonotum piceum*
11. *A. Simile*
12. *Apogonia proxima*
13. *Anomala polita*
14. *Adoretus versutus*
15. *Myllocerus II pustulatus*
16. *Drastorius* sp.
17. *Anomala dussumieri* In Kamrup farm.
18. *Pentodon hispinifrons*
19. *Pentodon bengalense*.
20. *Tanymericus*

(4) Beetles The following adult beetles have been observed to be injuring sugarcane with external symptoms of similar to those caused by borers. They feed underground:

1. *Oryctes rhinoceros* Damages sugarcane setts in Coimbatore and Travancore.
2. *Xylotrupes gideon* Damages in the same manner as No. 1.
3. *Alissonotum impressicollis* Caused serious damage in Kamrup farm.
4. *Heteronychus sublaevis* Found in company with the above in Kamrup farm.
5. *Heteronychus sacchari* Caused extensive damage in Rangpur.
6. *Pentodon bengalense* Gnawed setts and shoots in Tarnab farm.
7. *Pentodon hispinifrons* Gnawed setts and shoots in Baroda.
8. *Autoserica* sp Gnawed shoots in March in Pusa.

The following beetles and weevils usually eat leaves or new shoots. They may cause a set back to the growth, but they do not kill them :—

1. *Tanyecus hispidus* . . . Occurred largely in sugarcane plantation in Cooch Behar.
2. *Tanyecus sciurus* . . . Eat tender leaves at Rangpur.
3. *Myllocerus blandus* . . . Eat tender leaves of young canes.
4. *Myllocerus discolor* . . . Eat tender leaves of young canes.
5. *11-pustulatus* . . . Eat tender leaves of young canes.
6. *Phidodonta modesta* . . . (Included under Leaf-eating insects).
- (5) *Red and (Dorylus)* . . . It gnaws the base of sugarcane shoots in a few cases.

ANNEXURE I-C.

NOTE DATED THE 2ND AUGUST, 1933, BY SECRETARY, ON PROPOSALS FOR THE INITIATION OF FUTURE RESEARCH INTO THE INSECT PESTS OF SUGARCANE.

The attached note on a scheme for research work on sugarcane pests in the Punjab, dated the 31st July, 1933, by Mr. Afzal Husain has been forwarded by the Director of Agriculture, Punjab, for the use of the Committee. The scheme itself has not yet been considered by either the Director of Agriculture, the Provincial Research Committee or the Punjab Government and does not therefore commit them.

A scheme for research work on pests of Sugarcane in the Punjab.

Introduction.—Sugarcane is an important money crop in the Punjab and excepting the Simla District it is grown all over the Province. The Punjab thus stands second in area among the cane-growing provinces of this country. For the year ending 1931-32, approximately 4,15,000 acres were under sugarcane in this Province. Since the development of refined sugar manufacture by the open pan-system and the establishment of Sugarcane factories, sugarcane cultivation has assumed very great importance and is undergoing very great fundamental changes.

In the Punjab sugarcane is mostly an irrigated crop only 1/5th of area under cultivation being *barani*. It is sown in March-April and is cut from December to February except in the case of factories when it is allowed to stand till the end of April.

Pests of sugarcane in the Punjab.

Sugarcane is the favourite food of a large number of animals of all sizes. From elephants to mites, there is a whole series of the enemies of this crop. We have in the Punjab the pigs, jackals, hares, rats, white-ants, borers, beetles, bugs and mites. From the time the sets are put in the ground to the time the cane is crushed, or seed is sown some enemies are at it. Below is given the list of pests belonging to the classes Insecta and arachnida. Only those pests have been mentioned which seriously affect the crop, and if not controlled would reduce the yield so effectively that profitable sugar manufacture would be impossible.

1. *Microtermes obesi*.—(White ant) attacks sets and often causes serious losses.
 2. *Sugarcane mite*.—Attacks leaves which turn red, and crop dries up. It is very serious at Gurdaspur and Karnal. It attacks *buru* and then comes to sugarcane.
 3. *Emmalocera depressella* (root borer).
 4. *Argyria sticticraspic* (stem borer).
 5. *Scirpophaga nivella* (top borer).
 6. The New Pyralid Borer (first found at Gurdaspur and is rapidly spreading).
 7. *Raphimetopus ablutella* (yellow brown borer) (confined to South-East Punjab).
 8. *Sesamia*.—The borers are well-known serious pests of sugarcane, causing enormous damage every year.
- Besides there are some beetle borers of importance.
9. *Pyrilla* spp.—The crop badly effected is ruined. The juice does not boil into gur.

10. *Aleuralabus bardensis*, sugarcane white fly.—The attacked crop dries up and does not form gur.
11. *Macropsis excavatus* (sugarcane bug).—It is so far confined to parts of Kangra district. The attacked crop dries up, unless it recovers after the rains.

Amount of damage.—The insect damage to the sugarcane crop begins with the sowing of sets when white ants play havoc. When the crop has emerged from the soil the stem borers start their action. *Pyrilla* soon follows and is later on helped by mites and white flies. A concrete illustration of this may be found in what happened at Sonepet in the neighbourhood of the Punjab Sugar Corporation Factory.

In April *Pyrilla* attacked the cane, simultaneously the root and stem borers appeared, in July the top borer almost completed the work of destruction and the crop has another six to nine months to go.

A sugar cane crop entirely free from insect is of course an impossibility, but it is possible to make sugarcane growing profitable by proper control of insect pests. It is very difficult to estimate in money value the damage done to sugarcane by insects and other animals. In some cases as much as 75 per cent. of the crop may be completely lost. 26 per cent. is not an uncommon occurrence.

Need for research on Sugarcane Pests.

If India is going to retain the position, which she has recently attained, in sugar manufacture, it is essential that her efficiency in sugar production should be increased. It is not in the interest of the consumer that an important food-stuff be produced under protection or by a huge subsidy. Therefore, all sources of loss must be eliminated. Our output per acre compares very unfavourably with that of other sugar producing countries. And undoubtedly insect pests of sugarcane take a heavy toll. Hence the urgent necessity of investigation on the problem of sugarcane pests.

The rapid increase in the number of factories is altering the entire scope, system and basis of sugarcane cultivation. If previously sugarcane was grown over small scattered plots, now in the neighbourhood of the factories it is grown in concentrated blocks, very extensive in areas.

The failure of the sugarcane henceforth is not going to be the personal loss of a few individual cultivators, but is going to affect most seriously a much larger number of cultivators, and the factories, and through the factories it is bound to have a much wider economic effect.

Moreover, it is well known that extensive areas of the same crop provide an unlimited scope to the pests in their multiplication. Thus, with increase in the number of factories, and consequent increase in the area under cane in the neighbourhood of these factories, there is bound to be an increase in the number and variety of pests.

Further, it is a matter of common knowledge that more highly domesticated and improved a variety is, more liable it is to the attacks of pests and diseases. Same is true of the sugarcanes. The new high yielding varieties of sugarcane, before they are spread must be thoroughly tested under local conditions for resistance to insect pests. We have in the Punjab an instance of this in 3 F cotton which was given out to the people and during the very first year was so badly attacked by jassid that the entire crop was ruined, and indemnity had to be paid to the farmers. New varieties are being produced at a very rapid rate and are introduced at an equally rapid speed. This necessitates a vigorous entomological research work. It is very necessary that, *under local conditions*, the efficiency of a variety not only from the point of view of yield, but also from the point of view of pest resistance be thoroughly studied.

There is one other aspect of the question. It has been established that some of the pests of sugarcane prefer the broad leaved, softer varieties, e.g., *Pyrilla* spp. but the fact factories prefer the softer varieties with high sugar yields and less fibre percentage. Thus there is difficulty—the Entomologists recommending what sugar manufacturers do not want. It is absolutely necessary to determine the safest and the best course. !

It appears that under the altered conditions of sugarcane growing ratooning is to extend. It has already extended to a very large extent in the neighbourhood of one of the factories in the Punjab. What should be the policy of the Department of Agriculture regarding this practice? So far ratooning has been condemned, but in some countries it is a general feature of sugar growing and some people do maintain

that even in India ratooning pays inspite of the pests. The question of ratooning must be thoroughly studied from this point of view. The consideration of saving in labour and money and of obtaining better yields for two or three years from ratoons, immunity from white-ants damage are very important factors. If previously we would recommend a close season and ask people to crush all the canes before February, pull out the stubbles, for profitable sugar manufacture, the cane period is to be extended so that the factories can crush from November to May. The overlapping of crop with its serious entomological problem has to be faced. In short, the whole outlook has to undergo a complete change and this demands a very careful and thorough study of the entire situation and its numerous problems.

The altered conditions have one advantage also. While it was not possible to make an individual farmer take up control measures against pests, now that the cane-growing would be more concentrated it would be economical to undertake large scale control measures.

General scheme of work.

Preliminary observations on the life and seasonal history of most of the above-mentioned pests have been made in the Punjab (A brief account is given with each pest separately). It is, however, necessary that a very detailed ecological and epidemiological study *under local conditions* be made. This study would cover the following general lines:—

1. *Distribution.*—These pests of sugarcane vary greatly in their abundance in different parts of the Province. The borers are not of any significance in the Kangra district and *Macropes* is only serious in that District and does not occur anywhere else. The New Pyralid borer is so far confined to the Gurdaspur and the adjoining parts of the Hoshiarpur Districts. It is causing great damage and is providing a very serious pest because of its rapid increase. It is not infrequent that seed cane is taken from Gurdaspur to other parts of the province and there is every likelihood of this borer spreading over other districts.

So far we have exceedingly incomplete information regarding the distribution of relative incidence of infestation of the various pests of sugarcane in different parts of this Province. This knowledge is most essential.

2. *Ratooning and overlapping of crops.*—As stated above it is almost certain that ratooning would become a regular practice in certain parts of the Punjab, unless it is stopped by legislation. But before such a legislation is recommended it is necessary to study the whole question of ratooning in relation to insect pests, and the efficiency of ratooning inspite of insect pests. A very thorough work is required on this exceedingly important aspect of sugarcane cultivation because it appears to me that the whole future of sugarcane industry in the Punjab depends on this. This applies to overlapping of crops also. For profitable running of factories the crushing period should be prolonged and keeping the crop standing provides food to borers and *Pyrrilla* in a season, which is otherwise a close season for these insects.

3. *Destruction of stubbles.*—The destruction of stubbles has been recommended as a means of control of the sugarcane borers which hibernate in stubbles. In view of what has been said regarding ratooning and overlapping of crop, this measure does not seem practicable and even if practicable how far it would help to check the incidence of attack in so far as the sugarcane borers are concerned?

4. *Alternative food plants.*—A number of sugarcane borers are known to feed on wild grasses such as *buru* and *sarkanda* and on other cultivated gramineous plants such as maize, *jowar*, rice. Statement attached gives detailed information so far obtained in the Punjab. One of the solutions of the borer trouble would certainly be the elimination of alternative food plants, but before this can be obtained it is necessary to undertake intensive investigation.

5. *Traps, etc.*—Almost all sugarcane borers are attracted to light. Some work has been done on light trap in the Punjab but a great deal remains to be done. During recent attack of top borer at Sonapat light trap appeared to be a very effective method of control—the conditions apparently being most favourable, high humidity and high temperature. A great deal of work is necessary before this method is placed on sound footing.

The other method of control consists in chemical trap but practically nothing has been done in this country on this line.

Hand nets have proved very useful against *Pyrrilla* at Lyallpur, Gurdaspur and at Sonepat. This method, however is very laborious. It is necessary to devise an appliance that would be easy to work and would give better results. Something of the type of hopper dozer is contemplated.

6. *Parasites*.—The possibility of controlling sugarcane borers and other sugarcane pests by means of their parasites cannot be ignored. No work has been done in India on this problem.

7. *Resistent varieties*.—A very large number of new varieties of sugarcane are being produced and are being tried in different parts of the Punjab. It is necessary to discover the immunity, resistance and tolerance of these varieties to pest attack. A very thorough work on this aspect of sugarcane growing is most necessary.

I.—*Borers of Sugarcane.*

Of all these pests of sugarcane the borers are the most important as they do far greater damage than all other pests put together. Observations on the life history and seasonal history of the borers have been made in the Punjab, but ecological and epidemiological investigations must be made in different places. The pests are very important and in the changed conditions of sugarcane cultivation their importance is going to increase. It is, therefore, necessary that very intensive work should be done on these borers. We propose that observations should be made at different centres such as Sonepat, Jullundur, Gurdaspur and Lyallpur. An Entomological Assistant is already sanctioned for the general scheme of sugarcane and I presume that this man will be stationed at Jullundur. We have already a man working on these borers at Gurdaspur, he should get additional help so that he can concentrate on the New Pyralid borer. We should have men for two other stations, one for Sonepat and two for Lyallpur. This work should be under a well qualified Assistant Entomologist.

Preliminary observations have also been made regarding varietal susceptibility of sugar-cane borers and statement attached gives some idea of the work which has already been accomplished. Work on these lines over an extensive period in different localities is very necessary.

We have also studied the hibernation of these borers particularly *Argyria sticticropis* and *Emmalocera depressella* which will convey the importance of the destruction of stubbles in the control of these insects, and point out the difficulty that we shall have to face when rationing will be practised and there would be overlapping of successive sugarcane crops.

The work so far done has been summarized in the statement attached.

Assistant Entomologist, Sugarcane would be in charge of all sugarcane borers investigations carried out in the Punjab and he will be under the guidance of the Entomologist to Government, Punjab, Lyallpur.

PROGRAMME OF WORK ON BORERS OF SUGARCANE.

PROGRAMME OF WORK AS DETAILED IN THE GENERAL SCHEME.

Staff required and the cost of the Scheme.

			One Year.	Five Years
			Rs.	Rs.
Assistant Entomologist, Sugarcane	Rs. 300—25—400	One	3,500	21,000
Assistants	Rs. 100—10—140	Four	4,800	28,800
Fieldmen	Rs. 25 p.m.	Twelve	3,600	18,000
Rent of the Laboratory	Rs. 600 p.a.		600	3,000
Travelling Allowance	Rs. 4,000 p.a.		4,000	20,000
Contingencies and labour	Rs. 1,500 p.a.		1,500	7,500
Grand Total			18,100	98,300

Microscopes and other non-perishable apparatus would be supplied by the Entomologist to Government, Punjab, Lyallpur.

Statement showing percentage of borer attack on different varieties of irrigated sugarcane.

Locality.	Year.	Variety.	No. of shoots examined.	Percentage of dead hearts.		
Gurdaspur	August, 1929	Co.	285	472	17-30	
		"	290	196	21	
		"	281	184	27	
		"	223	209	23	
		"	213	103	25	
		"	276	167	19	
		"	270	175	19	
		"	271	410	26-30	
		September, 1928	Co.	223	2,747	12
			"	213	210	6
	"		285	635	4	
	"		290	560	8	
	"		281	236	6	
	"		276	348	7	
	"		270	310	5	
	"		262	521	7	
	October, 1928	Co.	223	1,352	14	
		"	213	158	13	
		"	285	302	9	
		"	290	287	11	
"		281	194	12		
Lyallpur		July, 1928	Co.	205	..	7
	"		223	..	11	
	"		213	..	17	
	Kahu		..	..	17
	Suretha		..	..	17
	August, 1928	Co.	205	..	5-6	
		"	223	..	7-9	
		"	213	..	7-8	
		Kahu	..	..	10
		Suretha	..	..	12
	September, 1928	Co.	205	..	7-10	
		"	223	..	8-10	
		"	213	..	9-9.5	
		Kahu	..	..	10-12
		Suretha	..	..	12-13
	May, June, 1929	Co.	223	11,770	4.7	
		"	210	12,666	3.6	
		"	205	12,000	2.7	
		Desi	..	7,733	7.8	
						0

Locality.	Year.	Variety.	No. of shoots examined.	percentage of dead hearts.	
Gurdaspur	May, 1929	Co. 223	8,084	15—23	
		" 290	1,370	13·9—18	
		" 285	2,897	8—15	
		" 270	1,003	19	
		" 262	1,058	18	
		" 281	1,039	19	
Gurdaspur	July, 1928	Co. 294	364	22—30	
		August, 1928	" 285	347	23—30
			" 272	410	26—30
			" 205	1,227	26—29
			Katha ..	598	26—33
Gurdaspur	May, 1929	Co. 205	4,095	19·6—37	
		" 235	2,969	10·8—30	
		" 281	..	29·5	
		Katha ..	1,133	47	

Table showing the number of borers (*Argyria sticticrepsis* and *Enmalocera depressella*) hibernating in stubbles of sugarcane from different localities of the province during 1921-25.

Locality.	Year in which examined.	Total No. of stubbles examined.	No. of borers found.	No. of borers per 100 stubbles.
Lyallpur	1921-25	3,278	679	3·7 to 70·0
Montgomery	1922-23	14	9	50 to 100
Gujrat	"	30	5	16·6
Gurdaspur	"	275	27	8 to 80
Hansi	"	117	12	3·3 to 20
Karnal	"	25	20	80
Ferozepore	1922-25	101	62	27 to 102·5
Multan	"	115	17	6·6 to 20
Sialkot	1924-25	96	17	15·8 to 24·2
Jullundur	"	75	13	16·7
Ludhiana	"	17	8	49

II.—CONTROL OF SUGARCANE INSECTS BY MEANS OF THEIR PARASITES.

Parasites of a number of cane pests are known, but so far no sustained and systematic work has been done to determine the efficiency of any of these parasites. The egg parasites (*Trichogramma*) of the borers and *Pyrilla* are of particular importance. Similarly the control of sugarcane white-fly may be possible through the agency of parasites. This aspect of Agricultural Entomology has so far been completely ignored in India and we are completely ignorant of what possibilities it may offer.

It will be interesting to open a parasites breeding station in the Punjab, where efforts can be made to study the parasites of the cane pests and means adopted to multiply them under laboratory and natural conditions.

Programme of work.

1. Collection and identification of the parasites of the pest of sugarcane, sarkanda, maize, jowar, etc., etc., particularly *Trichogramma*.
2. Study of the bionomics of some of the more important parasites, particularly the egg parasite.
3. Multiplication of the parasites under artificial and natural conditions.
4. Determination of the efficiency of parasites.

Staff required and the cost of the scheme.

	One year.	Five years.
	Rs.	Rs.
Senior Assistant Rs. 300—25—400 (one)	3,600	21,000
Junior Assistants Rs. 100—10—140 (two)	2,400	14,400
Fieldmen Rs. 25 (six)	1,800	9,000
Rent of the laboratory Rs. 50 p. m.	600	3,000
Travelling Allowance Rs. 2,000 p. a.	2,000	10,000
Contingencies and labour Rs. 600 p. a.	600	3,000
Apparatus:		
Non-recurring	1,000	1,000
Recurring	500	2,500
Grand total	12,500	63,900

The staff may be placed at Sonapat or Jullundur.

III.—White-ants.

White-ants attack sugarcane sets during March and April, i.e., soon after sowing. Observations taken show, that of the sets sown, upto 53 per cent. may be destroyed and may fail to germinate. The following figures based on a number of observations on the percentage of sets of thin cane attacked by white-ants give an idea of the severity of Termite damage.

Year	No. of observations.	Average percentage of sets attacked.
1925	6	25.5
1926	25	24.9
1928	13	17.7
1929	21	44.7

Sometime the damage from white-ants is so serious that some varieties cannot be cultivated in certain areas, e.g., *Ponda* (a thick cane) is very difficult to grow in Iyallpur.

Special observations have been made on the control of white-ants on sugarcane sets (a summary of the results given in the statement attached). It was discovered that dipping these sets in 0.25 per cent. solution of corrosive sublimate about one hour before sowing kept them free from attack. The same results were obtained by dusting moist set with a mixture of 1 part of lead arsenate or Paris Green and 9-12 parts of fine ashes.

Programme of work on White-Ants.

1. A regular survey of the sugarcane crop in the Punjab to determine the effect of climatic and agricultural conditions on the extent of termite damage; places where sugarcane cultivation is decreasing on account of termite attack.

2. Collection of termites and their identification, appearance of swarms, habits and status of various species. Experiments on fumigating the existing nests and collecting the colonising adults at light-traps.
3. Field experiments on the effect of cultural methods, viz., clean cultivation, hoeing, irrigation ratooning, etc.
4. Collection and identification of termitophiles and a study of their relations with the termites.

Staff engaged and the cost of the scheme.

This work on termites was being done by Mr. Taskhir Ahmad, who is at present on deputation doing locust work and is proceeding to England on two years leave. This work will be entrusted to an Agricultural Assistant of the Entomological Section :—

				One year.	Five years.
Assistant	Rs. 150—10—190	One		1,800	10,200
Fieldmen	Rs. 25	Two		600	3,000
Travelling allowance	Rs. 500 p. a.			500	2,500
Contingencies, labour, etc.	Rs. 250 p. a.			250	1,250
				3,150	16,950

Results of treating sugarcane with various repellants and poisons against termite attack.

No.	Treatment.	Strength.	Variety of cane.	Effect on germination.	No. of experiments tried.	Average percentage of attack.		
						Treated.	Control.	
1.	Corrosive sublimate (solution)	{	0.25% (Co. 223)	No effect	6	8.8	44.8	
			0.5% (Ponda)	"	2	11.5	58	
			2.5% "	"	4	1.0	22.8	
2.	Lead arsenate (dust)	. . .	1:25 (Co. 223)	No effect	2	20.1	42.6	
			Do.	1:22 "	"	2	15.9	45.1
			Do.	1:9 "	"	2	12.9	40.3
			Do.	1:4 "	Slight effect	4	0	43.9
3.	Arsenic (suspension)	. . .	0.2% (Katha)	No effect	2	3	31.5	
			Do.	0.5% (Ponda)	"	5	7.8	43.2
4.	Paris green (dust)	. . .	1:25 (Co. 223)	No effect	2	45.9	54	
			Do.	1:12 "	"	2	15.7	56
			Do.	1:9 "	Slight effect	2	4.3	53.7
			Do.	1:4 "	No germination.	4	0	32.7
			Paris green (suspension)	1% "	"	1	0	25
Do.	0.5% (Ponda)	Slight effect.	5	2.6	33			
5.	Crude oil emulsion	. . .	2.5% (Ponda)	No effect	2	16	43.5	

IV.—Sugarcane mites.

This mite is present practically all over the Punjab and periodically does enormous damage. Only this year I received a letter from the Superintendent, Criminal Settlement, Kaithal, complaining of the serious attack of this pest over an extensive

area. The variety attacked was Co. 285. Practically no work has been done on the life-history, etc., of this pest. We have been undertaking effective control measures by the use of Lime Sulphur and Rosin Soap. It is very desirable that some work should be done on this pest. The work could be entrusted to a member of the Entomological Staff.

Programme of work on sugarcane mites.

1. Life-history. Seasonal history.
2. Alternative food plants.
3. Control measures

Staff engaged and the cost of the scheme.

			One year.		Five years.	
			Rs.	Rs.	Rs.	Rs.
Assistant	Rs. 150—10—190	One	1,800		10,200	
Fieldmen	Rs. 25	Two	600		3,000	
Travelling allowance	Rs. 500 p. a. . . . .	..	500		2,500	
Contingencies and labour	Rs. 250 p. a. . . . .	..	250		1,250	
Grand Total			3,150		16,950	

Microscopes and other non-perishable apparatus would be supplied by the Entomologist to Government, Punjab, Lyallpur.

V.—The new Pyramid Borer.

This insect is a specific pest of sugar-cane and has not so far been found feeding on any other plant. At present it is only known from Gurdaspur and the adjoining parts of Hoshiarpur District. Single specimen of it was found from the collection received from Sialkot in 1921.

Preliminary observations on the life-history of this borer have been made. The life-cycle is completed within 69 to 84 days. This is the longest life-cycle among the sugarcane borers. This borer is not present in the fields during April, May and June. The moths emerge from over-wintered larvæ hibernating in sugarcane stubbles and lay eggs in July. The moths of the second brood come up towards the end of September or first week of October. The percentage of attack at Gurdaspur varied from 6 to 15 per cent., and Co. 285 was worst attacked while Co. 300 was least attacked and Co. 237 was entirely free. It is very destructive in its habits because it makes a spiral burrow in the cane, thus killing the plant entirely. The female evidently lays a very large number of eggs because its population increases rapidly. Some little work has been done on this pest and it is very necessary that the work should be continued. The Agricultural Assistant who has been doing this work shall be engaged on this problem for some time.

Programme of work on the new Pyralid Borer

1. Study of the distribution of this pest in the Punjab. Alternative food plants. Seasonal history.
2. Susceptibility of different varieties of cane.
3. Control measures.

Staff engaged and the cost of the scheme.

			One year.		Five years.	
			Rs.	Rs.	Rs.	Rs.
Assistant	Rs. 325 p. m.		3,900		19,500	
Fieldmen	Rs. 25 p. m.	Three ..	900		4,500	
Rent of the Laboratory	Rs. 20 p. m.	..	240		1,200	
Travelling Allowance	Rs. 800 p. a.	..	800		4,000	
Contingencies and labour	Rs. 250 p. a.	..	250		1,250	
Grand Total			6,090		30,450	

Microscopes and other non-perishable apparatus would be supplied by the Entomologist to Government, Punjab, Lyallpur.

Statement showing the attack of the New Pyralid Borer on different varieties of sugar-cane.

Variety.	September 1928.			October 1928.			July 1929.		
	Total shoots examined.	No. of borers per 100 shoots.	%	Total shoots examined	No. of borers per 100 shoots.	%	Total shoots examined.	No. of borers per 100 shoots.	%
Co. 223 .	2,767	316	12	1,352	201	14	..	..	..
.. 213 .	210	14	6	156	21	13	..	..	..
.. 290 .	560	47	8	287	34	11	..	..	..
.. 285 .	635	27	4	302	27	9	277	96	32
.. 281 .	236	15	6	194	25	12	..	..	..
.. 276 .	348	26	7	..	..	..	..	..	..
.. 270 .	310	17	5	..	..	..	..	..	..
.. 262 .	521	40	7	..	..	..	..	..	..
.. 244 .	150	18	12	..	..	..	..	..	..
.. 208 .	547	18	17	979	183	18	..	..	..
.. 285 .	187	42	22	443	72	16	..	..	..
.. 272 .	109	25	22	180	10	11	..	..	..
.. 252 .	..	..	..	..	..	..	115	10	8
.. 284 .	..	..	..	..	..	..	28	31	120
.. 287 .	..	..	..	..	..	..	47	11	23
.. 288 .	..	..	..	..	..	..	104	12	11
.. 289 .	..	..	..	..	..	..	65	5	8
.. 300 .	..	..	..	..	..	..	9	1	11
.. 318 .	..	..	..	..	..	..	26	14	50
Katha .	215	23	15	587	163	28	..	..	..

VI.—*Sugar cane Pyrilla*.

Sugar-cane *Pyrilla* may be regarded as one of the most serious pests particularly of the broad leaf improved Co. variety. Observations on host preference carried out over a number of years support our view. The attached table gives the population of the nymphs of this insect per square inch on the leaves of different varieties of cane. This pest starts its attack on the cane when it is very young and the attack continues practically throughout the year. Its life history and seasonal history has been studied under local conditions. Observations have been made on the alternative food plants also. An Assistant of the Entomological Section has been engaged on this work for the last two years and will continue to work on this pest.

The methods of destruction and precaution which have been recommended consist of the use of hand nets for the adults, destruction of egg clusters on leaves and burning trash in the sugar-cane fields. Attempts at present are being made to evolve some sort of suitable hopper dozer which will work efficiently, cheaply and do the work in the quickest possible time.

The two egg Parasites *Ooecyrtus papilionus* and *Tetrastichus Pyrrillae* occur in abundance, and parasitization has been as high as 79 per cent. This work could not be pursued any further on account of lack of staff.

Programme of work.

1. Bionimica.
2. Susceptibility of different varieties of cane
3. Control measures.

Staff engaged and the cost of the scheme.

			One year. Five years.	
			Rs.	Rs.
Assistant	. . .	Rs. 180—10—220	One .. 2,160	12,000
Fieldmen	. . .	Rs. 25	Three .. 900	4,500
Travelling Allowance	. . .	Rs. 500 p. a.	.. 500	2,500
Contingencies	. . .	Rs. 250 p. a.	.. 250	1,250
Grand Total			.. 3,810	20,250

Microscopes and other non-perishable apparatus would be supplied by the Entomologist to Government, Punjab, Lyallpur.

Table showing the population of nymphs of Sugar-cane pyrrilla on different varieties of cane.

Month and year.	Variety of cane.	Average number of nymphs per 25 square inches of leaf surface.
January 1929	Co. 205	1.5
"	Reora	3.0
"	Katha	3.0
"	Co. 285	9.5
"	Co. 213	34.5
"	Co. 223	85.0
October 1930	Co. 285	19.0
"	Co. 205	21.5
"	Co. 223	248.5
"	Co. 213	231.0
November 1930	Katha	3.5
"	Ponda	19.5
"	Co. 285	29.5
"	Co. 205	31.0
"	Co. 223	197.5
"	Co. 213	123.0
December 1930	Katha	2.0—10.5
"	Ponda	121.5
"	Co. 285	33.5
"	Co. 215	32.5
"	Co. 223	126.0
"	Co. 213	91.5

VII.—*Macropes Excavatus.*

This bug has been reported on sugar cane from Pusa, but as far as our knowledge goes, as a pest of any importance its activities are confined to the hilly tracts of the Kangra District. It occurs mostly concealed in the whorls of leaves and the fields attacked look blighted and dried, in cases of severe infestation. Even when the attack is mild the yield is low and the gur is not formed.

Preliminary observations on the life-history and seasonal-history of this pest have been made by one of the Assistants working on this problem for a part time. It is necessary that further work should be done on this insect.

Since 1928 there has been a great increase in sugarcane area in the Kangra District and new high yielding varieties are being grown and some cultivators are making money. Some people have started open pan system factories, e.g., at Chait-roo (near Geggul). There is further scope for increase because conditions are suitable and this is the only money crop of the locality.

Programme of work on M. Excavatus.

1. Study of the distribution of this pest, geographical as well as ecological. (It is stated that this pest is only bad in the rice lands, i.e., occurs under conditions of water-logging). |
2. Study of the incidence of attack on different varieties
3. Study of control measures. |

Staff required and the cost of the scheme.

		One year.	Five years.
		Rs.	Rs.
Assistant*	Rs. 100—10—140	One . 1,200	7,200
Fieldmen	Rs. 25	Three . 900	4,500
Rent of the Laboratory	Rs. .25 p. m.	One . 300	1,500
Travelling Allowance	Rs. 500 p. a.	500	2,500
Contingencies, labour, etc.	Rs. 250 p. a.	250	1,250
Grand Total		3,150	16,950

* This man shall have to be posted at some suitable place in the Kangra District. Nagrota or Kangra is suggested.

Microscopes and other non perishable apparatus would be supplied by the Entomologist to Government, Punjab, Lyallpur.

Consolidated Statement of Staff required and the cost of the scheme.

		1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.	Remarks.
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
<i>Borers of Sugarcane.</i>								
Assistant Entomologist, Sugarcane	300—25—400	One	3,600	3,900	4,200	4,500	4,800	21,000
Assistants	100—10—140	Four	4,800	5,280	5,760	6,240	6,720	28,800
Fieldmen	25	Twelve	3,600	3,600	3,600	3,600	3,600	18,000
Rent of the laboratory	50 p.m.	..	600	600	600	600	600	3,000
Travelling allowance	..	..	4,000	4,000	4,000	4,000	4,000	20,000
Contingencies and labour	..	..	1,500	1,500	1,500	1,500	1,500	7,500
Total			18,100	18,880	19,660	20,440	21,220	98,300
<i>Control by means of parasites.</i>								
Senior Assistant	300—25—400	One	3,600	3,900	4,200	4,500	4,800	21,000
Assistants	100—10—140	Two	2,400	2,640	2,880	3,120	3,360	14,400
Fieldmen	25	Six	1,800	1,800	1,800	1,800	1,800	9,000
Rent of the laboratory	50 p.m.	..	600	600	600	600	600	3,000
Travelling allowance	..	..	2,000	2,000	2,000	2,000	2,000	10,000
Contingencies and labour	..	..	600	600	600	600	600	3,000
Apparatus—								
Non-recurring	..	..	1,000	..	..	..	..	1,000
Recurring	..	..	500	500	500	500	500	2,500
Total			12,500	12,040	12,580	13,120	13,660	63,900
<i>White Ants.</i>								
Assistant	150—10—190	One	1,800	1,920	2,040	2,160	2,280	10,200
Fieldmen	25	Two	600	600	600	600	600	3,000
Rent of the laboratory	..	..	..	..	..	..	..	..
Travelling allowance	..	..	500	500	500	500	500	2,500
Contingencies and labour	..	..	250	250	250	250	250	1,250
Total			3,150	3,270	3,390	3,510	3,630	16,950

Funds to be obtained from the Imperial Council of Agricultural Research.

Funds paid by the Punjab Government.

			1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.	Remarks.
			Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
<i>Sugarcane Mites.</i>									
Assistant	150—10—190	One	1,800	1,920	2,040	2,160	2,280	10,200	
Fieldmen . . . . .	..	Two	600	600	600	600	600	3,000	
Travelling allowance . . . . .	..	..	500	500	500	500	500	2,500	
Contingencies and labour . . . . .	..	..	250	250	250	250	250	1,250	
Total			2,150	3,270	3,390	3,510	3,630	16,950	16,950
<i>New Pyralid borer.</i>									
Assistant	325 p.m.	One	3,900	3,900	3,900	3,900	3,900	19,500	
Fieldmen	25	Three	900	900	900	900	900	4,500	
Rent of the laboratory	20	..	240	240	240	240	240	1,200	
Travelling allowance . . . . .	..	..	800	800	800	800	800	4,000	
Contingencies and labour . . . . .	..	..	250	250	250	250	250	1,250	
Total			6,090	6,090	6,090	6,090	6,090	30,450	30,450
<i>Sugarcane Pyrilla.</i>									
Assistant	180—10—220	One	2,160	2,280	2,400	2,520	2,640	12,000	
Fieldmen	25	Three	900	900	900	900	900	4,500	
Travelling allowance . . . . .	..	..	500	500	500	500	500	2,500	
Contingencies and labour . . . . .	..	..	250	250	250	250	250	1,250	
Total			3,810	3,930	4,050	4,170	4,290	20,250	20,250

Funds paid by the Punjab Government.

Macropes Excavatus.

Assistant	100—10—140	One	1,200	1,320	1,440	1,560	1,680	7,200
Fieldmen	25	Three	900	900	900	900	900	4,500
Rent of the laboratory	25 p.m.	..	300	300	300	300	300	1,500
Travelling allowance . . . . .	..	..	500	500	500	500	500	2,500
Contingencies and labour . . . . .	..	..	250	250	250	250	250	1,250
Total			1,150	3,270	3,390	3,510	3,630	16,950
								16,950
								2,63,750

Funds to be obtained
 from the Imperial
 Council of Agricultural Research

Microscopes and other non-perishable apparatus would be supplied by the Entomologist to Government, Punjab.

From funds of the Imperial Council of Agricultural Research 1,79,150

From funds of the Punjab Government 84,600

Taking into consideration the fact that guidance and supervision in Research work and costly apparatus would be supplied by the Punjab Government and in many cases laboratory accommodation will be provided and library facilities given, this works out at 50 : 50 basis.

ANNEXURE I-D.

SUGARCANE PESTS IN MYSORE, BY MR. T. V. SURENANIAM, OFFIC. ENTOMOLOGIST,
DEPARTMENT OF AGRICULTURE IN MYSORE, BANGALORE.

Area and varieties of canes.—Out of a little over 1,044,000 acres of irrigated area in the State about 36,000 acres are planted with sugarcane annually. The varieties planted being (1) a soft stout white cane "Rasthali"; (2) a soft red and white striped cane "Pattapatti"; (3) a thin hard rinded reed cane "Cheni"; (4) Exotic canes and (5) seedling canes.

The first three varieties form the bulk of the sugarcane cultivated although seedling canes now occupy about one-third of the total area. Irrigation is from tanks, wells and channels from rivers, etc.

Insect Pests.

Moth borers.—The caterpillars of 6 or 7 different kinds of moths are found to injure sugarcane from the time of planting until about harvest. The most important of these and fairly widely distributed are two, viz., (i) *Argyria sticticrasspis*, Hmp., which attacks the cane stem in the early stages of its growth and causes what are known as "Dead hearts" the injury to the seedlings going up to 80 per cent., in cases of severe attack; (ii) *Scirpophaga nivella*, Fabr. and *S. monostigma* Zell which are shoot borers. The others noted are *Diatraea venosata*, Wlk, *Sesamia inferens* Wlk and *Sesamia uniformis* Ddgn., stem and shoot borers; *Emmaocera depressella*, Swinh, a root borer.

Among *Coelopterous pests* (Beetles) noted is the group of *Holothichia serrata* F., whose destruction on the roots of cane has been found to be sporadic, but when it does occur, the damage to the cane has been very serious.

Among the *sap-sucking insects*, the most important noted in certain localities has been two species of scale insects, viz., *Ripersia sacchari*, Green and a *Pseudococcus* sp.

The *Aleurodid Neomoekellia berji*, Sign has been noticed to come to prominence in certain areas.

Termites or White ants are found to attack seedling canes soon after planting, in areas with insufficient irrigation facilities and lack of moisture and also in land newly opened up for sugarcane cultivation.

Control measures.

Of the various control measures against moth borers the "Trash heap" method of collecting the moths in young cane fields has been found to be of very great use in checking the moth borers. In an instance, an infestation of 80 per cent. was reduced to 10 per cent. This method has been in vogue for the last 7 or 8 years and is very readily adopted by the riyat. The Trash-heaps not only attract the moth borers alone but several other borers of Juar, rice, cotton bolls, etc.

In an area of 7 acres where Trash heaps were kept at the rate of 5 heaps per acre the average collection of moths was 70 per day. A total of 230 moths was collected in 4 days and an analysis of the catches showed 173 of *Argyria* moths, the worst enemy of cane seedling, 24 *Diatraea venosata* and 73 other kinds of moths including a number of *Chile zonellus*, Swinh, *Sesamia* sp. and others. In cases where the cane fields are close to cotton belts, large numbers of *Earias* sp. (the spotted boll worm moth of cotton), have been obtained.

Another method very successfully tried has been the handpicking of the egg masses particularly of *Scirpophaga* sp. on sugarcane leaves of young canes. The egg masses are very conspicuous and children are able to collect very large numbers of these. In one season in an area of 15 acres of young cane a total of 2,376 *Scirpophaga* egg-masses was collected by a few children in the course of two months.

Biological control.—A very minute wasp *Trichogramma minutum*, Riv., has been found to be a natural parasite of the moth borer eggs in the fields. It has been found possible to breed a large number of these wasps in the Laboratory on eggs of common flour pest *Corcyra cephalonica* St. Hundreds of these parasitised eggs on strips of cards (millions of parasites enemies of moth borer eggs) were got ready and kept in a refrigerator to be utilised when wanted in the fields. Two releases of 52,000 and 14,000 in two lots in two sugarcane areas were made last year. The work is being continued.

In conclusion I have to state that the problem of sugarcane pest control is sure to assume very serious proportions in the near future as the new Sugar Factory established now in Mysore has not less than 3,000 acres of sugarcane in all stages of growth within a radius of 6 miles.

A study of the various borer and other pests of cane and the resistance of different varieties of canes to borer attack has already been started in the Government Sugarcane Farm in this area.

BANGALORE

The 30th July 1933.

ANNEXURE I-E.

NOTE ON SUGARCANE INSECTS AND PROBLEMS CONNECTED WITH THEM IN SOUTH INDIA BY
DR. T. V. RAMAKRISHNAMURTY AYYAR, GOVERNMENT ENTOMOLOGIST, COIMBATORE,
MADRAS.

INTRODUCTION.

In the Madras Presidency, sugarcane is cultivated in all the important agricultural tracts and at present the area under this crop occupies somewhere about 126,000 acres*. Of this total area, over two thirds of the acreage is confined to the Northern Circars including the Ganjam, Vizagapatam, Godaveri and Kistna Districts and the central tract including the districts of Chittoor, North Arcot, Salem, Coimbatore and Trichinopoly. As a result of the recent inducements to develop this industry in the shape of tariff protection and the opening up of several irrigation projects in the different provinces, there are indications to show that the existing area under sugarcane is sure to increase considerably during the coming years and that the problems connected with this industry are sure to assume more and more prominence in the near future. And of the various such problems, those connected with the animal and vegetable parasites which levy their toll on this important crop are no less important. According to Fletcher, the damage done by cane borers alone is roughly estimated at 30 million rupees a year. Though this estimate may not be quite accurate, it gives us some idea of the loss by pest infestation and reminds us of the fact that this aspect of the sugar industry is well worth thorough investigation at the hands of scientific men and sugarcane cultivators. This note is prepared with the idea of presenting in a brief manner the present position regarding sugarcane insects in S. India, their comparative economic importance and the chief problems connected with them which the sugar planter has to deal with. As far as possible, scientific details and technicalities have been avoided.

Sugarcane Pests in South India.

Though the area under cane in S. India is far less than in some of the Northern Provinces and the damage caused to the sugarcane crop by insect and other pests is not so pronounced as in the case of crops like paddy or cotton, sugarcane often suffers at the hands of such pests and diseases, and appreciable damage and loss are caused thereby. To the sugarcane farmer who is anxious to grow a good crop and reap a decent harvest of vigorous vermin free and healthy canes, a knowledge of the nature and habits of the more important pests and some familiarity with the possible control measures against them will always be of very great help. And now that the area under sugarcane is increasing rapidly, information in this direction might be of great use and very much appreciated. With regard to cane insects with which only this note deals, though a dozen or fifteen insects have been found associated with the sugarcane plant in the different tracts of this province†, not more than three or four could at present be put down as forms which might be considered as serious major pests; the others are ordinarily of minor importance and become serious only very rarely causing sporadic local infestations.

* The latest available crop statistics show the following distribution of cane area in the Presidency—N. Circars 48,750 acres; Central districts 44,500; Carnatic including Nellore, Chingleput and S. Arcot 12,500; the Ceded Districts 11,700; the Southern districts 3,800; West Coast and Hill 3,620. For the whole of India the area under cane during 1931-32 has been noted to be 2,886,000 acres; over 50 per cent. of the sugar products is from the U. P.

† Vide author's bulletin on List of S. Indian crop pests—Madras Department Bulletin No. 27 (1932.)

The Major Pests.

The most important pests of sugarcane in S. India which may be ranked as the foremost and which generally cause appreciable damage are the Moth borers and Termites, and it is only in connection with these two sets of pests that the Entomologist very commonly receives complaints and reports. As next in importance to them, we may include the two or three sucking insects which occasionally appear as pests, viz., the cane mealy bug, the mealy wing and the leaf hopper. These are the only really important cane insects in S. India which call for some serious consideration.

The Moth borers—Of the insects associated with sugarcane, the moth borers of one or other species are very ancient and well-known pests of this crop, being found in almost all the sugarcane areas of the world; and unlike other insects which have often a local or restricted distribution the moth borers are very cosmopolitan and practically perennial pests of the crop; the only point to be noted is that the species in different countries are not the same. The species chiefly concerned in the West Indies, Louisiana, Mexico and British Guiana is *Diatroea Saccharalis*, F. Of the three or four species of sugarcane moth borers found in S. India the only important one is the insect known by the name *Argyria sticticraspis*, H. Though this insect has been known for a very long time it was not until very recently that the correct identification of this borer was obtained. For many years past this insect was confused with one or two similar borers which very closely resembled this species and had practically the same life habits; and all these passed under the same name *chilo Simplex*, B., since all these allied insects were found breeding on sugarcane, sorghum, maize and allied plants. Recent work on this insect and other allied borers, especially done in Puna*, has clarified this confusion to a certain extent, and as far as we know, our most important moth borer-pest of sugarcane is now definitely identified as *Argyria sticticraspis*, H. Though found on allied plants it is particularly partial to sugarcane and attacks the latter usually during the very early stages causing 'dead hearts' in young plants; it does not infest grown up canes so much as in the younger stages. This insect may be considered as the most important of sugarcane pests in the province. Another borer (*Diatroea venosata*, W.) which has practically the same habits as *Argyria* is not so common as the latter and is generally found attacking grown up canes and causing comparatively much less damage. The whole top shoot borer (*Scirpophaga nivella*, F) is another very easily distinguishable cream white moth with quite different habits and found occasionally in Circars, S. Arcot and Coimbatore. The caterpillar, unlike as in other forms, burrows down into the top shoots of the grown up cane, kills the central shoot and often causes the peculiar bunched side shoots which indicate the presence of the pest in the field. Though this insect is mainly confined to sugarcane as its food plant and does not breed on sorghum and other crops like the two previously mentioned forms, it has rarely assumed the status of serious pest so far. Another borer worth noting in connection with cane is what is known as the wheat stem borer in N. India and the Ragi Pink borer (*Seamia inferens*, D) in S. India. In S. India it is a specific pest of ragi and maize and is found only occasionally breeding on sugarcane; the caterpillar has a pinkish colour and the moth is a member of a different family from the other borers noted above and does not strictly come under the category of what are considered as typical moth borers.

Termites—Next to the moth borers we may place the termites as cane pests of some real importance. Two species have so far been found connected with injury to cane, viz., *Odontotermes obesus*, R., and *Eutermes heimi*, W. The great bulk of the damage caused to sugarcane by white ants is to planted underground setts; these are entirely eaten up hollow and the germinating buds completely destroyed in many cases. This happens especially in white ant infested and comparatively dry areas and this kind of damage is due chiefly to the work of *O. obesus*, R. a very widely distributed termite in S. India. Serious and wholesale losses of seedlings are often reported from different parts, especially from newly planted and termite infested tracts. The other species (*E. heimi*, W) is a leaf eater and swarms of these appear late in the evening on young seedlings, cut out pieces of the leaf blades and strip the leaves outright, skeletonising the few leaves of seedling canes. This kind of damage is often noted particularly bad in the nurseries raised in the Sugarcane breeding station at Coimbatore where very young seedlings are raised from seeds.

Minor Pests.

Among the insects of secondary importance as cane pests in S. India we may include in the order of their importance, the mealy bugs, the mealy wings and the cane leaf hopper; all these are sucking insects and are not internal feeders like borers. The

* Vide papers in the Reports of 3rd and 4th Entomological Meetings—Puna—by Fletcher and Ghosh.

damage done by mealy bugs consists in colonies of the small insect in different stages attaching themselves to the nodes of the growing cane, sucking up the juice and allowing the plant to lose its vigour and in bad cases fade. Generally these are small pale reddish creatures covered with a white mealy bloom and found partially protected by the drying up leaf sheaths at the nodes and this protection hides them from exposure. Often these creatures are carried in setts used for planting and get distributed from place to place. Of the species known from S. India the commonest appears to be *Ripersia sacchuri*, Gr. (Fig.) though the species *Aclerda japonica*, N., is occasionally noted. The mealy wings and the leaf hopper are found on the foliage where they cause the same kind of harm as the mealy bug by sucking up plant juice thus draining away the nutrition from the growing plants and allowing them to fade. The mealy wings found include two species *Aleurolobus barodensis*, M., and *Neomas-kellia bergii*, S., though the former is the commonest (see Fig.) and has a very wide distribution all over India; the bluish black puparia of this insect are often found in numbers on the foliage of grown up canes in certain tracts and this often gives a blighted appearance to the leaves. The cane leaf hopper (*Pyrilla perpusilla*, W.) is a very active straw colored bug with the head prominently drawn forwards as a sort of rostrum (Fig.). In certain seasons and tracts the insect increases in some numbers and colonies of the same in its various stages are found causing appreciable damage to the tender foliage of sugarcane plants. This insect may, to some extent, be compared with the Frog hopper pest of Trinidad and the cane leaf hopper of Hawaii, though our insect has not as yet assumed the role of either of these two serious exotic pests. Masses of eggs and colonies of the hopping nymphs may be found in badly infested fields and generally the eggs are found badly parasitised.

The other insects associated with sugarcane in S. India include one or two leaf caterpillars, (1) a leaf eating beetle (2) a species of thrips (3) and a species of root aphid. The leaf caterpillars and the beetles have never been noted as serious so far: the thrips which attacks the tender foliage and causes the peculiar rolling and wriggling of the leaf tips occasionally causes the leaf tips to dry, but is very rarely serious. The same can be said of the root lice (4) also which now and then damage the roots in some areas.

The rice grasshopper (5) though known to be a pest of cane in parts in N. India is not generally found so in this province; it might, as in parts of Ganjam, do some occasional damage to cane growing in the midst of paddy on which the insect is a very serious pest.

Before closing the remarks on cane insects mention has to be made of the notorious *Aphis madis*, F., which is said to be responsible as the vector of the mosaic disease of cane; which is not absent in S. India. This insect is commonly found on cholam and as far as the writer is aware it has not been found in any notable numbers on cane in S. India.

Problems connected with Sugarcane Insects.

The entomological problems connected with sugarcane in S. India are mainly, if not solely, those relating to the investigation and control of the moth borers and the *Termites*. Recent studies carried out by the Entomological staff of the Madras Agricultural Department especially in the N. Circars have shown more than anything else that the only borer with which we in S. India have to be seriously against is the species *Argyria stricticraspis*, H. This borer is present in all the important cane tracts like the Northern Circars, Coimbatore Ceded Districts, S. Arcot, etc. The extent of damage done by this borer to the primary shoots often ranges from 10 to 30 per cent. or more in certain years. The intensity or otherwise of the infestation often varies with seasonal changes taking place in the area in addition to the different varieties of cane grown. The infestation generally takes place from the period of germination up to a period of 5 weeks and it is during this period that dead hearts appear in the infested fields. Though the results of work so far done show in many cases a final difference of 10 per cent. in favour of borer free canes, the writer is of opinion that the actual loss finally caused to the cultivator by this insect does not very much depend upon the percentage or degree of infestation of the primary shoots. For, in

(1) *Tellicota augias*, L. (a butterfly).

(2) *Phidodonta modesta*, W. (a small spiny black beetle).

(3) *Bregmatothrips ramakrishnae*, B.

(4) *Tetraneura ulmi*, V. G.

(5) *Hieroglyphus banian*, F.

some cases, the final outturn from badly infested fields have been found to be much more than that from fields which were comparatively free or very mildly infested in the early stages. There is one important factor which has to be taken into account in investigating the subject of borer attacks in the early stages of cane and that is the tillering properties of canes and the consequent power they often possess of picking up vigour during their 8 or 10 months growth after initial borer infestation and regaining the standard output. Though some substantial work has been done in estimating the loss caused by the borer and data have been collected it is believed that a good deal of further work has to be carried out to definitely ascertain the actual loss caused by moth borer attack to different canes and in important cane growing tracts. In this connection it will not be out of place to quote the pertinent remarks* of Dr. Myers on this question of determining the loss by borer attack—"What we most clearly lack, however, is a standard method of estimating infestation and from that determining damage so that figures from different fields and different countries can be legitimately and conveniently compared so that we may, in some, keep our thumb on the pulse of moth borer destruction and really observe whether our own or our neighbours' attempts at control are having any effect and if so just how much". We have therefore to devise some standardised methods of estimating borer injury to cane to get at the real loss caused. A good deal of ecological work has also to be done in connection with the moth borer in its relation to cane varieties, seasonal changes, host plants, temperature, humidity and other factors including the nature and activities of natural enemies.

Regarding trials of control methods a good deal might be done in the way of prophylactic measures. Of these the selection of healthy sets for seed is a very important one, for unless this is very carefully done we will be planting the borers also when we plant the seed cane: Trials with insecticidal methods of killing with arsenicals, etc., have not shown any encouraging results; nor has the time arrived to suggest such measures to Indian ryots. Neither the adoption of trash traps nor the method of egg picking has been found of any avail as effective or practical control propositions. There is a good field, open of course, to cane breeders to help the ryot by breeding and evolving out borer resistant varieties and such work is being carried in all the important cane growing areas of the world. Coming to the method of biological control it is known that the borer is subject to the attacks of some hymenopterous parasites some of which are present in most areas† However, it is not yet definitely known whether their work of checking the borer has been sufficiently evident and satisfactory. Speaking especially of the biological method of control with the egg parasite *Trichogramma minutum*, Ry. (Fig.) now being adopted in various parts of the world, though it has been boomed by some people in different countries as a remarkable success, there is a consensus of opinion among the more responsible men concerned in this work that this method of control has not as yet been found very convincing. This may be gathered from an important resolution‡ adopted on Biological control by the meeting of several eminent Entomologists at the Fourth Congress of the International Society of Sugarcane Technologists held in March 1932 at San Juan in Porto Rico. The resolution was to this effect. "In view of the great publicity which has been given to costly attempts in various parts of the world to control the cane moth borer by mass breeding and liberation of *Trichogramma* egg parasite, and in view of the fact that Entomologists who have been engaged in this work on a comprehensive scale are in wide disagreement as to the practical results, if any, of this method, this congress, after examination of all published evidence cannot endorse the plan until answerable statistical evidence of its efficacy is forthcoming". This weighty statement does not, of course, mean that further investigations should not be continued in this line, but only goes to show that the work with parasites is not after all as easy and smooth sailing as some of us believe; in the words of Dr. Howard "one's outlook becomes more or less confused when one considers the complications" connected with such work. Coming to the direct methods of control cutting out the dead hearts in time to check the multiplication of the borer at the very early stages might deserve a word or two. The borer which attacks the cane during the younger stages can be controlled to some extent by prompt destruction of the shoots with dead hearts; but in most cases the cultivator is either indifferent or the operation is done very unsatisfactorily by only pulling out the dead shoot and leaving the borer intact. In the N. Circars where there is the method of wrapping and supporting the growing canes, some of the side shoots are removed as a cultural

* International Sugar Journal—October 1932, p. 377.

† In S. India we have one or more braconids of the genera *Stenobracon* & *Apanteles* and of the Ichneumonids *Xanthopimpla* and among Scelionids a *Pachyura* and of the chalcids we have the now well-known and famous wasps *T. minutum*, R.

‡ International Sugar Journal—October 1932, p. 379.

practice during the operation; if in this process the farmer takes some care to specially cut out the infested shoots with the borer *in situ* and destroy them, a certain amount of control could also be effected. One unfortunate fact in connection with the cane borers is that, in most of these cane areas, there is sugarcane growing at some stage or other throughout the year for the pest to pass over from season to season and help its perennial multiplication. As suggested above, we have to carry out first and foremost an intensive study of the bionomics of the borers to gauge the actual loss caused and then experiment with different control measures before we are in a position to suggest any methods of an economic and practical nature to the ryot.

The Termite problem is not half so important or serious as that of the borers which are often described as 'the hardy annuals if not perennials among the pests of sugarcane'. Proper selection of termite free area for cultivation, sufficient culture of the land, proper irrigation and other prophylactic measures like selection of healthy seeds and treating the setts with deterrent substances would certainly keep away termites, and even if they occur there are methods which can check their damage in the shape of soil fumigation, mixing the irrigation water with tar water or crude oil emulsion. A radical method for termites in any area is to locate the termite nests in the vicinity, dig out the nests and destroy the queens and in the case of the leaf feeding termites in cane nurseries the plants may be sprayed with a dilute solution of some deterrent like Crude Oil emulsion. In this work, of course, proper identification and habits of the termites concerned is an essential preliminary since errors are very often made in mistaking one species for the other and applying the wrong treatment.

Regarding the other insects—only the Mealy bugs, Mealy wings and the Leaf hopper occasionally call for attention though they have been noted rarely as serious pests in the province. As in the termites some preliminary work has to be done in identifying correctly the mealy bugs and mealy wings responsible for the damage on cane in the different tracts before adopting the appropriate measures suited to each form. For mealy bugs, the selection of clean setts is of very great importance. Some of the other measures suggested by Hall* for the Egyptian mealy bug may also be tried. The mealy wings and the leaf hopper which are leaf pests, occasionally appear to do some harm in certain seasons but prompt mechanical methods may be found to check these pests to a great extent. Both these kinds of insects are also subject to the attacks of some effective parasites.

Suggestions for Future Work

In the opinion of the writer, the following appear to be the more important items in research work connected with sugarcane insects in India.

(i) A complete survey of the insect fauna of the sugarcane plant in different parts of India and Burma; this should include the geographical distribution, alternate food plants, natural enemies, life history notes and the economic importance of each insect.

(ii) A detailed study of the more important cane pests of each tract with special reference to such factors as the time of planting, manurial response, spacing, tillering with reference to varieties, etc.

(iii) The exact nature and the correct estimate of the damage caused by each pest both in relation to different localities and varieties of cane.

In Madras, such special studies are to be devoted to the *borers*, *termites*, *mealy bugs* and the *leaf hopper*.

(iv) The study of sugarcane mosaic in relation to insects as vectors.

(v) Trial of remedial measures including Prophylactic, Cultural, Mechanical, Insecticidal and Biological methods. Special attention may be devoted to the study of natural enemies and methods of biological control. These may be carried out in ways which will suit the different local and economic conditions in the different tracts of India.

(vi) Trials in evolving varieties of cane which may be pest resistant in co-operation with breeders.

Thus, the investigations relating to cane pests have to be carried out with due regard to all the different aspects of the subject; it may not be a wise policy to

* The out-break of *Pseudococcus Sacchari*, C. on sugarcane in Egypt by W. J. Hall.—Technical and Scientific Bulletin, Cairo, 1922. There are some records of the existence of this bug on cane in some parts of India but this has to be definitely ascertained.

depend on one set of activities alone to get quick and satisfactory results. It is all very easy and convenient to remark glibly that the easiest way of fighting disease is by a change of variety and dispense with Entomologists and Mycologists, or to opine that Biological control is the only successful remedy against pests. But responsible workers all over the world, realising, as they do, the short-comings of such one sided activities in relation to the time factor, economy etc., appear to be of opinion that we cannot depend upon one or two factors alone and wait for the results, but should explore all avenues of attack until we have found out the most suitable measure for each pest and region. Our main aim is to help the sugar planter as quickly and economically as possible.

Before concluding this short note the attention of entomologists and others interested in the sugar industry in India may be invited to the fact that, while we are engaged in devising ways and means to fight our local pests, we should not forget to provide ourselves with the proper precautions which will prevent the entry of the some of the serious sugarcane pests of other countries such as the sugarcane weevil (1) of Australia, the dreaded leaf hopper(2) of Hawaii, the frog hopper(3) of Trinidad, the cockchafer(4) of Mauritius or the widely distributed moth borer(5) of the West Indies—insects which have been causing very serious losses to the sugar industry in their respective countries. It is needless to add that in these days of rapid and convenient transportation facilities, animals and plants have very good chances of getting widely dispersed from place to place. I believe some of us are already aware of the fact that on two occasions the Imperial Entomologist, Pusa, while examining parcels of sugarcane setts received from abroad came across the live grubs of the west Indian sugarcane weevil (*Stephanophorus sacchari*) in a parcel from Antigua and that of the Javanese beetle pest (*Holanaria picesens*) in a parcel from Java. It is up to us, therefore, to see that, while we are engaged in solving our own insect problems connected with sugarcane, we are also careful to see that no exotic pests of any kind get entry into the country and add to our already existing troubles.

ANNEXURE I-F.

SUGARCANE ENTOMOLOGICAL RESEARCH.

Note by Mr. P. B. Richards, Entomologist to the Government of the United Provinces.

The opinions expressed in this note are based on general observations rather than upon a detailed investigation of the sugarcane pests in the United Provinces and elsewhere.

The more important insect pests of sugarcane in the United Provinces are root, top, and shoot borers, leaf-hopper, white-ants, and white-fly. Other insect pests such as the kharif grass-hoppers, beetle grubs, mealy bugs, mole crickets are either periodic and limited in attack or have not yet been credited with sufficient damage to give them importance in relation to the cane culture of the Province.

Conclusions drawn from casual observations may require to be modified or abandoned upon detailed investigation. Also the conditions ruling in the United Provinces may differ so considerably in India that any conclusions may be of only local validity.

Speaking generally I have been impressed with the fact that apparently healthy, well cultivated, and well nourished plants are usually not seriously damaged by insect attack. Insect pests undoubtedly are present, but not to the extent to be a serious menace to the crop. For example, canes which are weakly appear generally more attractive to borers and white-ants. Mosaic-affected canes show more obvious attack than mosaic-free. Top shoot borer concentrates on waterlogged patches. Pyrrilla attack only appears to become of serious importance when the cane crop is otherwise upset, either by unsuitable weather conditions or by disease. Aleurolobus also appears to thrive on unhealthy canes, particularly if water requirements are inadequately met. White-ants also appear to attack weak and unthrifty plants more readily than when healthy and strong growing. The problems of insect pest control on sugarcane, therefore, appear not to be purely entomological, but to be linked up with all aspects of agricultural science. This conclusion will be reverted to after considering the purely entomological aspect of the question.

All agricultural Entomologists in sugarcane growing areas presumably receive numerous reports of insect pest attack and requests for remedial recommendations for attacked cane crops. I imagine that the majority of such Entomologists have, like myself, no practical recommendations to make in the majority of cases. Take for

(1) *Rhabdocnemus obscurus*.

(2) *Perkinsiella saccharida*.

(3) *Temasple saccharina*.

(4) *Phytalus smithi*.

(5) *Diatroea saccharalis*, F.

first example white-ants. The prevalence of white-ants in serious number in a sugar-cane field is the result of various factors. Light soils encourage them, while in heavy clay soils, especially under frequent irrigation, the white-ants make little headway. Even in the same soil, the nature of the manure greatly affects the subsequent incidence of attack. Undecomposed farm-yard manure encourages the pests, providing excess food upon which they multiply, and the hungry hordes subsequently turn their attention to the crop. Previous cropping is of importance in the same way. Stubbles, or even weeds during a fallow, foster white-ants, and increase the attack upon the sugarcane crop. White-ants cannot be eliminated from a field by any methods of cropping or the utmost attention in cultivation; nor perhaps is it desirable that they should be. They can, however, be kept down to almost negligible proportions by refraining from providing conditions suitable to their multiplication. When, however, they are attacking a cane field in force, remedial measures are not practicable, other than cultivation and stimulating the plant, irrigating to make the soil temporarily unsuitable, and employing deterrents or poisons such as crude oil emulsion, neem cake, and the like in special cases. Serious attack by beetle grubs is also a result of unsuitable soil management and subsequent remedies do not appear practicable.

The position in regard to boring caterpillars is even more unsatisfactory. If there could be a close period between harvesting and germination, if only sound setts were planted, and cane stools were removed and pitted prior to emergence of the pests from hibernation, the attack could be reduced to insignificance. Practically none of these is possible, except the sowing of healthy setts; and with the risk of reinfection from late harvested fields and from undestroyed stubbles, it is doubtful if careful selection of setts will have much effect. Something can be done on sprouting cane, by destruction of egg masses of the top and shoot borers; but nothing for root borer which is thought to be the most serious of all in the United Provinces. Similarly collection of egg masses, and the hand collection of the first generation of leaf hoppers are possible, though too laborious, and requiring too much co-operative application, to be readily carried out and are applicable only in the first few weeks of growth. Thereafter no direct control method can be advocated, and outbreaks of borers or leaf-hoppers can only be watched with commiseration. Stomach or contact poisoning, even if effective, would generally be uneconomic, and almost always impossible to carry out. Traps have not proved themselves sufficiently effective, and, again, would require a degree of co-operation which is not to be expected from the average cultivator.

The Agricultural Entomologist, therefore, has at the moment to confess himself almost devoid of any practicable direct methods for the control of most sugar-cane pests. The difficulties of control inherent in the nature of the crop have concentrated attention upon biological methods, notably encouragement of egg parasites. As a general cure for indigenous pest insects, I have no faith in ever achieving success with indigenous parasites or predators. Spectacular success has undoubtedly been achieved in special cases, but in all of these the pest is an introduction, and the controlling parasite or predator has been introduced from the original habitat of the pest. Possibilities of biological control undoubtedly require investigation, which may prove me pessimistic; but at present I feel that no reliance can be placed upon any great improvement in the condition of the cane crop coming out of research in parasite control methods.

One is thus driven back upon the non-entomological factors affecting pest insects. With suitable soil and the right rotation, and provided all stubbles and weeds are removed and utilised in preparation of compost manure, there is no doubt in my own mind that our present canes would suffer much less insect damage. This, however, involves changes of agricultural practice which, even if practicable—as in removal of the cane stubbles—may not be readily acceptable. The limiting factor is the average cultivator and what he is able and willing to accomplish; and no immediate and considerable improvement can be expected along these lines in the United Provinces, where cane production is mostly in the hands of small cultivators. The utilisation only of suitable soil for cane growing, and the adoption of suitable rotation and agricultural practice, may undoubtedly be expected to be accepted in time, as the cultivator realises their economic advantages. They do not, however, promise to meet the immediate necessities of the case. Nevertheless it is very essential to push forward investigations upon them. There remains the provision of canes which offer greater resistance to pest attack. This appears to me the most promising major line of investigation, and in this the Entomologist has to take an important part along with the Agriculturist, the Plant Physiologist, and the Plant Breeder. The Entomologist may not be able to prevent attack, but he can measure the relative attack on the present standard canes and new seedling canes under different agricultural practice and in different areas; and thus provide data for the guidance of his fellow-workers. He may, in addition to determining the comparative susceptibility of cane varieties,

be able to indicate the factors which control susceptibility of attack by particular pests, though this is more a matter for the Physiologist; as responses to different climates, soils, and soil treatment are more properly the province of the Agriculturist.

The ideal to aim at is the right cane, in the right area, on the right soil, and under the right agricultural practice. This involves team work with which the Mycologist also should be associated. Canes less susceptible to attack by pest and disease may be expected to result from such an investigation. Their behaviour will, however, require continuous watching. Their degree of susceptibility is likely to vary with climatic and soil conditions, and they may in the course of vegetative multiplication even weaken in their resistant factors. Moreover, in the course of generations, strains of the pests may adapt themselves to the resistant factors, and the canes in this way again become susceptible.

It is, of course, assumed that the Sugar Technologist and the Economist play their part in the investigation; for the final criterion would not be whether such and such cane is more or less susceptible to insect attack in a particular area, but whether, in spite of the attack, it is the one which produces the greatest tonnage, sugar content, and cash value to the grower.

It is upon such lines that the entomological investigations in the United Provinces Sugar Research Scheme, financed by the Imperial Council of Agricultural Research, are tentatively laid down. The relative susceptibility of standard varieties is proposed to be determined on the Research Farm, and in the adjoining cane areas; as also upon new seedling varieties of agricultural promise. The sugarcane Entomologist will be stationed in the western districts. It is desirable to carry out parallel observations in the eastern sugar growing areas, where it is proposed to station an entomological assistant for the purpose. Quantitative and qualitative determination of damage; and preventive and remedial measures, including cultivation and rotation effects, deterrents and insecticides, and parasitic control, also must enter into the investigation; but the first step must be the determination of the relative attack upon canes now under distribution or under trial. So far as the United Provinces is concerned, therefore, provision has already been made for much of the preliminary research indicated; and it may be hoped that the results arising out of this may be of use to other cane areas. It does not appear, however, that the United Provinces enquiry can touch more than the fringe of the All-India aspect. It is desirable that parallel investigations are made in all other important cane areas, and that these should be co-ordinated under the Imperial Council of Agricultural Research. This appears to indicate the necessity, not only for the provision of adequate staff for local requirements, but of a competent Sugar Entomologist under the Imperial Council of Agricultural Research, to direct and co-ordinate the whole enquiry. The Plant Breeder and the Sugar Technologist are already available to the Imperial Council of Agricultural Research. An important necessary addition to the team of workers, who also should be under the Imperial Council of Agricultural Research, is the Plant Physiologist.

ANNEXURE I-G.

REPORT OF THE SUB-COMMITTEE APPOINTED TO FORMULATE A SCHEME OF RESEARCH ON THE INSECT PESTS OF SUGARCANE.

PRESENT :

1. Mr. B. C. BURT, C.I.E., M.B.E., I.A.S. (*Chairman*),
2. Mr. AFZAL HUSAIN,
3. Mr. M. CARRERY,
4. Khan Bahadur FATEH-UD-DIN,
5. Mr. P. V. ISSAC,
6. Mr. C. A. MCLEAN,
7. Rai Bahadur C. S. MISRA,
8. Dr. RAMA KRISHNA AYYAR,
9. Dr. P. B. RICHARDS,
10. Mr. WYNNE SAYER,
11. T. V. SUBRAMANIAM,
12. Rao Sahib B. P. VAGHOLKAR.

REPORT.

In all provinces the most important pests of cane are the moth borers of sugarcane and this group of insects is responsible for very serious economic loss. Termites constitute a much less important pest but in most provinces are rather more than minor pests. There are numerous other pests but they are of local or occasional importance. Work is specially required on the various borers including the top-shoot borers, stem borers, and the root borers.

2. It is of great importance that the behaviour of all standard and new varieties of cane in regard to insect pests should be carefully studied on all cane-testing stations. Such work should be extended to test plots of cane grown under ordinary cultivators' conditions. The record of the behaviour of important varieties, especially recent introductions, relative to the sugarcane borers and other pests should not be discontinued when the general introduction stage has been reached but should be carried on.

3. In the past control measures of the ordinary type have not proved of much practical value. It is necessary to find out which varieties are resistant and which relatively susceptible to damage by each of the major pests and to analyse the causes of such resistance or susceptibility. The ultimate means of control probably lie in the selection of suitable varieties and in the improvement of methods of cultivation. The problem is not entirely entomological and close co-operation with the cane-breeder and later with the plant physiologist will be necessary to secure optimum results.

4. The prospects of effecting the control of the sugarcane borers by biological methods, i.e., by means of parasites are open to question. There is great difference of opinion as to the degree of success which has attended the use of the *Trichogramma* parasite in other countries but some success has been obtained in Mysore with this parasite. The question is of great importance and justifies thorough study.

5. The study of the parasites of the borers of sugarcane can be carried out by one research worker with a small staff at one centre for the whole of India but he will need the fullest co-operation from provincial Entomologist and other sugarcane research workers. The latter stages of work, if success is attained, will require development throughout India. It is recommended in the meantime that this research worker should first be stationed at Pusa in view of the importance of carrying on the work in some suitable centre in Northern India.

NOTE.—Mr. Issac (Offg. Imperial Entomologist) does not consider Pusa a very good centre for the breeding of parasites in view of its climatic conditions and thinks that this work might be done better at some station in South India with which opinion Dr. Rama Krishna Ayyar and Mr. Subramaniam agree. The opinion of the rest of the Committee is that this work needs to be done in Northern India. Mr. Sayer wished it to be understood that any intensive work on sugarcane pests at Pusa should be under the strictest control in order that the other experimental work on sugarcane may be properly safeguarded.

6. The Committee consider that work on the sugarcane borers (and some other sugarcane pests to be mentioned later) is necessary on an All-India basis. The work in the United Provinces, Bihar, Bengal, Assam and Bombay should be co-ordinated and directed by an all-India senior Sugarcane Research Entomologist who would be responsible for the framing of the programmes, the technical direction of the work and the collation and interpretation of the results obtained in those provinces. It was considered that the all-India Sugarcane Research Entomologist should be stationed at Pusa. An Assistant Entomologist with a small staff would be required in each province. In Madras and in the Punjab the Government Entomologists consider that the supervision and direction of the work of the Assistant Entomologist for sugarcane pests should be under their control but they collaborate with the all-India research officer.

7. The general scheme would involve the expenditure shown in the following table. These estimates are approximate and the Committee recommend that the Governments concerned should be invited to put forward schemes on these lines to form part of a co-ordinated whole.

Approximate estimate of requirements.

	Rs.
<i>Headquarters—</i>	
(a) Senior sugarcane Research Entomologist on	1,000—50—2,000 p. m.
(Pay according to experience and qualifications within that scale.)	
(b) Assistant Entomologist for Parasite Research on (Initial pay in each case according to qualifications)	200—25—500 p. m.
(c) Assistant Entomologist for Systematic work and for collating results on	200—25—500 ..
(d) Two Junior Assistants on	100—10—140 ..
Six Fieldmen on	
(e) Statistical Assistant on	150—10—200 ..

*Headquarters—contd.**(f) Clerical staff—*

Three clerks at suitable local rates.		Rs.
(g) Travelling allowance		5,000
(h) Contingencies		3,000
<i>(i) Non-recurring—</i>		
(i) Parasite laboratory and insectory		10,000
(ii) Apparatus		2,000

*Provincial Section—**Bengal—*

Assistant Entomologist on scale	200—25—300 p. m.
Two Assistants	100—10—140
Six Fieldmen on Rs. 25 p. m. each	
Travelling allowance	2,000
Contingencies and apparatus	1,000

Bihar—

Assistant Entomologist on scale	200—25—300
Three Assistants on scale	100—10—140
Nine Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	2,000
Contingencies	1,000

Bombay—

Assistant Entomologist on scale	200—25—300
One Assistant on	100—10—140
Three Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	1,200
Contingencies	3,000

United Provinces—

Assistant Entomologist (already provided).	
Three Assistants	100—10—140 p. m.
Nine Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	2,000
Contingencies	1,000

Punjab—

Assistant Entomologist on scale	200—25—300 p. m.
Four Assistants on scale	100—10—140 p. m.
Twelve Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	2,000
Contingencies	1,000

Madras—

Assistant Entomologist on scale	200—25—300 p. m.
Two Assistants on scale	100—10—140 p. m.
Six Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	2,000
Contingencies	1,000

Provincial Sections—contd.

<i>Mysore—</i>	Rs.
One Assistant	100—10—140 p. m.
Three Fieldmen on Rs. 25 p. m. each.	
Travelling allowance	750
Contingencies	1,000

The Mysore State Entomologist will gladly collaborate in this all-India scheme.

The Committee have no particulars of Assam requirements before them.

Termites.

8. The Information is required as to the species of termites which actually attack and damage sugarcane; information is also required as to what varieties of cane are seriously attacked and a study should be made of the reasons why some varieties are attacked and others are not. Experiments are also required on deterrents especially for the protection of cane sets. The Committee consider that what is mainly required is a common programme of work and an interchange of results; this can be secured by the arrangements already proposed for work on sugarcane borers provided that the Senior Research Entomologist at Pusa is provided with a Research Assistant for termite work.

Leaf-hoppers, white flies and their parasites.

9. Work on these pests is needed mainly in the United Provinces and the Punjab and it is considered that it would justify a small grant for a special Research Assistant in each of the two provinces. Several other cane-pests were mentioned and it was considered that work on these should be undertaken provincially.

The insect vectors of the Mosaic disease of sugarcane.

10. There is a great need for information on the insect vectors of the mosaic disease of cane in India. Research work on the Mosaic disease, with the aid of a grant from the Council is already in progress at the Imperial Institute of Agricultural Research, Pusa. Transmission experiments by the Entomological Section to determine what insects carry the disease in India have not yet been undertaken. The Imperial Entomologist's Section could undertake this work if given one Research Assistant and one routine Assistant with a non-recurring grant for insect-proof cages. It is recommended that such a grant should be made.

Conclusion.

11. The Committee consider that the scheme which they have outlined would enable sugarcane pests in India to be thoroughly studied and recommend that Governments concerned be invited to put forward specific proposals for grants on these lines.

(Sd.) B. C. BURT.
 „ M. AFZAL HUSAIN.
 „ M. CARBERY.
 „ C. A. MACLEAN.
 „ T. V. SUBRAMANIAM.
 „ T. V. R. AYYAR.
 „ C. S. MISRA.
 „ P. V. ISAAC.
 „ PHILIP B. RICHARDS.
 „ B. P. VAGHOLKAR.
 „ FATEH-UD-DIN.
 „ WYNNE SAYER.

SIMLA,

Thurs. 8th August 1933.

ANNEXURE I-H.

EXTRACTS FROM THE PROCEEDINGS OF THE VI. MEETING OF THE SUGAR COMMITTEE HELD ON THE 15TH NOVEMBER 1933.

Proposals for the initiation of future Research into the insect pests of sugarcane. Report of Special Committee. (Subject No. 12 of the Agenda.)

Mr. Burt in introducing the subject explained the main features of the report of the Sub-Committee appointed to formulate the scheme of research on Insect pests of sugarcane. He pointed out that the scheme consisted of two inter-dependent parts, one central and the other provincial. The estimates of cost given were approximate and the Governments concerned would be invited to put forward detailed schemes on these broad lines,—which would be placed before the Committee again before they were finally sanctioned. He drew attention to the fact that under the present proposals the supervision and direction of the work of the Assistant Entomologist would in the case of Madras and the Punjab rest with the provincial Entomologists who would collaborate with the All-India Sugarcane Research Entomologist. In the case of the other provinces the programme of work would be framed by the All-India Sugarcane Research Entomologist. He moved that the report of the Sub-Committee may be adopted.

2. In reply to a question by Mr. Walchand Hirachand Dr. McRae stated that the post of Imperial Entomologist at Pusa was at present vacant, but when an appointment was made this Officer would not have sufficient time to undertake Sugarcane work in addition to his ordinary duties. Mr. Sethi suggested that as the scheme in so far as work at Headquarters is concerned, relates to the Imperial Department of Agriculture and as the post vacant is also under that department, the officer to be appointed should undertake this work. The ordinary work of the Imperial Entomologist might be undertaken by the Second Entomologist at present provided at Pusa.

3. Dr. McRae pointed out that the range of salaries provided in the estimates for the senior posts was very wide, which would make it difficult to prepare an exact budget.

4. Mr. Burt explained that the Sub-Committee attached great importance to securing properly qualified men and hence they had suggested that pay according to qualifications and experience may be given to suitable men within the scale recommended by them. In the usual course, the Public Service Commission would be asked to make selection and would advise regarding the exact salary to be paid.

5. Dr. McRae then drew attention to certain items in the estimate relating to the Headquarters Section which he considered required to be increased or altered. Subject to modification later on when exact estimates were prepared, he desired that the following additional provision should be made —

	Rs.
1. Parasite laboratory	10,000
2. Water, gas, and electric power for this laboratory	3,000
3. Apparatus for this laboratory	2,000
4. Cages for mosaic work	1,000
5. Fittings for board room	2,000
6. Additional Room for Insectory	2,000
7. General apparatus	10,000
8. Quarters for staff	78,000
9. Fencing for a plot of 15 acres	2,000
10. Shed	150
11. Three pairs of bullock	800
12. Rent of 15 acres of land for five years (if necessary)	3,750
	1,15,000

6. Rao Bahadur Venkataraman enquired if it would not be feasible to attach the Senior Entomologist to the proposed Sugar Research Institute (Item No. 11 of the Agenda).

7. The Chairman pointed out that this appeared to be the original view of Mr. Richards also, who has stated in the note on Sugarcane Entomological research submitted by him to the Special Committee that :—

“This appears to indicate the necessity not only for the provision of adequate staff for local requirements, but of a competent Sugar Entomologist under the Imperial Council of Agricultural Research, to direct and co-ordinate the whole enquiry. The Plant Breeder and the Sugar Technologist are already available to the Imperial Council of Agricultural Research. An important necessary addition to the team of workers, who also should be under the Imperial Council of Agricultural Research, is the Plant Physiologist.”

8. Rao Bahadur Venkataraman thought that a Botanist should also be added to the scheme, to try and work possible correlations between structure and resistance to insects. This would be useful in breeding disease resistant canes.

9. Dr. McRae stated that he would not mind the work on insect pests being carried on in the South, say at Coimbatore or Poona instead of at Pusa. In his opinion there was advantage in working in an area where the acreage under cane was not large. Moreover, the equable temperature at the place would help in the work.

10. Mr. Burt, however, pointed out that the Sub-Committee thought that unless large numbers of parasites can be bred in northern India, the work will not be of much use, and hence Pusa had been selected for the work on parasites.

11. The Chairman enquired whether it was the intention that the scheme should be worked under the Imperial Council of Agricultural Research or the Imperial Department of Agriculture.

12. Dr. McRae was not in favour of the latter arrangement on account of the difficulty regarding quarters in Pusa.

13. Mr. Venkataraman did not consider it essential that the work to be done at Pusa. Moreover if the work is done at a place where quarters can be rented, the expenditure on residential buildings would be avoided.

14. Mr. Ramamurty suggested that the scheme as approved by the Sub-Committee should be adopted, subject to final schemes, when received, being examined by the Committee again before sanction.

15. Mr. Sethi desired that the question of control, that is, whether the scheme would be run by the Research Council or by the Government of India, should be decided.

16. The Chairman stated that if the Government of India agreed to allow the Imperial Entomologist to take up this work, there should be no objection to the work being done at Pusa. For the present, however, he suggested the adoption of the report of the Special Committee. This was agreed to.

APPENDIX XXVII.

REPORT OF THE COMMITTEE APPOINTED TO EXAMINE THE SCHEME OF THE UNITED PROVINCES POULTRY ASSOCIATION TO DEVELOP EGG AND POULTRY MARKETING ON A CO-OPERATIVE BASIS (SUBJECT NO. 4 OF THE AGENDA FOR THE ADVISORY BOARD MEETING), HELD AT NEW DELHI ON THE 21ST FEBRUARY 1934.

The following were present :—

1. Col. A. OLVER.
2. Mr. E. J. BRUEN.
3. Khan Bahadur SHEIKH NIAZ MOHAMMAD.
4. Mr. P. J. KERR.
5. Mr. T. F. QUIRKE.
6. Mr. B. K. BADAMI.
7. Mr. NURUL ISLAM.
8. Mr. A. E. SLATER.
9. Mr. G. K. DEVADHAR.

As the Chairman was engaged in another meeting of the Fruit Committee Colonel Olver took the chair.

The meeting lasted from 2-30 to 4-15 P.M.

The Committee considered that the scheme submitted by the United Provinces Poultry Association was costly for the work proposed and it also would not provide what is most required for the development of the industry, viz., an expert Marketing Officer capable of advising and assisting provincial organizations and with facilities for developing the marketing of eggs and poultry products all over India, particularly in the big consuming centres. For this purpose they considered it necessary to have an Egg Marketing Officer, working directly under the Imperial Council of Agricultural Research and recommended that the Animal Husbandry Expert should put up a separate scheme for this work and that the United Provinces Poultry Association scheme should deal only with the investigation of the best methods of storage, preservation and disposal of poultry products in various ways, e.g., in the form of dry powder, on the lines indicated on printed pages 3 and 4 of their scheme. It was stated that the local marketing of eggs and poultry products was already being dealt with in some provinces and States but that a great deal of precise information was required on these matters. For this work the scheme would require modification and it was suggested that the Association should be requested to submit a modified scheme in which details should be given of the accommodation and facilities which would be available and required for carrying on such work.

Note of dissent.

I am afraid I am unable to agree with the views expressed in the enclosed report. I may here state that I am of the same opinion in this connection as that I expressed in the sub-committee meeting. The scheme in question is definitely one for an All-India work. I cannot find anything in the scheme to indicate that there is no provision for an expert Marketing Officer, capable of advising and assisting provincial organizations. Regarding the second portion of the third sentence I may only refer the Board to pp. 2 and 3 of the scheme. The author, however, in drawing up this scheme felt that the work should be carried on, on a small scale in the beginning in the United Provinces, where, there is unanimity of opinion, that there is the biggest field for this work, and later extended to other places. This should be done after the public are convinced of the utility of the work. Even during the course of the work proposed in the scheme there can be no objection to the services of the officer being utilised by other provinces, and I am unable to find anywhere in the scheme any word which indicates any restriction on the activities of the officer to the United Provinces only.

(Sd.) NURUL ISLAM.

APPENDIX XXVII-A.

NOTE, DATED THE 23RD JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 4.—APPLICATION FROM THE UNITED PROVINCES POULTRY ASSOCIATION, LUCKNOW, FOR A GRANT OF Rs. 42,130 (Rs. 2,500 NON-RECURRING AND Rs. 39,630 RECURRING) FOR A SCHEME TO DEVELOP EGG AND POULTRY MARKETING ON A CO-OPERATIVE BASIS SPREAD OVER FIVE YEARS.

Attention is invited to the attached letter from the Government of the United Provinces, No. 24-I, dated the 11th January 1934, forwarding a scheme for the development of egg and poultry marketing on a co-operative basis (Annexure). The Provincial Agricultural Research Committee which considered this scheme suggested some modifications, in the light of which the scheme has been recast.

2. The scheme is for the consideration of the Advisory Board.

 ANNEXURE.

COPY OF LETTER FROM THE SECRETARY TO THE GOVERNMENT OF UNITED PROVINCES, INDUSTRIES DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 24-I., DATED THE 11TH JANUARY 1934.

Scheme to develop egg and poultry marketing on a co-operative basis.

I am directed to forward an application (Enclosure I), from the United Provinces Poultry Association, Lucknow, for a grant of Rs. 42,130 (Rs. 2,500 non-recurring and Rs. 39,630 recurring spread over a period of five years) for the above mentioned scheme as recast by the Provincial Director of Agriculture in accordance with the views expressed by the United Provinces Agricultural Research Committee at its meeting held at Lucknow on November 28, 1933. A copy of the Committee's resolution on the subject is enclosed (Enclosure II)

2. The Association is a body registered under the Societies Registration Act and is in receipt of a recurring grant from this Government for running a demonstration poultry farm. A copy of its last annual report* is enclosed, showing the nature of the work done by it. The Governor, acting with his Ministers, approves of the scheme as now recast. I am to request that it may be placed before the Advisory Board of the Imperial Council at its next meeting.

3. One hundred and fifty copies of the scheme are being sent to you under separate cover.

 ENCLOSURE I.

Item.

APPLICATION FROM THE UNITED PROVINCES POULTRY ASSOCIATION, LUCKNOW, TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A GRANT OF Rs. 42,130 (Rs. 2,500 NON-RECURRING AND Rs. 39,630 RECURRING) FOR A SCHEME TO DEVELOP "EGG AND POULTRY MARKETING ON A CO-OPERATIVE BASIS" SPREAD OVER FIVE YEARS (AS RECASTED BY THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES IN ACCORDANCE WITH RESOLUTION No. 5, DATED NOVEMBER 28, 1933 OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE).

Introduction.

Marketing of eggs and poultry has, of late, received the most careful attention of the whole world. There is a general impression that the quality and marketing of the produce leave much to be desired. The urgent necessity for effecting an all-round improvement is being seriously felt and efforts, on a co-operative basis, in this direction are already in progress in many countries. India is no exception to this condition. Trade in poultry and eggs in this country has been carried on for a long time past though in a very crude manner. Eggs have a great nutritional value for human beings as they are rich in proteins, fats, minerals and vitamins. They are a rich food for building up healthy children and are of considerable help to restore lost strength during convalescence. Eggs, besides many other uses, have a great importance from the industrial point of view also as they are used in different forms in the manufacture of ivory, paints and varnishes and are also utilized in book-binding, photography,

* Not printed.

tanning and the making of glue. Their last named service is perhaps not generally known in India. The demand for edible eggs of an improved quality is fast increasing in this country as its food value is being gradually better realized. A considerable portion of the year has to be idled away by the farmer because of no suitable occupation. This can be employed by means of poultry raising. The production of poultry and eggs, besides having several advantages of great economic importance to farmers, entails the investment of a very small capital. Its benefits are therefore accessible to the poorest class of peasant. But his difficulties begin when he tries to improvise his own crude system of housing, feeding and breeding. He keeps poultry in ill-ventilated and tiny mud-houses and let the poor birds take care of themselves in regard to water, food and protection. Eggs are collected only when and if noticed and stored in *chatties*, jars, etc., where the embryo often begins to develop or the eggs go bad. The average hen in India finds her food and water in filthy places. As the quality of the egg depends very largely on the methods of production the result is a mass of sickly-looking and under-sized birds laying about five clutches of eggs (60 to 70) in a year, each weighing about $1\frac{1}{4}$ to $1\frac{1}{2}$ oz. only. Eggs produced by such birds cause great harm to the health of the country. But a very large part of the population of India has either to depend for its living on, or its income is substantially supplemented by this industry in spite of these unhygienic methods. The economic value of poultry farming began to be universally recognized by about the middle of the 19th century. The first fruits of this realization in India took the form of an All-India Poultry Club which was formed in 1910. The formation of this club and later that of the United Provinces Poultry Association through the efforts of Sir Harcourt Butler, the then Governor of the United Provinces and a life member of the club, and some other poultry enthusiasts, gave a great impetus to this industry in India. The economic value of poultry farming is being generally appreciated but what is now urgently called for is an organized policy of assistance in solving two vital problems, *viz.*, improved marketing and control of diseases. The latter of these is to receive attention. The present scheme is directed to dealing with the peculiarities of the former under Indian conditions.

METHODS OF MARKETING POULTRY AND EGGS IN INDIA WITH SPECIAL REFERENCE TO THE UNITED PROVINCES.

Marketing of eggs and poultry in these provinces is generally in the hands of egg contractors of whom the "Khatik" (professional egg and poultry dealer) is the most important. These Khatiks employ egg collectors who make house-to-house visits in order to collect the eggs and fowls from producers living in villages and towns. These egg collectors are generally given some commission per dozen eggs collected as a remuneration. In some cases they are also given daily wages on the quantity collected. Thus the produce has to pass two, three and sometimes even four intermediate agencies before reaching the actual consumer and consequently most of the profit is eaten up by these intermediaries. The necessity for eliminating or reducing as far as possible these intermediaries is obvious. Methods of packing and transporting the produce are unscientific and cause much avoidable loss. The total value per annum of poultry produce in a small country like Denmark comes to 4½ crores of rupees and her export in eggs gives her an annual income of 2½ crores of rupees. The value of hen egg alone on poultry farms in the United States of America in 1924 was approximately Rs. 1,93,02,92,410. This has been possible mainly by improved methods of production on farms and by the proper handling of eggs from the nest to the market. It is therefore evident how much more profitable this industry would become if the methods of marketing in this country as described in the preceding paragraphs could be replaced by those practised in Denmark and United States of America with necessary modifications to suit India's requirements. A comparison between the income derived by the two kinds of methods of marketing, given below, will be of interest:—

Income by indigenous methods.

Average number of eggs laid by a hen in a year.	Average weight of an egg.	Average price fetched by an egg.	Production value per hen per annum.		
			Rs.	a.	p.
70	$1\frac{1}{4}$ oz.	$4\frac{1}{4}$ pies.	1	10	3

Income by the improved methods in the Scheme.

Average number of eggs laid by a hen in a year.	Average weight of an egg.	Average price fetched by an egg.	Production value per hen per annum.		
150	2 oz.	9 pies.	Rs.	a.	p.
			7	0	6

The object of the scheme and reasons governing the character of the request.—The improvement of poultry has received a large amount of attention in the United Provinces during the past 20 years and during the last 12 years impartial. The United Provinces Poultry Association is one of the best known organization of the kind in the country. Mrs. Fawkes' work in establishing this association, in bringing the importance of this work before the public and in instituting courses of instructions are well known all over India and have had their most marked effect in the Province with which her work was most closely associated. In the last 12 years over Rs. 3½ lakhs has been spent on the improvement of the birds to which the Government of the United Provinces has contributed Rs. 3,09,041.

The outcome of this work has led to wide spread interest all over the Province and in others and there are at present day in the United Provinces alone many hundreds of persons interested in some way in improved fowls whether as pure stock breeders or as working on the indigenous fowl with pure bred cocks.

The Poultry Association has now the nucleus in every district of future district associations and in 20 of these definite district organizations are established or are being established.

Those thus interested are estimated as handling over 12,000 fowls and giving rise approximately to 1,800,000 improved eggs per annum. In addition to the many individuals at present struggling on their own or in recently formed district units, there are in addition six Co-operative Societies concerned with egg and poultry production. There is thus ample material on which a Research and Marketing officer could operate with effect and wide scope for expansion as utilizing people who are willing to be directed and organized into some form in which they could more profitably dispose of their eggs than is very frequently the case.

The best methods of handling eggs and alternative methods of disposal, their relative costs, profits and possibilities require close study as also do the best methods of building up a marketing organization for those engaged in this industry.

The United Provinces thus provides an excellent field for investigation in all phases of the egg industry from the time they are laid till they reach in some form or other the ultimate consumer. Experience gained in these will be applicable anywhere in the country.

The importance of the development of the marketing side of an industry in conjunction with or in close connection with technical improvements in increasing production are now fully realized.

The Imperial Council of Agricultural Research have under close consideration the establishment of a Central Marketing Bureau for agricultural products. The United Provinces have expressed their willingness to provide a Deputy Director of Marketing to investigate and organize the marketing of agricultural produce in general and as working an association with the Central Body. They have also under close consideration the appointment of Fruit Expert and staff who will be employed to a considerable extent not merely in developing fruit production but also in studying and organizing its effective disposal as a special branch of agricultural marketing. This present proposal is in reality the application of the same principle to the Poultry Industry. The officer and his staff will, however, deal primarily with the disposal of the egg and with investigation on the feeding of fowls for market sale, leaving production and the expansion of the use of better birds with the United Provinces Poultry Association, as being work of a more provincial character. His work will be directed to work of all India application. As the whole development of Poultry within the Province has rested with the Poultry Association, it is proposed in this scheme that he should work as part of that organization; but it is intended that in the technical side of his work he will be guided in his efforts by the provincially appointed Marketing officer who

will be of Provincial Class I Status. In short that this officer and his staff will form one of the branches of marketing enterprize, differing only in the fact that his work as a species of research will have a much wider significance.

The United Provinces in view of their coming developments in agricultural produce marketing in other directions and in view of the more general applicability of the results of the work of this officer and his staff, if appointed, are not in a position to come to the aid of the Poultry Association, though they are fully satisfied that such help is necessary, if the full advantage of the last decade and more of technical improvement is to be gained by the egg producer wherever such technical advance has been fully established.

The principle duties of this officer will be :—

- (1) to investigate and improve on present methods of collection storage, preservation, packing of eggs and of preparing fowls for markets,
- (2) to study on a small scale the application of other methods of disposal as by dry powder or in pulp form,
- (3) to investigate the demands of different markets,
- (4) to study different methods of organizing producers and the best methods of transport and disposal of the produce of organized units,
- (5) to study the extent and scope of profit derivable by different types of society production, production and sale, collecting and marketing.

It is normal in the case of an application for a grant to state what is being provided by the applicant. Though this may be a *sine qua non* in respect of a grant as made to a Government, in the case of a private association it is not possible for them to offer much of substantial character. It may, however, be pointed out that the association as evidenced earlier in this note has contributed very substantially to the advancement of the poultry industry both in the Province and generally in India—men from all parts of the country have received training at its hands and settings of eggs have been distributed to every province. Further that as the outcome of its efforts it has been able to offer a state of improved poultry development in which research of this kind may have an ample field of investigation, a condition which could not have existed but for the efforts of the association and its office bearers. It thus places its application for help in seeking a solution for an important problem of the industry on which the ultimate success or failure of any such enterprize as that which they represent must depend with every expectation that the Imperial Council of Agricultural Research will recognize the claims for help of this kind which the Poultry industry deserves as the poor man's industry and as providing another avenue of increasing rural wealth.

CONCLUSION.

Work on almost the same lines, as proposed, is being done in England, Ireland, and United States of America. This method, with the modifications referred to in this scheme, may be tried which it is hoped, will lead to an improvement and subsequently create conditions favourable for the development of an export trade in eggs, specially by the availability of the quality and quantity of eggs necessary for export purposes and by the regularity in supply.

COST OF THE SCHEME.

The estimated cost of the scheme is Rs. 42,130 spread over a period of five years the details of which will be found in the annexures.

ANNEXURE A.

Non-recurring.

Equipment—	Rs.
Egg testing lamp ; egg weighing scale ; caponising set ; grading and packing machine, cups, mixers, etc., for dry egg work	1,900
Cages for fattening fowls	50
Egg boxes ; packing cases and cupboards for storing eggs, etc.	100

ENCLOSURE II.

COPY OF RESOLUTION No. 5 PASSED AT THE 9TH MEETING OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE HELD AT THE COUNCIL HOUSE, LUCKNOW, ON NOVEMBER 28, 1933.

Agenda.	Resolution.
<p>5. Consideration of an application from the United Provinces Poultry Association, Lucknow, to the Imperial Council of Agricultural Research for a grant of Rs. 42,050 (Rs. 2,000 non-recurring and Rs. 40,050 recurring) for a scheme to develop "Egg and Poultry marketing on a co-operative basis" spread over five years.</p>	<p>5. Resolved that the Director of Agriculture be asked to recast the scheme in the light of discussion and that the scheme so amended be recommended to the Imperial Council of Agricultural Research.</p>

APPENDIX XXVIII.

NOTE DATED THE 23RD JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 5.—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF RS. 1,73,970 SPREAD OVER FIVE YEARS FOR A SCHEME FOR RESEARCH ON THE WATER REQUIREMENTS OF CROPS UNDER CANAL IRRIGATED CONDITIONS (REVISED SCHEME).

In January 1932, the Advisory Board considered a scheme submitted by the Government of the Punjab, for the establishment of an agricultural research station at Risalewala (near Lyallpur) for work on the water requirements of crops, which had been examined by a special Committee. Details of the scheme together with the report of the Committee thereon will be found in Appendix XXXI (pages 317 to 329) of the printed proceedings of the meeting of the Board held in January 1932. The Board recommended the scheme as revised by the Committee, for sanction, but it was rejected by the Governing Body, *vide* extracts enclosed (Annexure I).

2. The Government of the Punjab have now submitted a revised scheme (Annexure II) for research on the water requirements of crops under canal irrigated conditions which involves, so far as the Council is concerned, a recurring expenditure of Rs. 1,24,090 and a non-recurring expenditure of Rs. 49,880, or, a total expenditure of Rs. 1,73,970 spread over a period of five years. The Local Government also propose to credit to the Council annually a sum equal to the income derived from the area under the scheme which is estimated at Rs. 45 per acre per annum or Rs. 22,500 for the entire period of the scheme. This will reduce the net cost of the scheme to the Council to Rs. 1,51,470. It will be observed that the present scheme does not include the Plant Physiology and Soil Physics Sections which were included in the original scheme.

The revised scheme (Annexure II) is for the consideration of the Advisory Board.

ANNEXURE I.

EXTRACTS FROM THE PROCEEDINGS OF THE GOVERNING BODY, OCTOBER 1932.

Application from the Government of the Punjab for a grant for the establishment of an Agricultural Research Station at Risalewala (near Lyallpur) for work on the water requirements of crops (Rs. 4,06,215 spread over five years) (Subject No. 56 of the Agenda).

Sir Jogendra Singh explained the scheme which Mr. Walchand Hirachand opposed on the ground that it was a work for the Irrigation Department and not for the Agriculture Department to do and said that the Council could not spend Rs. 4,00,000 in one province. Mr. Rama Rao wanted that the Punjab should meet a share of the proposed expenditure. Mr. Collins criticised the scheme on the score of expense and in this connection referred to the large and expensive staff. Maulvi Abdul Hamid, Mr. Gokhale and Mr. Slater also opposed the scheme. After Sir Jogendra Singh had replied, the scheme was rejected.

ANNEXURE II.

SCHEME FOR RESEARCH ON THE WATER REQUIREMENTS OF CROPS UNDER CANAL IRRIGATED CONDITIONS.

At its meeting in January 1932, the Advisory Board of the Imperial Council of Agricultural Research considered an extensive scheme for the investigation of the water requirements of crops, submitted by the Punjab Government. The cost of the scheme involved a total expenditure of Rs. 5½ lakhs spread over a period of five years, but a sub-committee, appointed by the Imperial Council of Agricultural Research to consider it, reduced the proposed net cost to Rs. 4,06,215. The Advisory Board recommended the scheme as amended, for the sanction of the Governing Body, but at its meeting in October, 1932, the latter body rejected the scheme because of its high cost. In view of the great importance of the subject proposed for research, the whole question has been thoroughly re-examined and the present smaller and much less expensive scheme has been prepared. The estimated cost now amounts to Rs. 53,680 non-recurring and Rs. 1,25,590 recurring, or a total expenditure of Rs. 1,79,470, spread over a period of 5 years.

2. In the original scheme the construction of pucca water courses in eight squares (220 acres) of land (subsequently reduced to four squares by the sub-committee), was responsible for a considerable proportion of the expenditure. The construction of such water courses cannot be avoided in an investigation of this nature, but the cost of the present scheme has been reduced by limiting the pucca construction to two squares (55 acres) of land only, the remainder of the work to be carried out under ordinary zamindari conditions. A part of the area of the Risalewala Seed Farm will be utilised for the scheme, as was proposed originally.

3. In irrigation farming important problems before the cultivator are :—

- (a) The optimum amount of water to use on each crop and on each field from the point of view both of outturn and of profit.
- (b) The best way to distribute the water available to him for his crops during each canal rotation throughout the growing period of the crops; and
- (c) The extent of the loss entailed by different degrees of deviations from these ideals.

4. Inter-related with these problems of the cultivator is an important problem of the Canal Department, namely, the optimum quantity of water to allow per acre. Obviously it must always be a loss to the State, and generally also to the cultivator, if an excess of water is applied per acre or if the optimum intensity of cropping is not practised or if crops are grown, which will not give the most profitable return.

5. The amount of water which it is best to use, and the return for the water used, depend to a great extent on the condition of the soil at the time of sowing and during the growth of the crop. This condition in its turn is closely connected with the rotation of crops grown. The object of the proposed experiments is to determine the relationship between the amount of water applied per acre to each of the important canal colony crops and the yields of these crops, together with an investigation of other closely allied problems bearing on irrigation farming.

6. *Problems to be investigated.*—The main problems which it is proposed to investigate under this scheme are :—

- (1) The effect of varying numbers of irrigations of the same depth on the yields of each of the principal crops
- (2) The effect on the yields of the principal crops of frequent light irrigations compared with that of heavy irrigations at longer intervals (the total quantity of water applied in both cases being the same).
- (3) The effect on the yield of the crop of applying equal quantities of water but varying the time of application.
- (4) The effect of deep and shallow preparatory tillage on the conservation of soil moisture.
- (5) The effect of inter-culture on the conservation of soil moisture.
- (6) The best way to prepare land in order to enable the cultivator to spread the water supply at his command over the largest area.
- (7) The value of 'kiaries' of different sizes and shapes in saving water, for discharges of water common on zamindari lands.
- (8) The relative quantities of water required to irrigate land when crops are sown—
 - (a) on the flat;
 - (b) on ridges;
 and the effect of these two systems on yields.
- (9) The application of the scientific results obtained to suit zamindari conditions and practices.

7. *Lay-out of the land.*—In the canal colonies a square consists of 25 killas (27·8 acres) and is divided by five water courses, as shown in the sketch attached. For the purpose of the present scheme these five water channels must be made pucca in order that the irrigation water supplied to the crops may be accurately measured and that additional sources of supply through seepage or loss by absorption in katcha channels may be eliminated. The main water course carrying the supply to the area under investigation must also be pucca. No other pucca channels are required; the blocks of five killas between channels being sub-divided into smaller plots by making bunds of earth as required according to the usual farming practice.

8. The installation of measuring weirs within each square and of iron outlets and water level recorders is necessary for the proper measuring of the water used.

9. In order to obtain a better command of the land intended for the experiment when the pucca channels are constructed it is necessary to lift the water a few feet as it comes from the canal and a pumping plant has been included in the scheme for this purpose.

10. It is intended to carry out the scientific measurements and to collect the exact data of water requirements on two squares (55 acres) of land. At the same time, on a further area of two squares experiments will be conducted under zamindari conditions to ascertain the water requirements of the various crops. On this land also a very important part of the investigation will be conducted, namely, a study of the application of the scientific results obtained in the other area to suit zamindari conditions and practices.

11. *Buildings.*—It is intended to utilize, wherever possible, such old katcha buildings as already exist on the farm by repairing them sufficiently to house the labourers and other low paid staff employed on the scheme. For this purpose a small expenditure is unavoidable in order to make them habitable. In addition, it will be necessary to put up a katcha bullock shed and to provide accommodation for implements, office, etc. Most of the laboratory work of the two Research Assistants will be carried out in the laboratories of the Agricultural College and Research Institute situated at a distance of five miles from the farm, but the provision of a small field laboratory on the farm itself may be also necessary. The Extra Assistant Director of Agriculture, who will be in charge of the experiments under the Deputy Director of Agriculture, Lyallpur, can be housed in the Rest House which exists on the farm; the remaining staff not required by the nature of their duties to be resident on the spot, will find their own accommodation. There will be a small recurring expenditure for the upkeep of the buildings.

12. *Staff.*—An Extra Assistant Director of Agriculture of some years' experience will be placed in charge of the experimental work under the direction of the Deputy Director of Agriculture. The other staff required consists of two Agricultural Assistants to take immediate charge of the experiments, a Research Assistant to carry out investigations and make estimations in connection with soil moisture and other aspects of the work connected with the soil, a Research Assistant for plant physiological investigations and an Overseer to take charge of the measurement and application of water.

13. *Cost of the scheme.*—The total cost of the scheme, according to the attached statement, amounts to—

	Rs.
Non-recurring	53,880
Recurring	1,25,590

It is proposed that the Punjab should contribute towards this expenditure as follows:—

	Rs.
(a) Provide funds required for the repairs of the existing quarters and for the erection of such other buildings as are required	4,000
(b) Undertake the repairs and upkeep of these buildings at an estimated cost of Rs. 300 per annum	1,500
(c) Credit to the Imperial Council of Agricultural Research annually a sum equal to the income derived from the area under the scheme and credited into the treasury annually. This is estimated at Rs. 45 per acre per annum	22,500
(d) Provide free of cost the necessary facilities in land, buildings, laboratories, equipment and part-time services of the senior staff.	

It is requested that the Imperial Council of Agricultural Research should contribute the following :—

	Rs.
Non-recurring	49,880
Recurring over a period of 5 years.	1,24,090
Total	<u>1,73,970</u>

The item of Rs. 22,500 which will be credited to the Council as income of the area will reduce the net grant to Rs. 1,51,470.

Non-recurring expenditure.

Layout of land.

	Rs.
1. Levelling old water courses	250
2. Excavation of new water courses—	
C.ft.	
Mian Khal—1,625' × 4½' × 2½'	= 18,281
Service Khals—10 × 1,100' × 3½' × 1½'	= 57,750
76,031 c.ft. at Rs. 7 per 1,000 c.ft.	<u>76,031</u> 530
3. Construction of pucca water courses—	
12,625 ft. at Rs. 2-4-0 per foot	28,400
	Ra.
4. <i>Fitting for irrigation—</i>	
(a) Iron outlets 350 at Rs. 12-8-0 each	8,750
(b) Measuring Weirs 10 at Rs. 80 each	800
(c) Level recorder	1,000
(d) Portable meters 4 at Rs. 600	2,400
(e) Purchase and erection of pump and engine	2,600
5. Implements	2,000
6. Furniture, stationery, etc.	350
7. 16 bullocks at Rs. 175 each	2,800
8. Repairs to katcha quarters for staff, erection of katcha bullock shed and stand and other accommodation	4,000
Total	<u>53,880</u>

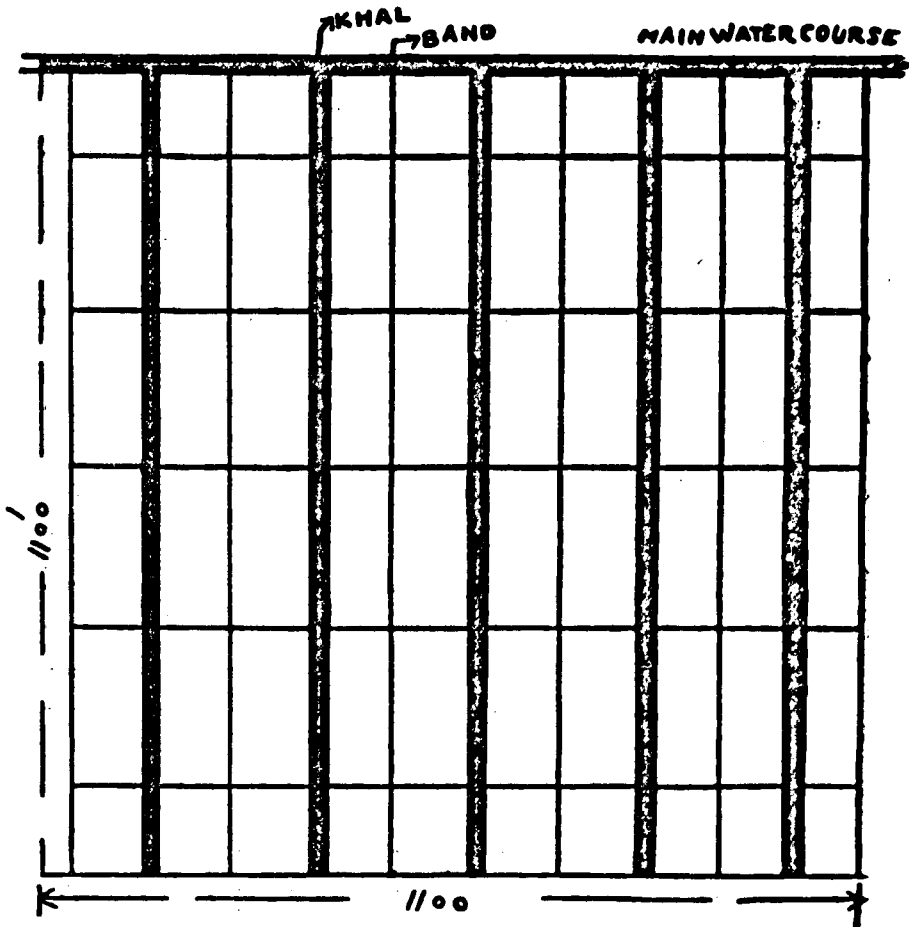
Recurring expenditure.

Staff.	1st Year.	2nd Year.	3rd Year.	4th Year.	5th Year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
One Extra Assistant Director of Agriculture of 4 years' standing on Rs. 300 per mensem in the grade of Rs. 200—200—250/25—750.	3,600	3,900	4,200	4,500	4,800	21,000
Two Agricultural Assistants of 5 years' standing on Rs. 150 per mensem each in the grade of Rs. 100—10—300.	3,600	3,840	4,080	4,320	4,560	20,400
One Research Assistant for Soil Physics of 5 years' standing on Rs. 150 per mensem in the grade of Rs. 100—10—300.	1,800	1,920	2,040	2,160	2,280	10,200
One Research Assistant for plant physiology of 5 years' standing on Rs. 150 per mensem in the grade of Rs. 100—10—300.	1,800	1,920	2,040	2,160	2,280	10,200
One overseer of 2 years' standing in the grade of Rs. 80—7—255.	1,128	1,212	1,296	1,380	1,464	6,480
One Storekeeper Accountant on Rs. 75—5—125 (less 15 per cent).	765	825	885	945	1,005	4,425
Four Mukaddams on Rs. 20—1—30/2—50. [2 on Rs. 25 per mensem (no out) and 2 on Rs. 20 (less 15 per cent)].	1,008	1,056	1,104	1,152	1,200	5,520
One Mechanic on Rs. 35—2—43 (less 15 per cent).	357	381	405	429	453	2,025
Two Laboratory Attendants on Rs. 20—1—24.	480	504	528	552	576	2,640
One peon on Rs. 14	168	168	168	168	168	840
One chowkidar on Rs. 13	156	156	156	156	156	780
One sweeper on Rs. 12	144	144	144	144	144	720
Sixteen beldars on Rs. 16 per mensem each.	3,072	3,072	3,072	3,072	3,072	15,360
Total	18,078	19,098	20,118	21,138	22,158	1,00,590

Other Recurring expenditure.

	Per annum.
	Rs.
Variable labour	600
Repairs to katcha buildings	300
Upkeep of bullocks	1,000
Purchase and repair of implements	300
Water rates	600
Seeds and Manures	500
Laboratory Equipment	200
Running expenses of pumping plant	1,500
Total	5,000
For 5 years	25,000
Total recurring, over a period of 5 years	1,25,590

PROPOSED LAYOUT FOR A SQUARE OF LAND
AT
THE AGRICULTURAL RESEARCH STATION
RISALE WALA



APPENDIX XXIX.

NOTE DATED THE 10TH JANUARY, 1934, BY SECRETARY, ON SUBJECT NO. 19, SCHEME FOR AN IMPERIAL SUGAR RESEARCH INSTITUTE.

Attention is invited to the attached note (Annexure I), dated the 7th October 1933 on the subject mentioned above which was circulated to the Sugar Committee at its last meeting held in November 1933.

2. It will be observed from that note that at its meeting held in March 1933, the Sugar Committee approved the general principle of a proposal for the establishment of an Imperial Sugar Research Institute and recommended the appointment of a sub-committee to examine the details. The sub-committee, the composition of which will be found in para. 2 of the note referred to above (Annexure I), suggested some changes in the original scheme, which was amended accordingly and the scheme, as thus amended, will be found in Enclosure I to Annexure I.

3. The scheme, as amended by the sub-committee, (Enclosure I to Annexure I) was considered by the Sugar Committee at its meeting held in November 1933 and an extract from its proceedings relating to the scheme will be found in Annexure II. The scheme as recommended by the sub-committee consisted of two alternative proposals. The first proposal provided for developing and extending the existing arrangements at the Harcourt Butler Technological Institute, Cawnpore, the work being carried on independently of the Government of the United Provinces, under the direct and exclusive control of the Research Council. The second proposal provided for the setting up of an entirely new All-India research and teaching institute without making use of any existing institution. The costs of these schemes respectively over a period of five years, were estimated as follows :—

Alternative I—

	Rs.
Capital expenditure	1,50,000
Recurring expenditure	12,49,400
Total	13,99,400

Alternative II—

	Rs.
Capital expenditure	15,38,000
Recurring expenditure	15,14,400
Total	30,52,400

In the above estimates the cost of the Sugar Technologist's office and the Sugar Cable Service was included. After considerable discussion the Sugar Committee unanimously recommended that the Harcourt Butler Technological Institute at Cawnpore may be used for the proposed Research Institute if satisfactory arrangements could be made with the United Provinces Government.

4. It will also be observed that the Committee resolved by a majority, that the Imperial Sugarcane Breeding Station, Coimbatore, should be made a part of the proposed Research Institute.

5. The subject is now for the consideration of the Advisory Board. If the Board endorses the recommendations of the Sugar Committee, further necessary action will be taken by the Council's Secretariat in regard to the taking over of the Sugar Department of the Harcourt Butler Technological Institute, Cawnpore, from the United Provinces Government, and of the Imperial Sugarcane Breeding Station from the Government of India. No accurate forecast of the financial commitments involved in respect of the scheme can be made unless the results of the negotiations with the authorities mentioned above are known.

ANNEXURE I.

NOTE DATED THE 7TH OCTOBER 1933, BY SECRETARY, ON THE SCHEME FOR AN IMPERIAL SUGAR INDUSTRY RESEARCH INSTITUTE (AS REVISED BY THE SUB-COMMITTEE.)

At the meeting held in March 1933, the Sugar Committee considered a proposal for the establishment of an Imperial Sugar Research Institute (*vide* pages 6-7 and 46-48 of printed proceedings). The general principle of the proposal was approved and it was recommended that a Sub-Committee should be appointed by the Chairman to examine the whole question.

2. The Vice-Chairman to the Council accordingly appointed the undermentioned Sub-Committee to consider the question:—

- (i) The Vice-Chairman Imperial Council of Agricultural Research, Chairman *ex-officio*.
- (ii) The Agricultural Expert, Imperial Council of Agricultural Research.
- (iii) Dr. J. H. Haldane, F.I.C., Chief Chemist, Messrs. Begg Sutherland & Co. (in the place of Mr. Noel Deerr).
- (iv) Lala Shri Ram (was unable to attend).
- (v) Mr. F. A. Sherwani.
- (vi) Lala Har Sahai Gupta.
- (vii) Mr. R. C. Srivastava, Sugar Technologist, Imperial Council of Agricultural Research, *Secretary*.

The Sub-Committee met at Bombay on the 1st September 1933, and considered the detailed draft proposals prepared by the Sugar Technologist to the Council. In Enclosure I will be found a note prepared by the Sugar Technologist. The changes recommended by the Sub-Committee have now been incorporated in the note referred to above. A copy of the Sub-Committee's proceedings is also attached (Enclosure II).

3. The Sugar Technologist is obtaining further information on certain points raised at the meeting of the Sub-Committee which will be placed before the Sugar Committee at the meeting. The subject is now for the consideration of the Sugar Committee.

4. Lala Har Sahai Gupta has given notice of his desire to move the following resolution at the meeting of the Sugar Committee:—

“That the proposed Imperial Sugar Research Institute should have an agricultural section for work of the following types:—

- (a) Giving instruction in cane cultivation in theory and practically in field;
- (b) Acting in an advisory capacity to provincial departments of agriculture and others carrying on sugarcane research work particularly in connection with schemes assisted by Imperial Council of Agricultural Research;
- (c) Collect, co-ordinate and publish the results of these researches;
- (d) To act as a central bureau of information in all agricultural matters connected with the sugar industry”.

ENCLOSURE I.

*Revised Scheme for an Imperial Sugar Industry Research Institute.**

The necessity for making adequate provision for research work for the Sugar Industry was stressed by the Sugar Committee of 1920. In paragraph 370 of their Report the Committee stated:—

“We were very greatly impressed by the manner in which the development of the Sugar industry in Java has been assisted by the completeness of its organisation. We are emphatically of opinion that, if any progress is to be made in India, an organisation on the Java model must be evolved, though that model will require extensive modification to adopt it to Indian conditions.”

*Note.—Changes made in the original scheme by the Sub-Committee of the Sugar Committee have been incorporated in the present revised scheme.

The Tariff Board were similarly emphatic regarding the need for research and development work in connection with the Sugar industry, their views as set forth in paragraph 99 of their Report being :—

“But it is recognised now by all authorities on sugar that no real progress is possible for the sugar industry without adequate expenditure on research and development and the description of the functions of the Research Institutes in Java and Hawaii indicates that much remains to be accomplished in this direction in India. What detailed schemes of research should be adopted and what expenditure is required for such schemes it would be beyond the functions of this Board to attempt to set forth.
* * * * * We have not not been able to obtain from the Imperial Council of Agricultural Research sufficient information to enable us to determine with exactitude the amount which should be devoted annually from Central Revenues for the development of sugarcane cultivation and of the sugar industry. Mr. Burt, the Agricultural Adviser to the Imperial Council of Agricultural Research, in evidence before us stated that not less than 10 lakhs of rupees should be granted annually. From the information supplied by the Imperial Council of Agricultural Research as to the schemes of development and research which they have approved or which are under consideration, it appears also that no smaller sum would suffice. Our recommendation, therefore, is that a grant of not less than Rs. 10 lakhs from Central Revenues should be made to meet the purposes which we have indicated and an assurance given that in future years similar grants will be made to meet the expenditure on schemes of research and development and the recurring expenditure on schemes already initiated. In view of the large outlay of public funds involved and the divergence of interests prevailing in the sugar industry we think it desirable that the Imperial Council of agricultural Research should act in consultation with the Government and the Legislature in constituting the machinery required for carrying out such measures as may be necessary to further the objects we have in view.”

Proposals of the Sugar Committee of 1920.

The Sugar Committee of 1920 gave careful consideration to the requirements of the Indian Sugar Industry in the matter of research work and facilities for training of technical men required in the industry. Although exact details could not naturally be gone into, the Committee set forth in Chapters XXIII and XXV of their Report the outline of their proposals for the formation of an Indian Sugar Board and for the setting up of an Imperial Research Institute with which was to be associated a Sugar School. The Committee's proposals are summarised below.

The central feature of the Committee's recommendations was the formation of an Indian Sugar Board with five official and six non-official members. An Imperial Sugar Research Institute was also proposed, having three divisions, Agricultural, Chemical and Engineering, each with its own independent head. The functions of the Sugar Board were to be (a) to control the policy of the Research Institute and the administration of its funds, (b) to advise government on matters affecting the Sugar Industry and (c) to supervise the issue and receipt of returns by the Institute.

The Committee considered that at the outset this organisation must be largely official, but the object should be eventually to hand it over almost entirely to non-official control. In the Committee's opinion, the sugar industry should be expected to contribute towards the cost of the Institute from the outset, and the first Representative Board should evolve a practical system of contribution. The peculiar conditions in India, especially the importance of the *gur* industry, preclude the complete elimination of Government interest in the organisation. When the industry is in a position to take over the main control, the funds should be provided by a voluntary levy on the factories, supplemented by a Government subsidy to ensure consideration of the interests of the small grower.

It was also recommended that the submission of returns by factories to the Institute in forms approved by the Sugar Board should be made compulsory by legislation; but proceedings for default should only be taken on the complaint of the Board. The Sugar Bureau should be absorbed in the Institute.

On the question of location of the Research Institute the Sugar Committee considered that it should be located at a place where it can serve not only the existing

factory industry of India but also the great cane tract further west and north and a site in the Basti or Kheri District of the United Provinces would fulfil these requirements.

As regards the cost of their scheme, the Sugar Committee estimated that the cost of the Sugar Board would be negligible and that of the Research Institute the Sugar School and the sub-stations in the provinces would be Rs. 35½ lakhs non-recurring and Rs. 12 lakhs per year recurring, though it was expected that a reduction in the latter figure would be possible on account of the earnings of the sub-stations.

The capital cost, according to the Committee, of establishing the Research Institute (including the Sugar School) and its sub-stations is shown in Table I.

TABLE I.

Capital Cost of Imperial Sugar Research Institute as proposed by the Indian Sugar Committee, 1920.

Head.	Land, buildings and equipment required.	Estimated capital cost. Rs.
<i>A.—The Institute and Sugar School.</i>		
I.—Director's Office	Office accommodation and Library	1,00,000
	Two Officers' Quarters	80,000
II.—Agricultural Division	Experimental farm of 500 acres	1,00,000
	Farm Buildings and equipment	1,50,000
	Office, Laboratory and Lecture Room of Agricultural Section	50,000
	Office, Laboratories (one for research and one for students) and Lecture Room of Botanical Section	1,00,000
	Four Officers' quarters	1,60,000
III.—Engineering Division	Demonstration sugar factory	5,00,000
	Workshop	1,00,000
	Drawing Office, Office and Lecture Room	50,000
	Two Officers' quarters	80,000
IV.—Chemical Division	Laboratories (one for research and one for students) and equipment	3,00,000
	Office, Lecture Room and Store Room	50,000
	Two Officers' quarters	80,000
V.—Mycological and Entomological Sections.	Mycological Laboratory, Office Room and Store Room	50,000
	Entomological Laboratory, Office Room and Store Room	50,000
VI.—Miscellaneous	Students' Hostels, dispensary, servants' quarters, etc.	1,50,000
	Quarters for subordinate staff	1,00,000
Total for Institute and Sugar School		22,50,000

Head.	Land, buildings and equipment required.	Estimated capital cost.
B.—Cane Research Sub-Stations.		
		Rs.
Madras	4 sub-stations	2,78,000
United Provinces	3 sub-stations and 1 station for hill sets	2,41,500
Bihar and Orissa	2 sub-stations	1,20,000
Punjab	2 sub-stations and 1 station for hill sets	1,29,500
Assam	2 sub-stations and 1 station for hill sets	1,89,500
Burma	2 sub-stations and 3 stations for hill sets	2,08,500
Bombay	3 sub-stations	1,18,000
	Total for sub-stations	12,85,000
	Grand total of Capital Expenditure.	35,35,000

The staff recommended by the Committee for the Institute and the Sugar School is shown in Table II

TABLE II.

Staff for the Institute and Sugar School as recommended by the Indian Sugar Committee, 1920.

Head.	Number and designation of officers.	Grade and Scale of salary.
I.—Director's office	1 Director	At first on special terms according to qualifications. Later, same pay and status as provincial Director of Agriculture.
	1 Secretary	To be recruited as member of I. A. S.
II.—Agricultural Division	1 Chief of Division	At first on special terms according to qualifications. Later, same pay as in the selection grade of I. A. S.
	1 Assistant Chief of Division (in charge of the experimental farm).	To be recruited as member of I. A. S.
	1 Assistant Chief of Division (in charge of cane breeding).	Do.
	1 Assistant Botanist (for teaching).	Do.
III.—Engineering Division	1 Chief of Division	As for Chief of Agricultural Division.
	1 Assistant Chief of Division.	To be recruited as member of I. A. S.
IV.—Chemical Division	1 Chief of Division	As for Chief of Agricultural Division.
	1 Assistant Chief of Division.	To be recruited as member of I. A. S.
V.—Mycological and Entomological Sections.	Officers to be deputed from Pusa, as required.	
VI.—Provincial sub-stations	7 officers in charge of sub-stations in each province.	To be recruited as member of I. A. S.

The above statement shows that, in all the Committee's recommendations involved the creation of 17 new appointments, immediately or eventually to be incorporated in the Indian Agricultural Service, the recurring cost of which, with their subordinate establishments and incidental expenditure was calculated at Rs. 70,000 per post or a total of Rs. 11,90,000, or in round numbers, Rs. 12 lakhs per annum.

Subsequent Development and Present Position.

Since 1920, when the Sugar Committee's recommendations were made, considerable development has taken place on the agricultural side on a decentralised plan. The necessity for a Central Institute for agricultural research has therefore ceased to exist, though a central organization which may act in an advisory capacity and may serve as a co-ordinating agency and a clearing house for the results obtained will be of considerable value.

The pressing need of the industry at present is on the Technological side. Provision for training of Chemists and Technologists is also a matter of urgency, owing to the rapid growth of the industry.

Research relating to the factory industry and training of students in Sugar Technology have already been partially provided for at the H. B. Technological Institute, Cawnpore, which is maintained by the Government of the United Provinces but which has received both a non-recurring grant from the Imperial Council of Agricultural Research amounting to Rs. 1,25,000 for putting up an experimental Sugar Factory, and a recurring grant of averaging Rs. 20,000 per annum (Rs. 1,00,000 spread over 5 years) for the running expenses of the factory. Under arrangement with the Government of the United Provinces, the Sugar Technologist to the Imperial Council of Agricultural Research is honorary Head of the Sugar Department of the Technological Institute, and thus controls all research and teaching work relating to sugar at the institute.

The factory was completed and brought into use during the season 1932-33. The following courses of training are now in existence at the Institute :

- (a) A two years Diploma Course in Sugar Technology, to which students who have passed the B.Sc. examination are admitted. The total number of admissions annually is fixed at 20, which has recently been increased to 30 for two years
- (b) A two years course for Sugar Analysts, to which those who have passed the Intermediate Examination in Science are admitted. Ten students are admitted annually at present.
- (c) A one year course for Sugar Boilers, to which those who have passed the High School Certificate Examination are admitted. Sixteen students are admitted annually at present.
- (d) A one year course for Khandsari Foremen, to which students who have passed out as Mechanics from a Technical School are admitted. Six students are admitted annually. So far the course has failed to attract any students.

In consideration of the grant given by the Imperial Council of Agricultural Research, ten students are nominated annually by the Council for training, without payment of tuition fees, in the Diploma Course in Sugar Technology. Negotiations are at present proceeding for securing a similar right of nomination by the Research Council to the other courses also.

Amongst the conditions subject to which the Imperial Council of Agricultural Research gave the grant to the United Provinces Government for the H. B. Technological Institute, mention may be made of the following :—

- (i) The Sugar Technologist will be in charge of the Experimental Factory at the Harcourt Butler Technological Institute.
- (ii) The local Government will allow research in Sugar Technology to be carried out for the Research Council at the Institute and will give the Council's Sugar Technologist the fullest possible facilities for experimental work in the miniature Sugar factory now to be installed.

The intention in imposing the above conditions was to form a nucleus at Cawnpore for research work in Sugar Technology under the direct charge of the Sugar Technologist. This object has been achieved due largely, to the sympathetic and helpful attitude of the United Provinces Government. But for the full development of the scheme, specially in view of the rapid expansion of the sugar industry, more

adequate arrangements are now necessary. The Sugar Technologist, who is also the Head of the Sugar Department of the Institute, has now a large amount of other work to attend to in the way of giving technical advice to sugar factories, and research work, therefore, does not get as much attention as it should. The staff at the Institute is meant primarily for teaching purposes. To be able to undertake research work of value to the industry it is necessary to have staff possessing, in addition to a sound academic training, considerable factory experience, and the Institute staff is lacking in such a combination of qualifications. The Sugar Technologist also has no technical staff under him either for helping him in giving advice to Sugar factories or in carrying on researches.

It is evident, therefore, that whilst the Technological Institute provides some facilities for technical research, these will have to be considerably added to if they are to meet the present needs of the industry. It is unlikely that, under the present condition of financial stringency, the Government of the United Provinces would undertake any further financial commitments in this connection. But it may be hoped that, in view of the fact that the United Provinces have the largest number of sugar factories and have the largest acreage under cane, the Local Government will assist by providing the necessary facilities for establishing a well-equipped and suitably staffed all-India research and teaching institute for the sugar industry.

Proposals for future Development.

Any proposals for extension of the present arrangement for research work must differentiate between the needs of the following sections—

- (a) Agricultural Research,
- (b) Research relating to the factory industry—
 - (i) Engineering,
 - (ii) Chemical and Technical,
- (c) Training of students in Sugar Technology,
- (d) Research relating to indigenous Sugar and Gur industry

It is items (b) to (d) with which we are now concerned.

For research work relating to the indigenous sugar and gur industry a scheme drawn up by the Sugar Technologist has just been sanctioned at a cost of Rs. 1,67,380 spread over a period of five years. A research station for this work will shortly be established in the United Provinces, under the direct charge of the Sugar Technologist. For the present, therefore, no further provision need be made for research, relating to this branch of the industry.

The more important and immediate need of the industry at present is the provision of facilities for research relating to the factory industry (chemical, technological engineering sections) for scientific assistance to factories, and for training of students in Sugar Technology. For this purpose an all-India research and teaching institute on a sufficiently comprehensive scale will be necessary.

Programme of work for the Institute.

As regards the nature of work which such an institute would undertake, the following tentative programme may be suggested :—

- (i) Research on Indian Sugar factory problems and in Sugar Technology in general, with specific reference to Indian conditions;
- (ii) Research on the utilization of by-products of the sugar industry;
- (iii) The provision of scientific assistance to all factories which need it to supplement the work of their factory chemists and engineers;
- (iv) The carrying out of extended tests on new varieties of cane, under factory conditions, when such tests are needed by Agricultural Departments;
- (v) Collection and tabulation of scientific control returns from factories, Critical examination of these returns;
- (vi) Issue of technical reports to factories on results of the collection of control data;

- (vii) When desired advice to individual factories :—
- (a) on faults disclosed by their returns—but without disclosing the results of other individual factories,
 - (b) on difficulties met with or extensions and improvements.
- (viii) A constant critical study of the working of Indian sugar factories and a comparison of individual results with;
- (a) the best established Indian practice,
 - (b) the results obtained in other countries.
- (ix) Demonstration of new or improved plant or processes;
- (x) Training of students in all branches of Sugar Technology;
- (xi) Short refresher courses for men already engaged in the industry.

Two alternative Schemes suggested.

For setting up an institute of this kind, two alternative schemes have been worked out. The first one depends on developing and greatly extending the existing arrangements at the Harcourt Butler Technological Institute, Cawnpore, the work being carried on independently of the Government of the United Provinces under the direct and exclusive control of the Research Council. The second scheme provides for the setting up of an entirely new all-India research and teaching institute, without making use of any existing institution.

Before proceeding to give details of the two alternative schemes their comparative merits may first be considered.

The scheme for developing the Cawnpore Institute will involve considerably smaller capital expenditure as buildings, laboratories, and an experimental factory are already available there. This is on the assumption that such buildings, in addition to those at present being used by the Sugar section of the Institute, as may be required will be allotted for the purpose by the local Government. This will necessitate the taking over of the entire Institute building and the attached residential buildings.

Cawnpore also possesses the advantage of being an important industrial centre, well served by railways. Although it is not in a cane growing or white sugar producing area, it is centrally situated for the important tracts in the western United Provinces on the one hand and the eastern United Provinces and Bihar and Orissa on the other.

As against these advantages it may be pointed out that as there are no cane sugar factories in or near Cawnpore, the Institute, if located there, will be lacking in that direct contact with the industry which is so important. The existing experimental sugar factory, at Cawnpore, is not able to get its full supply of cane, in spite of special arrangements with the local Government farms. It is unlikely therefore that the cane sugar industry will show any marked development in this area in the near future.

Scheme for developing the Technological Institute, Cawnpore.

If the proposed Research Institute is to be established by developing the Technological Institute at Cawnpore, the first necessary condition will be to settle suitable terms with the Government of the United Provinces. The following terms are suggested in this connection :—

- (i) As the proposed Sugar Institute will be established on a permanent basis, whatever arrangement is arrived at with the Government of the United Provinces will also have to be a permanent one.
- (ii) The existing plant and buildings, not only of the Sugar department, but of the entire Institute, will be allotted by the United Provinces Government for the staff and students of the Sugar Institute.
- (iii) The requisite staff quarters and hostels would also be allotted.
- (iv) In view of the desirability of undivided ownership of the plant, buildings and other fixtures, the Imperial Council of Agricultural Research would be in the position of lessees of these, subject to the usual stipulation of fair use and reasonable wear;

(v) Suitable arrangements will have to be made for cane supply for the experimental factory. The Government farms in Cawnpore may place a sufficient area under cane for this purpose. Failing this, some of the land which has been set free by the closing down of a portion of the farms at Cawnpore, may be given to the Sugar Institute on lease. Approximately 300 acres of land will be required.

If the Sugar Institute has to grow its own cane, it should not do this departmentally, but by giving out the land on lease.

(vi) As the plant, buildings and fixtures will remain the property of the United Provinces Government, additions and alterations to these should be paid for by that Government. Where the equipment is available elsewhere under the local Government it may be taken. Subject to exact details being worked out later on, it is estimated that the total expenditure on additions and alterations will be about Rs. 1 lakh spread over a period of five years, and this amount should be contributed by the local Government.

(vii) Any additional apparatus, laboratory and workshop equipment, etc., that may be found to be necessary, will be provided and paid for by the Imperial Council of Agricultural Research and will remain their property.

(viii) As regards the recurring contribution of the local Government a rough estimate may be made here.

The budget estimate of the H. B. Technological Institute for 1933-34 amounts to Rs. 1,55,252. The sanctioned estimates for 1931-32 and 1932-33 amounted to Rs. 3,32,110 and Rs. 2,03,524, respectively. Considerable retrenchments have been made during the current year.

A separate budget for the Sugar department is not prepared, but it is estimated that this will amount to between Rs. 60,000 and Rs. 70,000. After making a deduction of Rs. 26,000 for recoveries from the running of the sugar factory, the net cost of the department may be put down at Rs. 50,000.

The share of the United Provinces Government in the recurring expenditure, may be calculated as follows :—

	Rs.
Existing budget of the Sugar department (after deducting receipts)	50,000
Deduct existing grant from the Imperial Council of Agricultural Research	20,000
Net cost of existing Sugar Department to United Provinces Government	30,000

In view of the fact that the United Provinces Government will contribute Rs. 20,000 annually towards the cost of additions to buildings, plant and fixtures (which will however remain their own property), it will be fair if Rs. 15,000 out of the net recurring expenditure of the existing sugar department amounting to Rs. 30,000 is borne by the local Government.

(ix) The Imperial Council of Agricultural Research will have the option of taking over such members of the present staff of the Sugar department of the Technological Institute as it may require provided the local Government and the staff concerned agree to the terms. Staff not thus taken over will be dispensed with or utilized elsewhere by the local Government.

(x) The local Government will waive leave and pensionary contributions for the whole time staff taken over from the Technological Institute, but the Research Council will pay for such portion of the leave salary as is earned during deputation with the Council.

(xi) The local Government will continue to maintain the present buildings.

(xii) A certain proportion of vacancies (say 20 per cent.) for training of students should be reserved for *bona fide* residents of the United Provinces.

Staff required.

For adequate development of the work of the proposed Research Institute, the staff and equipment at present available in the Sugar department of the Technological Institute and under the Sugar Technologist will be entirely insufficient and provision will have to be made for these on a proper scale. The following staff is proposed in addition to the Sugar Technologist who would be in charge of the new Institute:—

- (i) One Manufacturing Chemist, in the grade of Rs. 1,200—50—1,500. He should possess complete Java technical qualifications and should have worked as a factory Manager in an up-to-date Java factory for at least three years. He may be appointed on contract for, say, five years.

The duties of this chemist will comprise research work on manufacturing processes, and giving technical advice to factory owners and others.

- (ii) One Sugar Engineer, on a salary of Rs. 1,200—50—1,500. He should possess suitable academic qualifications in Mechanical and Electrical Engineering and should have practical experience extending over at least 10 years of designing and manufacture of Sugar machinery and of erecting and operating sugar factories.

He may be appointed on short term contract for, say, five years. His duties will consist of research work intended to improve the design of sugar machinery and in giving technical advice to factory owners and others.

- (iii) One Professor of Sugar Technology, on a salary of Rs. 1,200—50—1,500. His qualifications will be similar to those prescribed for the Manufacturing Chemist. He may be appointed on a short term contract for, say, five years. His work will consist mainly of teaching, though he may do some research work also.

Applications for the posts of Manufacturing Chemist, Sugar Engineer and Professor of Sugar Technology will be invited in India and also from abroad and the best men available will be engaged irrespective of their nationality.

- (iv) One Assistant Manufacturing Chemist on the permanent scale of pay, in the new first class scale, with a suitable initial pay, which would probably have to be Rs. 600. Qualifications demanded should include a high degree in Science, complete training in Sugar Technology in a recognised institution in India or abroad and at least five years' experience of manufacturing cane sugar in India.

The duties will consist of assisting the Manufacturing Chemist.

- (v) One Assistant Sugar Engineer. The salary will be similar to that of the Assistant Manufacturing Chemist. The qualification required should include a high degree in engineering with at least five years' experience of sugar machinery. The duties will consist of assisting the Sugar Engineer.

- (vi) One Lecturer in Sugar Technology. The salary and qualifications will be similar to those of the Assistant Manufacturing Chemist. The principal duty of the Lecturer will be to teach students.

As the Assistant Manufacturing Chemist, the Assistant Sugar Engineer and the Lecturer in Sugar Technology will be required later on to take the place of the three senior experts, very careful selection will have to be made and men with very high academic qualifications alone will be appointed. If in order to get men with the requisite qualifications, the salary mentioned above is found to be inadequate, a higher salary in the scale of pay provided may be paid.

- (vii) One First Assistant to the Sugar Technologist. The salary and qualifications will be similar to those of the Assistant Manufacturing Chemist. His duties (as well as those of the Second Assistant) will consist of assisting the Sugar Technologist in dealing with technical enquiries from Sugar factories and others and in tabulating scientific control returns from factories and compiling for publication reports based on these.

- (viii) One Second Assistant to the Sugar Technologist, in the grade of Rs. 150—15—300—20—400, on the permanent scale of pay. The qualification required will be a degree or diploma in Sugar Technology and some factory experience.

- (ix) One Physical Chemist, in the grade of Rs. 400—20—600 on the permanent scale. He as well as the Biochemist should possess high scientific qualifications and should be able to work out scientific problems arising in the course of technological and engineering researches.
- (x) One Biochemist, in the grade of Rs. 400—20—600 in the permanent scale.
- (xi) One Statistician, in the grade of Rs. 200—15—350 in the permanent scale. The qualification demanded should be a high degree in statistical science with some experience of special investigation work. It will probably be necessary to place the candidate under special training at first. His duties will include the compilation of statistics of sugar trade and the working up of the returns received from factories. A Statistical Computer to assist the Statistician, has been provided under Subordinate office establishment.
- (xii) Subordinate and inferior Technical Establishment comprising Laboratory Assistants, Laboratory bearers, draughtsmen, mechanics, electricians, panmen, and other similar staff. A complete list of this staff can be prepared after full details of the proposed Institute have been worked out. A provisional list is, however, given in Appendix A. The cost of the staff may be provisionally placed at Rs. 2,500 per month, average for first five years.
- (xiii) Subordinate and inferior office Establishment, comprising Office Superintendent, Recorders, Accountant, Storekeepers, Stenotypists and ordinary typists, record keeper, librarian and sundry general clerks. In this case also a complete list can be prepared later. A provisional list of staff is given in Appendix B. The cost of the staff may be provisionally placed at Rs. 2,500 per month.
- (xiv) A certain amount of subordinate and inferior staff will be required for occasional and seasonal work, including contract work. Such staff will be required for special experimental work and other unforeseen types of work for which the permanent staff may not be suitable or sufficient. A lump sum provision of Rs. 5,000 per year may be made for this.

Cost of the two schemes.

The Capital Costs as well as the recurring expenditure involved in the two schemes are shown in Tables IV, V, VI and VII. The cost has been worked out with due regard to economy, but it is necessary to emphasize that as no proper estimates can be prepared at this stage, the details shown in these tables must be regarded as only approximate. It is hoped however that the figures for total cost are more or less correct.

The comparative cost of the two schemes is shown in Table III. It will be observed that the total cost, over a period of five years, of the Cawnpore scheme is Rs. 13,99,400 whilst that of the other scheme amounts to Rs. 30,52,400, the yearly average for the two being approximately 2½ lakhs and 6 lakhs respectively.

TABLE III.

Abstract Statement of Capital Cost and Recurring Expenditure of the two Schemes.

Particulars.	Cost for developing	Cost for independent
	Technological Institute, Cawnpore.	Suzar Research Institute.
	Rs.	Rs.
I.—Capital Expenditure—		
I Year	1,06,000	13,70,000
II Year	11,000	42,000
III Year	11,000	42,000
IV Year	11,000	42,000
V Year	11,000	42,000
Total	1,50,000	15,38,000

TABLE III—*contd.*

Particulars.	Cost for developing Technological Insti- tute, Cawnpore.	Cost for independent Sugar Research Institute.
	Rs.	Rs.
II.—Recurring Expenditure—		
I Year	2,53,000	3,44,000
II Year	2,42,240	2,83,240
III Year	2,43,480	2,84,480
IV Year	2,54,720	2,95,720
V Year	2,55,960	3,06,960
Total	12,49,400	15,14,400
Grand Total	13,99,400	30,52,400
Average Expenditure per year	2,79,880	6,10,480

It should be pointed out that the cost of the Sugar Technologist's office and the Sugar Cable Service is included in the schemes put forward. The budget estimate for these during 1933-34 is as follows:—

	Rs.
1. Budget of the Sugar Technologist's office	42,125
2. <i>Deduct</i> estimated receipts from the public as fees for technical advice, etc.	3,000
Net cost	39,125
3. Budget Estimate for the Sugar Cable Service	11,301
4. <i>Deduct</i> estimated receipts from subscriptions, etc.	10,500
Net cost	801
Total cost	39,926
or say	40,000

This represents a total cost during the next five years of between 2 lakhs and 2½ lakhs rupees.

Estimate of cost for developing the Technological Institute, Cawnpore.

The statements in Tables IV and V show the estimated Capital Expenditure and Recurring Cost of the Sugar Institute if it is located at the Technological Institute in Cawnpore. Explanatory notes regarding the various items comprised in these tables are given below:—

A. *Capital Expenditure.*—(Table IV).

- (i) *Experimental Factory.*—The present Experimental Factory at the Institute is incomplete and some additional machinery will be required to complete it. Some alterations to the buildings will also be necessitated by this. The estimated cost of these additions and alterations amounts to Rs. 46,000 during the first year. During the subsequent years approximately Rs. 5,000 per year will be required under this sub-head.
- (ii) *Engineering Laboratory.*—There is a small Engineering Workshop attached to the Technological Institute, but no Engineering Laboratory has so far been provided. A sum of Rs. 50,000 has therefore been provided in the first year for this purpose followed by Rs. 5,000 annually in the subsequent years. No provision has been made for any buildings for the Engineering Laboratory as it is expected that a part of the existing Institute buildings can be utilised for this purpose.

- (iii) *Laboratory Equipment*.—The existing Institute Laboratories will have to be re-arranged to suit the requirements of the Sugar Institute. A sum of Rs. 5,000 has been provided for this purpose in the first year. The provision for chemicals and apparatus has been included under recurring expenditure.
- (iv) *Contingencies*.—For miscellaneous expenses Rs. 5,000 has been provided in the first year followed by Rs. 1,000 annually in subsequent years.

The total Capital Expenditure during the first five years amounts to Rs. 1,50,000. As stated previously in this note, the suggested contribution of the Government of the United Provinces towards Capital Expenditure will be Rs. 1,00,000 spread over a period of five years. The local Government's contribution will therefore cover two-thirds of the entire Capital Expenditure.

B. Recurring Expenditure.—(Table V).

- (i) *Pay of Officers*.—The staff provided is in accordance with the list already given in this note. It is necessary to emphasize that for the success of the Institute it is essential that none but the very best men available should be employed. The total cost under the sub-head "Pay of Officers" amounts to Rs. 1,14,800 in the first year rising to Rs. 1,39,760 in the 5th year.
- (ii) *Pay of Establishment*.—Provision for Establishment has also been made on the lines already explained in this note. The total cost under this sub-head amounts to Rs. 72,000 in the first year rising to Rs. 92,000 in the fifth year.
- (iii) *Allowances and Honoraria*.—This covers provision for travelling Allowances of Officers and establishment amounting to Rs. 18,000 annually. A provision of Rs. 2,000 annually has also been made for the travelling allowances of students to enable them to visit factories and undertake instructional tours in general. The total cost under this sub-head therefore amounts to Rs. 20,000 annually.
- (iv) *Supplies and Services*.—
- (a) *Running Expenses of Sugar Factory*.—The existing experimental factory at the Technological Institute has an actual capacity of 30 tons cane per day. Normally a sugar factory should make a little profit, but as this factory will be used for experimental purposes its working will not be continuous and a certain amount of loss may be anticipated. To cover this a provision of Rs. 10,000 per annum has been made. Actually the gross cost of working the factory will be Rs. 60,000 per year and the recoveries may be estimated at Rs. 50,000.
- (b) *Alterations to Factory Plant*.
- (c) *Repairs and Maintenance of Plant, Tools and Equipment*.—It is necessary to make ample provision under these sub-heads in the case of an Experimental factory, where alterations have to be made frequently in order to suit the requirements of experimental and research work.
- (d) *Chemicals and Apparatus*.—The existing laboratory equipment at the Technological Institute is not adequate for the type of work which the Sugar Institute will have to undertake. Substantial provision has therefore been made for Chemicals and Apparatus; the amount provided being Rs. 50,000 in the first year, Rs. 30,000 in the second year and Rs. 20,000 annually for the remaining three years.
- (e) *Purchase of Materials*.
- (f) *Gas Manufacture*.
- (g) *Cost of Water, Oil, fuel, and other supplies*.—These are based approximately on the existing provision and do not call for special comments.
- (h) *Net cost of Maintaining the Sugar Cable Service*.—In order to keep pace with the development of the Sugar industry in this country and also to provide suitable statistical material relating to Indian as well as foreign markets, the present Sugar Cable Service will have to be considerably extended, so as to include also the proposed Indian Sugar Trade Service. It is estimated that the gross expenditure on the Service will amount to Rs. 20,000 per year, the receipts from subscriptions and other payments being estimated at Rs. 15,000; the net cost of the Service therefore being Rs. 5,000 annually.

(v) *Contingencies.*—The provision under this head is on usual lines. The only item to which a reference may be made is that for "Books and Publications". A good library is indispensable for the work of a Research Institute and the provision under this sub-head should therefore be on a liberal scale. A sum of Rs. 5,000 has therefore been provided in the first year followed by Rs. 3,000 annually in the following four years.

Deductions on account of receipts.—The Technical staff of the Research Institute will be called upon to do consultation work for which fees will be charged. The receipts from these fees are estimated at Rs. 10,000 annually.

The contribution from the Government of the United Provinces, if the arrangements already proposed in this note are accepted, will amount to Rs. 35,000 annually. The total receipts to be deducted from the gross recurring expenditure will therefore be Rs. 45,000 annually. The net recurring expenditure amounts to Rs. 2,58,000 in the first year, rising to Rs. 2,60,960 in the fifth year or a total of Rs. 12,74,400 in the five years.

Estimate of cost for establishing an Independent Sugar Research Institute.

A. Capital Expenditure.—(Table VI).

(i) *Land.*—It is estimated that approximately 50 acres of land will be required for the Research Station Buildings, Experimental Factory, Offices and residential buildings. The cost of this is estimated at Rs. 20,000.

No provision has been made for land for cultivating sugarcane as the cane required for the factory will be purchased from private cane growers or farm owners.

(ii) *Experimental Factory.*—A factory of 50 tons capacity is considered to be the smallest suitable unit for experimental and instructional purposes. The factory at the Technological Institute, Cawnpore, was designed of a smaller size owing to the difficulty in getting cane at Cawnpore. The new factory will include a variety of plant of different types to permit of experiments under varied conditions. The estimated cost of the factory is £15,000 F. O. B., whilst that of the factory ready erected complete with auxiliaries, buildings, railway siding, etc., is estimated at Rs. 3,50,000. A provision of Rs. 10,000 per year has also been made for additions to the factory during the following years.

(iii) *Engineering Laboratory and Power House.*—The Engineering Laboratory Equipment is estimated to cost Rs. 50,000 whilst the cost of the Power House machinery will amount to another Rs. 50,000. A provision of Rs. 3,000 annually has been made for additions to the Engineering Laboratory.

(iv) *Buildings.*—A list of buildings with approximate estimate of cost is given in Appendix "C". The total cost is estimated at Rs. 7 lakhs. For additions in the following years a provision of Rs. 20,000 annually has been made.

(v) *Laboratory Equipment.*—The furniture, fittings and fixtures are estimated to cost Rs. 50,000, whilst plant for gas manufacture, water supply, etc., are also expected to cost Rs. 50,000. For additions to laboratory equipment in the subsequent years Rs. 5,000 annually has been provided.

(vi) *Furniture and Fittings.*—The provision for furniture for lecture rooms, offices and laboratory and for electric fittings has been put down at Rs. 75,000 together with Rs. 3,000 annually for additions in the following years.

(vii) *Contingencies.*—For miscellaneous expenses Rs. 25,000 has been provided in the first year and Rs. 1,000 annually in the subsequent years.

The total Capital Expenditure thus amounts to about Rs. 13,70,000 in the first year and Rs. 42,000 annually in the subsequent years or a total of about Rs. 15,38,000 in five years.

B. Recurring Expenditure.—(Table VII).

The expenditure under the following heads is estimated to be identical with that for Recurring Expenditure if the Sugar Research Institute is established at the Technological Institute, Cawnpore:—

- I. Pay of Officers.
- II. Pay of Establishment.
- III. Allowances and Honoraria.
- IV. Contingencies.

The only differences occur under the head "Supplies and Services" which are explained below :—

- (i) *Running expenses of Sugar Factory.*—The running expenses are estimated at Rs. 10,000 per year. Although the factory will be of 50 tons capacity, as against 24 tons in the case of the existing factory at the Technological Institute, the loss in running should not be more, on account of the larger capacity and better efficiency.
- (ii) *Alterations to Factory Plant.*—
- (iii) *Repairs and Maintenance of Tools, Plant and Equipment.*—The provision under these sub-heads has also been increased to Rs. 7,500 each per year on account of the large size of the factory.
- (iv) *Chemicals and Apparatus.*—The provision under this sub-head amounts to Rs. 1,00,000 in the first year, Rs. 30,000 in the second year and Rs. 20,000 annually in the subsequent years.

The other items under "Supplies and Services" call for no comment.

Deductions.—The deductions to be made from the gross Recurring Expenditure amounts to Rs. 10,000 annually on account of receipts from public as fees for technical advice, analyses, etc.

The total net Recurring Expenditure of the Institute during the first year is Rs. 3,44,000 whilst in the fifth year it is estimated at Rs. 3,06,960; the total expenditure during five years being Rs. 15,14,400.

LOCATION OF THE INSTITUTE.

The exact location of the Research Institute is a matter of considerable importance as its success and usefulness to the industry depend on this to a very large extent. As already stated the Sugar Committee recommended Basti and Kheri as suitable sites for the Institute which they had proposed. Conditions in regard to sugarcane cultivation and the distribution of sugar factories have altered a good deal since the Sugar Committee reported. Taking into consideration the suitability of various provinces, particularly the United Provinces, Bihar and Orissa, Madras, Bombay and Delhi Province, for locating the Research Station, the United Provinces appears to provide the most suitable conditions for the purpose. It has the largest area under cane, the largest number of sugar factories and an extensive Khandasari Sugar Industry. It is centrally situated between Bengal and Bihar on the one side and the Punjab on the other. It is also easy of access from the Central and Southern India. The Research and Testing Station for the indigenous Sugar and Gur Industry will be located in this province and its activities will supplement those of the proposed All-India Institute in matters relating to the Khandasari and Gur Industries. The local Government has, in the past, taken the lead in research work and training of technical men for the sugar industry and may therefore be expected to actively assist the present scheme.

Coming next to the selection of suitable sites in the United Provinces, Cawnpore, Lucknow and Meerut may be considered. Cawnpore is an important industrial centre well served by railways. It has also two important institutions—The Agricultural College and the Technological Institute. If the proposal for developing the latter institution does not materialize, sufficient land for building the Research Institute can be had adjoining the city, particularly on the Kalyanpur side.

The importance of Lucknow, like that of Cawnpore lies in its central position in the United Provinces and also between the Punjab and Bihar. Moreover, with the advent of the Sarda Canal sugarcane cultivation is rapidly developing in the Lucknow Division. The most important advantage in favour of Lucknow, however, consists in its being easily accessible by rail from practically all parts of India.

Meerut is situated in an area having very large cane cultivation. The number of factories in this tract has increased rapidly during the last two years. Meerut will also serve the needs of the Punjab area, where important developments in the sugar industry are expected in the future.

It would appear therefore that Cawnpore, Lucknow and Meerut may be selected as the most suitable places, in order of merit, for locating the Research Institute.

CONCLUSION.

The scheme outlined in the present note is not intended to be exhaustive, although as much detail has been given as is practicable at this stage. The particulars which have been given, however, are sufficient to show the urgent necessity for an institution of this type whilst the schemes put forward have the advantage of being considerably cheaper than the one recommended by the Sugar Committee of 1920, without in any way curtailing the usefulness of the institution.

The present scheme together with the scheme for a Research and Testing Station for the indigenous Sugar and *Gur* Industry which has already been sanctioned constitute a normal development of the present work of the Council's Sugar Technologist which is justified by the rapid expansion of the sugar industry, and the increasing demand for technical assistance.

R. C. SRIVASTAVA,
Sugar Technologist,
Imperial Council of Agricultural Research.
India.

CAWNPORE;

The 2nd October 1933.

TABLE IV.

Capital Expenditure for establishing the Imperial Sugar Research Institute at the H. B. Technological Institute, Cawnpore.

Serial No.	Heads and Items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	<i>Experimental Factory—</i>					
	(i) Cost of additional plant for existing factory	25,000	} 5,000	} 5,000	} 5,000	} 5,000
	(ii) Freight and other charges on above	8,000				
	(iii) Erection charges and alterations to buildings	15,000				
2	<i>Engineering Laboratory—</i> Equipment for engineering laboratory (part of existing Institute buildings being utilised for the laboratory)	50,000	5,000	5,000	5,000	5,000
3	<i>Laboratory Equipment—</i> Cost of re-arrangement of laboratories	5,000	..	..	..	..
4	<i>Contingencies—</i> Contingencies and miscellaneous expenses	5,000	1,000	1,000	1,000	1,000
		1,06,000	11,000	11,000	11,000	11,000
	Grand total for five years		1,50,000			

TABLE V.

Recurring Expenditure for running the Imperial Sugar Research Institute at the H. B. Technological Institute, Cawnpore.

Serial No.	Heads and items.	I Year. Rs.	II Year. Rs.	III Year. Rs.	IV Year. Rs.	V Year. Rs.
<i>I.—Pay of Officers.</i>						
1	One Sugar Technologist, salary Rs. 2,000—100—2,400	24,000	25,200	26,400	27,600	28,800
2	One Manufacturing Chemist, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
3	One Sugar Engineer, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
4	One Professor of Sugar Technology, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
5	One Assistant Manufacturing Chemist, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
6	One Assistant Sugar Engineer, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
7	One Lecturer in Sugar Engineering, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
8	One First Assistant to Sugar Technologist, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
9	One Second Assistant to Sugar Technologist, salary Rs. 150—15—300—20—400	1,800	1,980	2,160	2,340	2,520
10	One Physical Chemist, salary Rs. 400—20—600	4,800	5,040	5,280	5,520	5,760
11	One Biochemist, salary Rs. 400—20—600	4,800	5,040	5,280	5,520	5,760
12	One Statistician, salary Rs. 200—15—350	2,400	2,580	2,760	2,940	3,120
13	Leave salary, leave and pensionary contribution of officers on deputation, etc.	5,000	5,000	5,000	5,000	5,000
Total, Pay of Officers.		1,14,800	1,21,040	1,27,280	1,33,520	1,39,760
<i>II.—Pay of Establishment.</i>						
1	Subordinate and inferior technical establishment, at Rs. 2,500 per month	30,000	32,500	35,000	37,500	40,000
2	Subordinate and inferior office establishment, at Rs. 2,500 per month	30,000	32,500	35,000	37,500	40,000
3	Subordinate and inferior occasional and seasonal establishment	5,000	5,000	5,000	5,000	5,000
4	Leave salary, leave and pensionary contribution of staff on deputation, etc.	2,000	2,000	2,000	2,000	2,000
Total, Pay of Establishment		67,000	72,000	77,000	82,000	87,000

TABLE V—*contd.*

Serial No.	Heads and items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
<i>III.—Allowances and Honoraria.</i>						
1	Travelling allowance of officers	15,000	15,000	15,000	15,000	15,000
2	Travelling allowance of Establishment	3,000	3,000	3,000	3,000	3,000
3	Travelling allowance of students	2,000	2,000	2,000	2,000	2,000
Total, Allowances and Honoraria		20,000	20,000	20,000	20,000	20,000
<i>IV.—Supplies and Services.</i>						
1	Running expenses of Sugar factory*	10,000	10,000	10,000	10,000	10,000
2	Alterations to factory plant	5,000	5,000	5,000	5,000	5,000
3	Repairs and maintenance of plant, tools and equipment	5,000	5,000	5,000	5,000	5,000
4	Chemicals and Apparatus	50,000	30,000	20,000	20,000	20,000
5	Purchase of material	5,000	5,000	5,000	5,000	5,000
6	Gas Manufacture	2,500	2,500	2,500	2,500	2,500
7	Cost of water, oil, fuel and other supplies	2,000	2,500	2,500	2,500	2,500
8	Net cost of maintaining the Sugar Cable Service†	5,000	5,000	5,000	5,000	5,000
Total, Supplies and Services		85,000	65,000	55,000	55,000	55,000
<i>V.—Contingencies.</i>						
1	Postage and Telegram charges	1,500	1,500	1,500	1,500	1,500
2	Books and Publications	5,000	3,000	3,000	3,000	3,000
3	Purchase and repair of furniture	500	500	500	500	500
Carried over		7,000	5,000	5,000	5,000	5,000

	Rs.
*NOTE.—This comprises—	
Gross expenditure	60,000
Recoveries	50,000
Net Expenditure	10,000

	Rs.
†NOTE.—This comprises—	
Gross Expenditure	20,000
Receipts	15,000
Net cost	5,000

TABLE V—concl'd.

Serial No.	Heads and items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
	Brought forward .	7,000	5,000	5,000	5,000	5,000
V.—Contingencies—contd.						
4	Stationery including local purchase and printing charges	1,000	1,000	1,000	1,000	1,000
5	Hot and cold weather charges	200	200	200	200	200
6	Telephone charges	950	950	950	950	950
7	Winter and summer clothing for inferior staff	150	150	150	150	150
8	Advertisement charges	1,000	1,000	1,000	1,000	1,000
9	Maintenance of museum for sugar, gur and rab	500	500	500	500	500
10	Repair of typewriters	100	100	100	100	100
11	Miscellaneous contingencies	300	300	300	300	300
	Total, Contingencies	11,200	9,200	9,200	9,200	9,200
	Total, Recurring Expenditure	2,98,000	2,87,240	2,88,480	2,99,720	3,10,960
<i>Deduct—</i>						
	(a) Receipts from public as fees for technical advice, analyses, etc.					10,000
	(b) Contribution of the United Provinces Government for—					
	(i) Additions and alterations to plant					20,000
	(ii) Recurring Expenditure					15,000
	Total Deduction	45,000	45,000	45,000	45,000	45,000
	Total, Net Recurring Expenditure	2,53,000	2,42,240	2,43,480	2,54,720	2,55,960
	Grand total for five years			Rs. 12,49,400		

TABLE VI.

Capital expenditure for establishing the Imperial Sugar Research Institute independently of the H. B. Technological Institute, Coimbatore.

Serial No.	Heads and items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	<i>Land—</i> Land for Research Station buildings, experimental factory, offices and residential buildings—50 acres	20,000	..	..	..	..
2	<i>Experimental factory—</i> (i) Cost of plant (capacity 50 tons cane per day) £15,000 F. O. B. (ii) Freight, customs duty, etc. (iii) Machinery erection, buildings, godowns, water supply, railway siding, drainage, etc.	2,00,000 50,000 1,00,000	10,000	10,000	10,000	10,000
3	<i>Engineering Laboratory and Power House—</i> (i) Engineering laboratory equipment (ii) Power House machinery	50,000 50,000	3,000	3,000	3,000	3,000
4	<i>Buildings—</i> As per details given in Appendix C	7,00,000	20,000	20,000	20,000	20,000
5	<i>Laboratory Equipment—</i> (i) Furniture, fittings and fixtures (ii) Plant, including Gas plant, constant temperature room, water supply, etc.	50,000 50,000	5,000	5,000	5,000	5,000
6	<i>Furniture and Fittings—</i> (i) Furniture for lecture rooms, offices, library, etc. (ii) Electric fittings for above	50,000 25,000	3,000	3,000	3,000	3,000
7	<i>Contingencies—</i> Contingencies and miscellaneous expenses	25,000	1,000	1,000	1,000	1,000
	Total	13,70,000	42,000	42,000	42,000	42,000
	Grand total for 5 years		Rs. 15,38,000			

TABLE VII.

Recurring expenditure for running the Imperial Sugar Research Institute independently of the H. B. Technological Institute, Cawnpore.

Serial No.	Heads and Items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
<i>I.—Pay of Officers.</i>						
1	One Sugar Technologist, salary Rs. 2,000—100—2,400	24,000	25,200	26,400	27,600	28,800
2	One Manufacturing Chemist, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
3	One Sugar Engineer, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
4	One Professor of Sugar Technology, salary Rs. 1,200—50—1,500	14,400	15,000	15,600	16,200	16,800
5	One Assistant Manufacturing Chemist, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
6	One Assistant Sugar Engineer, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
7	One First Assistant to the Sugar Technologist, as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
8	One Second Assistant to the Sugar Technologist, salary Rs. 150—15—300—20—400	1,800	1,980	2,160	2,340	2,520
9	One Lecturer in Sugar Engineering, salary as in I class scale, initial pay Rs. 600	7,200	7,800	8,400	9,000	9,600
10	One Physical Chemist, salary Rs. 400—20—600	4,800	5,040	5,280	5,520	5,760
11	One Biochemist, salary Rs. 400—20—600	4,800	5,040	5,280	5,520	5,760
12	One Statistician, salary Rs. 200—15—350	2,400	2,580	2,760	2,940	3,120
13	Leave salary, leave and pensionary contribution of officers on deputation, etc.	5,000	5,000	5,000	5,000	5,000
Total, Pay of Officers		1,14,800	1,21,040	1,27,280	1,33,520	1,39,760
<i>II.—Pay of Establishment.</i>						
1	Subordinate and inferior technical establishment, at Rs. 2,500 per month	30,000	32,500	35,000	37,500	40,000
2	Subordinate and inferior office establishment at Rs. 2,500 per month	30,000	32,500	35,000	37,500	40,000
3	Subordinate and inferior occasional and seasonal establishment	5,000	5,000	5,000	5,000	5,000
4	Leave salary, leave and pensionary contribution of staff on deputation, etc.	2,000	2,000	2,000	2,000	2,000
Total, Pay of Establishment		67,000	72,000	77,000	82,000	87,000

TABLE VII—contd.

Serial No.	Heads and Items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
<i>III.—Allowances and Honoraria.</i>						
1	Travelling allowance of officers	15,000	15,000	15,000	15,000	15,000
2	Travelling allowance of establishment	3,000	3,000	3,000	3,000	3,000
3	Travelling allowance of students	2,000	2,000	2,000	2,000	2,000
Total, Allowances and Honoraria		20,000	20,000	20,000	20,000	20,000
<i>IV.—Supplies and Services.</i>						
1	Running Expenses of Sugar Factory*	10,000	10,000	10,000	10,000	10,000
2	Alterations to factory plant	7,500	7,500	7,500	7,500	7,500
3	Repairs and Maintenance of plant, tools and equipment	7,500	7,500	7,500	7,500	7,500
4	Chemicals and apparatus	1,00,000	30,000	20,000	20,000	20,000
5	Purchase of material	5,000	5,000	5,000	5,000	5,000
6	Gas manufacture	2,500	2,500	2,500	2,500	2,500
7	Cost of water, oil, fuel and other supplies	3,500	3,500	3,500	3,500	3,500
8	Net cost of maintaining the Sugar Cable Service†	5,000	5,000	5,000	5,000	5,000
Total, Supplies & Services		1,41,000	71,000	61,000	61,000	61,000

Rs.

*NOTE.—This comprises—

Gross expenditure	1,50,000
Recoveries	1,40,000
	<u>10,000</u>

†This comprises—

Gross expenditure	20,000
Receipts	15,000
	<u>5,000</u>

TABLE VII—*concl'd.*

Serial No.	Heads and Items.	I Year.	II Year.	III Year.	IV Year.	V Year.
		Rs.	Rs.	Rs.	Rs.	Rs.
<i>V.—Contingencies.</i>						
1	Postage and telegram charges	1,500	1,500	1,500	1,500	1,500
2	Books and publications	5,000	3,000	3,000	3,000	3,000
3	Purchase and repair of furniture	500	500	500	500	500
4	Stationery including local purchase and printing charges	1,000	1,000	1,000	1,000	1,000
5	Hot and cold weather charges	200	200	200	200	200
6	Telephone charges	950	950	950	950	950
7	Winter and summer clothing for inferior staff	150	150	150	150	150
8	Advertisement charges	1,000	1,000	1,000	1,000	1,000
9	Maintenance of museum for sugar, gur and rab	500	500	500	500	500
10	Repair of typewriters	100	100	100	100	100
11	Miscellaneous contingencies	300	300	300	300	300
	Total, Contingencies	11,200	9,200	9,200	9,200	9,200
	Total, Recurring Expenditure	3,54,000	2,93,240	2,94,480	3,05,720	3,16,960
<i>Deduct—</i>						
	Receipts from public as fees for technical advice, analyses, etc.	10,000	10,000	10,000	10,000	10,000
	Total, Net Recurring Expenditure	3,44,000	2,83,240	2,84,480	2,95,720	3,06,960
	Grand Total for five years	15,14,400				

APPENDIX A.

Provisional list of Subordinate and Inferior Technical Establishment.

Serial No.	Designation.	No. required.	Proposed scale of salary.
			Rs.
<i>I.—Laboratory Staff.</i>			
1	Laboratory Assistants	3	75—5—125
2	Laboratory Bearers	8	16—1—25
3	Laboratory Storekeepers	1	45—3—60
<i>II.—Drawing Office.</i>			
4	Head Draughtsman	1	120—10—200
5	Draughtsman	1	75—5—125
6	Tracer	1	75—5—125
<i>III.—Workshop.</i>			
7	Foreman	1	100—10—200
8	Turner	1	60—5—100
9	Electrician	1	75—5—125
10	Moulder	1	50—4—80
11	Carpenter	1	50
12	Blacksmith	1	35
13	Fitters	2	60 and 75
14	Khalasis	2	20 and 30
15	Coolies	6	12
<i>IV.—Power House.</i>			
16	Power House Mechanic	1	100—10—200
17	Engine or Motor Drivers	3	50
18	Oilmen	3	12
19	Coolies	6	12
<i>V.—Factory Supervising Staff.</i>			
20	Head Panman	1	200
21	Factory Supervisor	1	100
22	Time Keeper	1	45
23	Storekeeper	1	45
24	Godown Keeper	1	45
25	Watchmen and Gatekeepers	6	12

NOTE.—This list is provisional and is intended only to give an indication of how the total expenditure on technical establishment has been estimated; details of number of men required as well as the scale of salary are subject to revision.

APPENDIX B.

Provisional list of Subordinate and Inferior Office Establishment.

Serial No.	Designation.	No. required.	Proposed scale of salary.
			Rs.
1	Office Superintendent	1	250—10—400
2	Recorders	3	150—10—250
3	Statistical Computer	1	100—10—200
4	Stenotypist and Camp Clerk	1	100—10—140— 12—200.
5	Stenotypists	3	90—5—105— 7—140.
6	Typists	4	60—5—100
7	Accountant and Head Clerk	1	100—10—140— 12—200.
8	Assistant Accountant	1	60—5—100
9	Cashier	1	60—5—100
10	Second Clerk	1	75—5—100— 6—130.
11	General Clerks	3	50—5—80
12	Despatch Clerk	1	50—5—80
13	Record Keepers	2	50—5—80
14	Librarian	1	50—5—80
15	Museum Clerk	1	50—5—80
16	Daftri	1	16—1—20
17	Jamadar	1	16—1—20
18	Orderly Peons	12	12—1—16
19	Office Peons	10	10—1—12

NOTE.—(1) Office establishment required for the Sugar Cable Service is not included in this list as it will be paid for out of receipts from subscriptions.

(2) The above list of staff is provisional, and is intended only to give an indication of how the total expenditure on office establishment has been estimated; details of number of men required as well as the scale of salary are subject to revision.

APPENDIX C.

Statement showing approximate cost of buildings.

Serial No.	Particulars of buildings.	Estimated cost.
		Rs.
1	Buildings for laboratories for research and teaching, lecture rooms, engineering laboratory, drawing office, library, museum	1,25,000
2	Buildings for Offices and Stores	25,000
3	Four Officers' bungalows, with outhouses	1,20,000
4	Six Assistants' bungalows	90,000
5	Eight quarters for subordinate staff	40,000
6	Twelve quarters for senior clerks	24,000
7	Twelve quarters for junior clerks and superior operative staff	18,000
8	Forty quarters for mistries and servants	24,000
9	Students' hostel, having 50 single and 25 double rooms.	75,000
10	Kitchens and outhouses for hostel	25,000
11	Laying out of grounds and roads	30,000
12	Water Supply and drainage	35,000
13	Electric wiring and fittings for residential buildings	35,000
	Total	6,66,000
	Add 5 per cent. contingencies	33,600
	Total	6,99,600

Say Rs. 7 lakhs.

NOTE.—The list of buildings is provisional and is intended only to give an indication of how the total expenditure on buildings has been estimated; details of number of buildings required as well as their cost will have to be prepared later on.

ENCLOSURE II.

PROCEEDINGS OF A MEETING OF THE SUB-COMMITTEE APPOINTED BY THE SUGAR COMMITTEE TO EXAMINE THE QUESTION OF STARTING AN IMPERIAL SUGAR RESEARCH INSTITUTE, HELD AT BOMBAY ON FRIDAY, THE 1ST SEPTEMBER 1933.

The following were present :—

- | | |
|--|-------------------|
| 1. Diwan Bahadur Sir T. VIJAYABAGHAVACHARYA, <i>Chairman</i> . | } <i>Members.</i> |
| 2. Mr. B. C. BURT, | |
| 3. Lala HAR SAHAI GUPTA, | |
| 4. Mr. F. A. SHERWANI, | |
| 5. Dr. J. N. HALDANE (<i>vice</i> Mr. NOEL DEBERR). | |
| 6. Mr. R. C. SRIVASTAVA, <i>Member and Secretary.</i> | |

Lala SHRI RAM and Mr. J. FENTON MILLAR were unable to attend.

2. The meeting lasted from 11-0 A.M. to 4-30 P.M., with an interval for lunch from 1 P.M. to 3 P.M.

3. Mr. Burt, in introducing the subject, referred to the note prepared by the Sugar Technologist (See encl. I to Annexure I) containing a tentative scheme for an all-India Research Institute for the Sugar industry. This formed the basis for discussion. Details of the scheme were considered in the following order :—

- (i) Programme of work.
- (ii) Staff required.
- (iii) Scheme for developing the H. B. Technological Institute, Cawnpore.
- (iv) Scheme for starting an independent Research Institute.
- (v) Location of the Research Institute.

4. *Programme of work*.—Mr. Burt explained that the programme of work as outlined on pages 247-48 of the Sugar Technologist's note formed a natural development of the work already being done by the Sugar Technologist. Lala Har Sahai Gupta pointed out that no provision had been made in the programme of work for agricultural research and suggested that suitable provision should be made for such work. As an instance of the need for such work he drew attention to the fact that Co. 213 cane had deteriorated considerably in the United Provinces and needed replacement urgently. Mr. Sherwani supported Lala Har Sahai Gupta and considered that agricultural work was more important than technological work.

Mr. Burt replied that the Sugar Committee and the Government of India have already given great attention to agricultural work. Thus the Coimbatore Research Station has been doubled, a sub-station has been provided at Karnal under the Imperial Sugarcane Expert and a chain of testing and research stations reaching from Dacca to the Punjab has been started. The Research Institute now proposed will probably be situated in Cawnpore which is not a suitable place for carrying out agricultural research work on sugarcane. If the Research Institute were located at Meerut, the agricultural work which it would be possible to do there would be similar to that at Karnal. The Chairman explained that the Sugar Committee does attach importance to agricultural work and at its very first meeting a proposal was accepted for starting a chain of research stations. He suggested that if there was a feeling that the agricultural side is being neglected in the present scheme, the matter may be brought up before the Sugar Committee.

After some further discussion it was agreed that the question of providing for agricultural work in the proposed institute may be raised in the Sugar Committee if any member so desired.

The programme of work given on pages 247-48 of the Sugar Technologist's note was then considered seriatim and agreed to. In connection with item (v) relating to the collection and tabulation of scientific control returns from factories, Mr. Burt explained that rules under Section V of the Sugar Industry (Protection) Act would shortly be published for criticism and any points arising in connection with this can be raised by the factories after they had seen these rules. In connection with item (viii) it was pointed out that the *average* results of Java and Hawaii factories are made freely available to the industry. In connection with item (xi) relating to short refresher courses for men already engaged in the industry, Dr. Haldane pointed out that such courses were very essential.

5. *Staff required.*—Mr. Burt explained that the staff mentioned on pages 250 to 251 of the Sugar Technologist's note would be required for either of the two alternative schemes. Mr. Sherwani pointed out that no Director, who would be in charge of the Research Institute, was provided for. The Chairman explained that the staff mentioned in the scheme was in addition to the Sugar Technologist, who would be in charge of the Research Institute.

Mr. Sherwani and Dr. Haldane doubted the advisability of having non-Indians, and especially men from Java, for the posts of Manufacturing Chemist, Sugar Engineer and Professor of Sugar Technology, as these were the most important posts in the Institute. It was explained by the Sugar Technologist that men with the requisite qualifications were not likely to be available in India and that as it was essential to develop the Indian industry on Java lines, it would probably be necessary to import the First Manufacturing Chemist and Professor of Technology from that country; the Sugar Engineer might be obtained from Glasgow. But as these men will be on short term contracts and as well-qualified Indian assistants will be placed with them as understudies, it was hoped that Indians will eventually occupy these posts. It was in the end agreed that applications for these posts should be invited in India as well as from abroad and the best men available should be engaged irrespective of their nationality.

In regard to items (iv), (v) and (vi), i.e. Assistant Manufacturing Chemist, Assistant Sugar Engineer and Lecturers in Sugar Technology, Dr. Haldane pointed out that as these men will be required later on to take the place of the three senior experts, very careful selection will have to be made and men with very high academic qualifications will have to be appointed. He also desired that, if in order to get men with first class qualifications, the salary mentioned in the scheme was found to be inadequate, a higher salary up to the maximum of the grade should be paid. The Sub-Committee agreed that these 3 posts are necessary that it was important to secure really able men for them, and pay if necessary higher salaries in the scale.

The Sugar Technologist next explained that the First and Second Assistants [items (vii) and (viii)] were required, as he had no technical assistants under him at present and his technical work, which had already considerably increased, was likely to expand still more when the Institute was established. It was unanimously agreed that the two assistants were required.

The Committee also agreed, after a detailed discussion of the work to be done, to the appointment of a Physical Chemist, a Pio-chemist and a Statistician [item (ix) and (x)]. A definite suggestion was, however, made that a separate Statistical Computer should be provided to work under the Statistician.

The Committee desired the Sugar Technologist to work out details of the subordinate and inferior technical and office establishment and occasional and seasonal staff [items (xii), (xiii) and (xiv)], and to incorporate these in the revised scheme to be placed before the Sugar Committee.

5. *Estimate of cost for developing the H. B. Technological Institute.*—Mr. Burt said that the items so far considered were common to both the alternative schemes, but in considering the estimates of cost, the two schemes had now to be differentiated. The scheme for developing the Technological Institute at Cawnpore as given on pages 251 to 254 and 248 to 249 of the Sugar Technologist's note was first taken into consideration.

(a) *Capital Expenditure.*—The items of Capital Expenditure were discussed and agreed to with the exception of the provision for Engineering laboratory [item (ii)]. Dr. Haldane and Mr. Burt considered that the initial provision of Rs. 20,000 with further Rs. 2,000 annually would not be sufficient for a well-equipped engineering laboratory. It was agreed that the provision should be increased to Rs. 50,000 in the first year with Rs. 5,000 annually thereafter. The Sub-Committee also desired the Sugar Technologist to give to the Sugar Committee some particulars of the equipment which will be required under this head.

(b) *Recurring Expenditure.*—The Sub-Committee next considered the items of Recurring Expenditure given on pages 252 and 254 of the Sugar Technologist's note and accepted the proposals made by him. In connection with item (iv) (b) "Nett cost of maintaining the Sugar Cable Service", Mr. Sherwani pointed out, and other members agreed, that there was urgent necessity now for collecting and making available to the Sugar Manufacturers, and the trade, market and crop reports and other statistical and commercial information relating to the Indian, as distinct from the foreign, Sugar industry. The existing Sugar Cable Service was devoted almost wholly to information relating to the foreign sugar industry and to prices.

The Sugar Technologist explained that he had already in hand a scheme for an Indian Information Service which he hoped to place before the next meeting of the Sugar Committee. The provision of Rs. 5,000 annually made under this head for the cost of maintaining the Sugar Cable Service would cover the cost of the proposed Indian Service also. This was agreed to.

Method of Control.—The Committee then considered the question of control of the Research Institute. Mr. Burt explained that the Harcourt Butler Technological Institute at present consists mainly of two active sections namely, the Oil and Sugar Sections. The General Chemistry section was practically suspended whilst the Oil Section is already asking for a grant from the Research Council and a scheme for this is at present under the Council's consideration. Mr. Burt suggested that probably the best arrangement would be to have the entire Harcourt Butler Technological Institute made available for use as the Sugar Institute, but no negotiations had so far been opened with the local Government in this connection. Mr. Sherwani stated that he considered it important that whatever arrangement was made, there should be no divided control.

The Chairman asked the Committee to express a clear opinion on the question of control—whether it would be advisable to give a grant from the Research Council to the local Government or whether the proposed Research Institute should be controlled exclusively by the Research Council itself. The Committee was unanimously and definitely against giving a grant to the local Government as it was felt that under such an arrangement, the Institute could not be fully developed as an all-India institution. In order that the Research Institute may be of a truly central and All-India nature, it was considered that no particular local Government should have a special interest in it.

It was also unanimously agreed that even if the Research Council takes over the Oil Section of the Technological Institute, the whole of the main building of the Technological Institute will be required exclusively for the Sugar Research Institute. If the local Government were not agreeable to handing over the Institute building and equipment but desired that a grant should be given to them for running the Institute on an all-India basis, in the Committee's opinion the proposal should not be accepted. The Institute must be run independently, even if this necessitated its being located elsewhere than in Cawnpore.

Conditions for taking over the Technological Institute.—The Committee then proceeded to consider the conditions subject to which the Research Institute might be established by developing the Technological Institute at Cawnpore (pages 248 and 249 of the Sugar Technologist's note), and came to the following decisions on the various items :—

- (i) Agreed.
- (ii) This will now be amended as the entire main building will be required for the Sugar Research Institute, leaving nothing for the Oil Technology and other sections of the Technological Institute. The Oil Section should be separately housed.
- (iii) and (iv). Agreed.
- (v) The Sub-Committee was of the opinion, that if the Sugar Research Institute has to grow its own cane, it should do this departmentally, but by giving out the land on lease to cultivators.

Mr. Sherwani and Lala Har Sahai Gupta pointed out that as the Research Institute would be having land and would be cultivating its own cane, it should do some agricultural work also. The Chairman repeated that, whilst appreciating the point, he would suggest that it should be discussed in the Sugar Committee as it was outside the terms of reference of the present Sub-Committee.

- (vi), (vii) and (viii). These will form subjects for negotiation.

(ix) Agreed.

- (x) This does not arise now as the Sugar Research Institute will be controlled by the Research Council.

(xi) This should read "The Local Government will waive leave and pensionary contributions for the whole time staff taken over from the Technological Institute, but the Research Council will pay for such portion of the leave salary, as is earned during deputation with the Council."

- (xii) This will now be unnecessary.

(xiii) This should be deleted excepting for the first sentence.

(xiv) Agreed. †

7. *Estimate of Cost for establishing an independent Sugar Research Institute.*—The Committee considered the details given on pages 254 and 255 of the Sugar Technologist's note :— †

(a) *Capital Expenditure.*—Item (i) and (ii) relating to cost of land and experimental factory were agreed to.

The figures for cost of Engineering Laboratory and Power House [item (iii)] were considered to be somewhat low. The Committee agreed to raising these figures from Rs. 30,000 to Rs. 50,000 in each case. †

(iv) *Buildings.*—The total cost of buildings had been placed in the scheme at Re. 2,20,000. This was considered to be far too low and a figure of between 6 and lakhs was considered to be more reasonable. The Sugar Technologist was asked to work out details. †

(v) *Laboratory Equipment.*—Agreed.

(vii) *Furniture and fittings.*—The Committee agreed to raise the provision in the first year from Re. 65,000 to Rs. 75,000 and the annual provision from Rs. 2,000 to Rs. 3,000.

The Sub-Committee considered that the total capital expenditure would come to about Rs. 13 lakhs. †

(b) *Recurring Expenditure.*—The Committee agreed to the details of Recurring Expenditure given in the note with the exception of "Running Expenses of Sugar Factory" [item (i)]. The provision under this sub-head was reduced from Rs. 20,000 per year to Rs. 10,000 as with a larger and more efficient factory than the existing factory at the Technological Institute, the margin of loss should be smaller.

8. *Location of the Research Institute.*—The Committee considered the suitability of various provinces for locating the Research Institute. The merits of the United Provinces, Bihar and Orissa, Madras, Bombay and Delhi Province were particularly considered. The Committee eventually agreed that the United Provinces provides the most suitable conditions for the Research Institute and it selected Cawnpore, Lucknow and Meerut as the most suitable places in order of merit.

The Committee finally desired that the Sugar Technologist should re-draft the entire note incorporating the changes made as a result of the Committee's deliberations.

ANNEXURE II.

EXTRACTS FROM THE PROCEEDINGS OF THE SUGAR COMMITTEE, SIXTH MEETING, NOVEMBER 1933.

Scheme for an Imperial Sugar Industry Research Institute as revised by the Sub-Committee (Subject No. 11 of the Agenda).—Mr. Burt explained the main features of the scheme prepared by the Sugar Technologist as revised by the Sub-Committee. He pointed out that as no negotiations had so far been conducted with the Government of the United Provinces, it had been necessary to prepare two alternative schemes—one for the Research Institute if located at the H. B. Technological Institute, Cawnpore, and the other for an independent institute. He drew particular attention to the programme of work laid down in the scheme, this defined the scope of activities of the proposed institute and was important as the whole scheme depended on this programme. †

La'a Har Sahai Gupta referred to the importance of agricultural work in connection with the proposed Research Institute. With the permission of the Chairman he moved the following amendment to the report which differed slightly from the one of which he had originally given notice :—

"That the Imperial Sugarcane Breeding Station, Coimbatore, should be made a part of the proposed Imperial Sugar Research Institute, which should have an Agricultural Section for work of the following types :—

(a) Testing the milling qualities of cane varieties in collaboration with the breeder and the provincial departments of agriculture;

- b) Acting in an advisory capacity to provincial departments of agriculture and others carrying on sugarcane research work particularly in connection with schemes assisted by Imperial Council of Agricultural Research ;
- (c) Collect, co-ordinate and publish the results of these researches ;
- (d) To act as a central bureau of information in all agricultural matters connected with the sugar industry. ;

Lala Har Sahai Gupta pointed out that the work being done at present at Coimbatore was in a great measure responsible for the development of the Sugar industry in India and now that a Research Institute was being started it was only right that it should have an agricultural section also. He cited example of Java where such an arrangement existed. Mr. Walchand Hirachand seconded the resolution. A discussion followed on the scheme recommended by the Sub-Committee as well as Mr. Gupta's resolution.

Mr. Noel Deerr stated that the scheme under consideration was one of extreme importance to the industry. The expenditure involved was low in relation to the quantity of sugar which Indian factories would shortly be producing and which was conservatively estimated at half a million tons. In Java, Hawaii and other countries, the industry itself had provided funds on a very much larger scale for work of this type. He was of the opinion that if necessity arose the industry in India also would not object to contributing towards the capital cost and the upkeep of the proposed research institute. Referring to the programme of work outlined in the scheme, he was in general agreement with the proposals made. Item (iii) of the programme, viz., the provision of scientific assistance to factories, would, in his opinion, be very welcome, as only a few firms had adequate provision for scientific staff. Referring to the item (iv) of the programme relating to the carrying out of extended tests on new varieties of canes under factory conditions he suggested that firms which have land of their own may be asked to collaborate with the research institute in carrying out such tests. Such tests will not only benefit the factories, but also the adjoining cane growers. In regard to the collection and tabulation of scientific control returns from factories [item (v) of the programme] Mr. Noel Deerr stated that in view of the importance of such returns he would be in favour even of compelling factories to maintain laboratories and provide necessary scientific control data according to a definite prescribed scheme. He mentioned that the Indian Sugar Technologists' Association of which he was the President and Mr. Srivastava, the Secretary, was being completely overhauled. Mr. Noel Deerr and some of his colleagues including Mr. Srivastava were getting out of a book dealing with approved methods of scientific control in sugar factories and enquired if the Committee could provide funds for the publication of the book as the association had no funds. The Chairman stated that the Research Council would be willing to undertake the publication of the book free of charge to the Association.

Continuing Mr. Noel Deerr drew attention to the qualifications of staff laid down in the scheme which required that the Manufacturing Chemist and the Professor of Sugar Technology should have Java qualifications. He suggested that as equally qualified men could be had elsewhere, the word "highest" may be substituted for Java in the description of qualifications given in the scheme. Mr. Sherwani agreed with the latter suggestion and stated that although the chances were that suitable men for the purpose will have to be recruited from Java it was not necessary to restrict the qualifications in such a manner as to make non-Java men ineligible. Rao Bahadur Venkatarama Iyer supported Mr. Sherwani. Mr. Srivastava explained that what he meant by Java technical qualifications was that the men should both have received suitable technological training and acquired practical experience in the field and the factory in the same manner as is considered necessary in Java in the case of persons appointed as factory managers. Mr. Noel Deerr stated that he would like the qualifications as explained by Mr. Srivastava to be described in detail, so that men possessing such qualifications may be eligible irrespective of the country from which they come.

Rao Bahadur Venkataraman pointed out that the Sugar industry in India had grown beyond the expectations of the Sugar Committee of 1920. One of the most important suggestions made by that Committee was the starting a central institute for the sugar industry. The time was coming when India would have to meet internal as well as foreign competition and to be able to meet this competition adequately it was necessary that the sugar question should be studied as a whole. He admitted that the original idea in connection with the present scheme was to

have an institute for the technological side of the industry only. Although the agricultural side to a great extent must be left to the provincial departments, he was unable to visualise a central institute without an agricultural section, for studying new varieties of cane, and for finding out exactly how the cane passes through the mills, how the juice works through the factory and the recovery of sugar. For this purpose he thought it was very essential that the central institute should have sufficient area of land so that the research institute may grow its own cane departmentally and study its life cycle in all its aspects. Continuing Rao Bahadur Venkataraman pointed out that considerations of economy should not stand in the way of setting up a really useful institute. Instead of linking the research institute to the H. B. Technological Institute, he would rather have an absolutely independent institution placed in a suitable locality where there would be plenty of cane. In his opinion Cawnpore had special advantages and although Meerut possessed some advantages it was not as suitable as Cawnpore, not being equally centrally situated.

Mr. Sethi stated that like Rao Bahadur Venkataraman he did not consider it possible to separate the agricultural side of the industry from the technological side. The industry as it stands to-day is the result of agricultural work so far done. Rao Bahadur Venkataraman had recommended having a large central farm for testing varieties, but Mr. Sethi would go further and would accept the resolution moved by Lala Har Sahai Gupta. Mr. Sethi also proposed that the name of the Institute may be changed into "Imperial Sugar Research Institute" so as not to restrict it to the purely industrial side.

Mr. Allan enquired whether, if an agricultural section were added to the proposed institute, it would not be contrary to the accepted scheme for a chain of sugar-cane research stations throughout India. Mr. Sethi pointed out that this would not be the case as the research institute would not interfere with provincial work. Rao Bahadur Venkataraman explained that what he contemplated was that the central research institute in its experimental factory would carry out factory tests on the milling quality and other properties of the different varieties of sugarcane the factory doing perhaps the same variety a whole day. Rao Bahadur Viswanath was of the opinion that the agricultural side of sugarcane work can be done better through a chain of stations than by a central institute. In his opinion the same considerations applied to research relating to the indigenous sugar and gur industry.

Mr. Ramanathan drew attention to the fact that no provision for a large farm had been made either in the original scheme or in Lala Har Sahai Gupta's amendment. He was in agreement with Mr. Allan that cane grown in one place would not give results to suit all localities. Otherwise he supported the amendment. Mr. Sethi explained that part (c) of Lala Har Sahai Gupta's resolution had in mind a farm big enough for supplying cane for milling tests. A farm to suit these requirements would necessarily be fairly large in size. He also considered that training in sugar technology could not really be complete without teaching students something about sugarcane and how it is grown and for this reason also it was important that a sugar farm should be attached to the institute.

Mr. Ramamurty stated that if the Sugar Committee, which was a Committee of the Imperial Council of Agricultural Research, omits the agricultural section from a scheme of this type, it would be leaving out the most important branch of the scheme. The Research Council is working in close collaboration with the provincial departments in all its schemes and there was therefore no question of overlapping with the work of these departments. He agreed with Mr. Sethi that agricultural research should form part of the work of the institute and also that the name of the institute should be altered as proposed by him. The Institute should in fact deal with sugar in all its aspects. It would be a good idea to co-ordinate all the work on sugar with which the Imperial Council or the Government of India was concerned. As regards the adding of a large farm to the institute he did not consider this essential. As regards the agricultural training of technological students, he felt that it may be possible to arrange for this at one of the farms financed by the Research Council. For testing the milling quality of sugarcane and other similar work he suggested that technological assistance might be given by the institute to provincial departments also. Mr. Allan explained that his objection was only to general agricultural research being carried on at the proposed research institute. He did not intend that there should be no agricultural section attached to the institute for testing the milling qualities of sugarcane. Mr. Sethi agreed with Mr. Allan. Dr. McRae pointed out that for some years milling tests on sugarcane grown at Pusa, were done at the adjoining factories. He did not consider that such tests in U. P. will be applicable to conditions in all parts of India.

Dr. McRae drew attention to the proposal in Lala Har Sahai Gupta's resolution for making the Imperial Sugarcane Breeding Station a part of the proposed Sugar Research Institute and stated that he was against such a proposal. He stated that Rao Bahadur Venkataraman had entire freedom at present for working as he desired although he had certain difficulties owing to financial stringency. Dr. McRae did not see what benefit would result from the transfer of Sugar Breeding Station to the institute. On being asked by the Chairman Lala Har Sahai Gupta explained that it was his intention that control over the Coimbatore station should vest in the Imperial Council of Agricultural Research.

The Chairman desired that, as the question of transferring the control of the Coimbatore station to the Imperial Council of Agricultural Research was an important one, the matter should be further discussed and the advantages and disadvantages of the proposal clearly brought out. Mr. Walchand Hirschand stated that for the sake of uniformity of control it was necessary that Coimbatore should be under the control of the Research Council. As regards funds, this Committee should help in getting more money for Coimbatore. There was no intention of interfering with the work being done by provincial departments of agriculture by adding an agricultural section to the Research Institute. He felt that land up to 500 acres may be had near Cawnpore. He would prefer the institute to be located at Cawnpore. If it can be arranged to take over the buildings of the H. B. Technological Institute a saving in time of 2 or 3 years may be affected. He did not approve of Lucknow or Meerut as suitable places for the institute. Finally, he agreed with Mr. Noel Deerr that wherever possible the institute should collaborate with factory owners in making tests on a factory scale.

Dr. McRae stated that his difficulty so far as Coimbatore is concerned is solely lack of money. If this Committee made a recommendation to the Department of Education, Health and Lands of the Government of India that more money should be allotted to the Imperial Department of Agriculture more rapid progress would be possible than that under Lala Har Sahai Gupta's proposals. Mr. Walchand Hirschand stated that he understood from Mr. Allan that difficulty in connection with getting land for the farm at Cawnpore anticipated by him was in regard to Government land or land adjoining the Agricultural College. If there was no objection to having land at a distance of 1 or 2 miles from the college, no difficulty need be apprehended. Mr. Walchand stated that if Coimbatore station came under the Council it would be easier for the Committee to give Coimbatore needed extra money. His point was that more money be allotted to Coimbatore station and not to Pusa as a whole.

Mr. Burt said that it should not be assumed that the Research Council had plenty of money; it had already sanctioned schemes to the full extent of the funds at its disposal. The Council was now depending for further funds for Sugar Research on the promise given by the Government of India whilst the Sugar Industry (Protection) Bill was before the legislature. He felt that as the matter was an urgent one, one of the proposals made by the Sub-Committee should be adopted so as to save time. As regards land for cane cultivation according to his information land available in Cawnpore or 5 miles from the H. B. Technological Institute though a fairly high price would have to be paid he had no objection to a farm for growing cane for testing being added to the Sugar Institute.

Mr. Sherwani stated that if necessary the miller should come to the help of the industry and finance research work, but the starting of the research institute must not be delayed. The institute should in his opinion be located at Cawnpore; it was not correct to say that cane cannot be grown in Cawnpore. He agreed that in order to save time, the H. B. Technological Institute should be utilised and control over Coimbatore station must come under the Research Council.

Mr. Sethi at this stage moved the following amendment:—

"That the Imperial Sugarcane Breeding Station should be made a part of the proposed Imperial Sugar Research Institute and in addition this institute should have an agricultural section with a suitable cane farm for the proper training of sugar technologists."

Lala Har Sahai Gupta stated that he was in agreement with the amendment. The Chairman however considered that the two propositions should be put before the Committee separately. Mr. Sethi eventually withdrew his amendment. The Committee then adopted the following resolution:—

- (a) That the H. B. Technological Institute at Cawnpore should be utilised for the proposed Research Institute if satisfactory arrangements can be made with the United Provinces Government. (Unanimously.)

(b) That the Imperial Sugarcane Breeding Station Coimbatore should be made a part of the proposed sugar research institute. (By a majority.)

(Dr. McRae and Rao Bahadur Venkataraman abstained from voting on the second resolution.)

Mr. Burt pointed out in connection with Lala Har Sahai Gupta's resolution that much of the work covered by portions (b), (c) and (d) of the resolution was already being done by the Sugar Bureau and it was therefore unnecessary to provide specifically for this in the resolution. Lala Har Sahai Gupta agreed with this and the Committee gave permission for this portion of his resolution to be withdrawn.

Finally, the Committee unanimously agreed that in regard to the qualifications of the Manufacturing Chemist and the Professor of Sugar Technology these need not be restricted to Java qualifications only, but other equivalent qualifications may be accepted.

APPENDIX XXX.

NOTE DATED THE 22ND JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 29—A, APPLICATION FROM THE GOVERNMENT OF MADRAS FOR A GRANT OF RS. 1,500 SPREAD OVER THREE YEARS FOR A SCHEME OF EXPERIMENTS FOR THE IMPROVEMENT OF SUNN-HEMP FIBRE AT THE AGRICULTURAL RESEARCH STATION, SAMALKOTA.

B. APPLICATION FROM THE GOVERNMENT OF BOMBAY FOR A GRANT OF RS. 1,500 SPREAD OVER THREE YEARS FOR RESEARCH WORK ON SUNN-HEMP IN THE BOMBAY PRESIDENCY.

C. APPLICATION FROM THE GOVERNMENT OF THE CENTRAL PROVINCES FOR A GRANT OF RS. 20,060 SPREAD OVER FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON SUNN-HEMP IN THE CENTRAL PROVINCES.

Attention is invited to the attached letter (Annexure I) No. F-137/33-A., dated the 29th June 1933, addressed by the Secretariat of the Council to the Departments of Agriculture in Madras, Bombay, Bengal, United Provinces, Bihar and Orissa and the Central Provinces, regarding the recommendations contained in the Report on Hemp Marketing in India by Mr. T. S. Sabnis. As a result of this, applications for grants for research work on sunn-hemp have now been received from the Governments of Madras, Bombay and the Central Provinces. A copy of each of these schemes will be found in Annexures II to IV. The Madras and Bombay schemes involve so far as the Council is concerned, an expenditure of Rs. 1,500 each, spread over three years while the Central Provinces scheme is for a period of five years and involves a non-recurring expenditure of Rs. 10,000 and a recurring expenditure of Rs. 10,060 or a total of Rs. 20,060 spread over the five-year period. The three schemes have been approved by the respective provincial Research Committee and the local Governments. In the case of the scheme from the Government of Madras, the local Government have definitely stated that their scheme is not one which they would be prepared to undertake at their own cost.

2. The three schemes are now for the consideration of the Advisory Board. In this connection it may be stated that at its meeting held in August 1933, the Advisory Board recommended an application from the Government of the United Provinces for a grant for research work on sunn-hemp in that province at a slightly reduced cost; this scheme has since been approved by the Governing Body and is at present awaiting the allotment of funds.

ANNEXURE I.

COPY OF LETTER No. F-137/33-A., DATED THE 29TH JUNE 1933, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO THE DIRECTORS OF AGRICULTURE, MADRAS, BOMBAY, BENGAL, UNITED PROVINCES, BIHAR AND ORISSA, AND THE CENTRAL PROVINCES.

Recommendations contained in the report on Hemp Marketing in India by Mr. T. S. Sabnis.

I am directed to say that Mr. T. S. Sabnis, who was appointed by the Imperial Council of Agricultural Research to conduct an enquiry into the problem of hemp marketing in India, in the course of his Report, recommended *inter alia*, that :—

- (1) The advantages of drying the harvested crops as practised in Ratnagiri district (Bombay Presidency) should be investigated. (Paras. 71 and 82).
- (2) Instructions should be given to cultivators regarding the proper time and method of harvesting, retting and extraction of fibre and efforts should be made to improve facilities for washing the fibre where these are deficient. (Paras. 11, 15, 29, 36, 45, 53, 71, 83 and 85).
- (3) The vertical and twisting actions of the retted bundles during washing as practised in the United Provinces (Para. 15) and beating of the retted material during extraction as practised in some parts of Bengal (para. 45) are undesirable (para. 83).
- (4) The practicability of improving the quality of sunn hemp fibre by 'sweating' should be investigated (para. 84).

- (5) The practice of leaving sticks and dirt in the fibre and of twisting it tightly into hanks which serve to hide 'loading' should be discouraged (paras. 16, 86).
- (6) It is desirable to study the effects of the season of growth, and of harvesting and retting practices on the fibre with a view to improvements (para. 87).

2. An *ad hoc* Committee appointed by the Imperial Council examined these recommendations and came to the conclusion that before any action could be taken on the above recommendations, investigations would be necessary in the provinces concerned. In this connection the question of having the work carried out at some central station was raised and the possibilities of the Harcourt Butler Technological Institute at Cawnpore were considered. The advantage claimed for a central station was that accurately controlled experiments could be conducted under the supervision of a skilled technologist who could also be employed to carry out tests on strength and quality of fibre. The results obtained at the Central Station would then be applied in the provinces with suitable modifications for local conditions. But the scheme of research at a central station was not favoured in present financial circumstances and it was decided that the investigations should be limited to the removal of specific defects pointed out by Mr. Sabnis in the matter of growing, harvesting and retting of the crop. It was also suggested that the Directors of Agriculture might arrange for experiments with the object of obtaining quickly results which would help the growers to produce fibre which would be cleaner and more suitable for the ultimate use to which it would be put. It was also agreed that the provinces concerned might each be offered a small grant of say, Rs. 500 per annum for a maximum period of three years for carrying out more urgent experiments and that if any tests, in the United Kingdom, were found necessary, the cost of these should be met by the Council.

I am to add that should you consider it necessary, an application for a grant from the Council, for carrying out the necessary tests etc., in this, may please be made in the usual way.

ANNEXURE II.

SCHEME OF EXPERIMENTS FOR THE IMPROVEMENT OF SUNN-HEMP FIBRE AT THE AGRICULTURAL RESEARCH STATION, SAMALKOTA (MADRAS).

Sunn-hemp is grown in circles in summer months as well as in winter months. The summer grown crop is used either for fibre or for manure while the winter sown one for fodder or for manure. In June-July it is grown in dry lands as a mixed crop with dry paddy, cotton and red-gram for seed purposes. The summer crop generally comes up well without much damage being done by insects but the winter sown one is largely damaged by insect pests particularly *Utethesia pulchalla* and as such the pest has got to be controlled if the experimental work is to be continued with the cold weather crop as well.

As it is not possible to take up fresh area due to the smallness of allotment an area of 3 acres from the farm land is proposed and the cropping will be fitted into the existing rotation.

As the final product required is only fibre, experiments relevant to the purpose are proposed in the following paragraphs.

1. *Collection and trial of varieties.*—Improvement of varieties or strains by selection is beyond the scope of this scheme. A large number of varieties will, however, be collected from different parts of the Province and tested for their fibre yielding capacity. The large seeded types are considered to give fibre of superior quality.

2. *Effect of seed rate on fibre content.*—Sparse stand induces branching of stem, which is not a desirable feature in fibre extraction while very thick stand is reported to be responsible for weak fibre. Seed-rates of 30, 50, 60, 70, 80, 100 pounds to the acre will be tried with the best yielding types with a view to arrive at the optimum seed rate required for procuring fibre of best quality and quantity.

3. *Seasonal planting.*—The crop will be grown in all possible seasons to see in which part of the year the weather conditions are not favourable for the successful production of fibre.

4. *Influence of soil on fibre content.*—Produce from lighter soils is considered fine, white and strong, while that obtained from heavier soil is comparatively coarse, dull-white and weak for the same variety. The crop will be grown in light medium and heavy soils to see their bearing on the quality and quantity of fibre.

5. *Fibre in relation to depth of soil.*—Good surface tilth is considered sufficient while deep ploughing is deemed unsuitable. This has got to be verified.—

6. *Effect of manure.*—Heavy manuring especially with nitrogenous manures is considered not desirable while moderate doses of the same are said to give best results. The effect of phosphatic manures on the fineness and strength of fibre will also be ascertained.

7. *Effect of Irrigation.*—Under dry conditions, fine and strong fibre is said to be obtained while irrigated conditions favour coarseness. The veracity of this belief has got to be verified.

8. *Effect of continuous cropping.*—Continuous cropping may have some deteriorating effect on the fibre content.

9. *Harvesting trials.*—(i) Harvesting of stalks.

- (a) before flowering;
- (b) after flowering;
- (c) before setting of seed;
- (d) after setting but before ripening of seed;
- (e) after ripening of seed.

It is believed that best colour and fineness are obtained when the crop is harvested before the seed sets and best combination of strength, colour and fineness is obtained if the crop is harvested just before the seed is ripe. When the seed is ripe, the fibre loses colour and fineness but gets stronger.

(ii) *Pulling versus cutting.*—In some places, the stalks are pulled out and retted while in others they are cut to ground level for retting. Differences in the quality and quantity of fibre due to this differential treatment will be noted.

10. *Treatment after harvest.*—(i) Grading of stems according to size to see whether it makes any material difference in the quality of sample obtained.

(ii) Drying as against non-drying of stalks before retting.

(iii) Cutting of roots and tops (a) before drying (b) after drying (c) not cutting at all.

11. (i) Optimum period of retting to get best quality fibre.

(ii) Complete immersion as against butts first and then the whole stalk.

(iii) Retting in stagnant water *versus* in running water.

12. *Washing and Cleaning.*—(i) Washing retted bundles as against extracted fibre.

(ii) Beating wet fibre as against dry fibre.

13. *Extraction.*—(i) Dry *versus* wet extraction.

(ii) Single stalk extraction *versus* small bundle extraction.

14. *Drying.*—Drying in shade *versus* drying in sun.

15. *Sweating.*—(i) Sweating *versus* non-sweating.

(ii) Sweating of extracted fibre as against retted material.

Area proposed.—As aforesaid already, an area of 3 acres will be allotted for the purpose. F. Nos. 1 a and b are lighter in texture.

Nature of experiments.—All the field experiments will be laid out on the Fisher's Lating square or randomised block method and there will be sufficient number of samples taken in other cases to give fairly accurate data.

Retting.—Retting will be done in the channel west of field numbers 17 to 22 and provision is made for a cement tub for retting and cleaning in well water.

Drying and sweating.—An amount of Rs. 55 is provided for a shed for the purpose.

Staff.—The work will be managed with the present staff of the station and provision is made only for some literate assistance during the period.

Receipts—

	Rs.
By sale of fibre— 3 candies at R 50/- each per ear	150
Receipts for three years	450 450-0-0

Expenditure.—As some items of work are of a non-recurring type and expenditure on these has to be undertaken at the very start an amount of Rs. 650 may be allotted in the 1st year and the balance of Rs. 850 equally in the other two years.

Details are given below :—

	Rs. a p.
<i>(a) Non-recurring expenditure—</i>	
(1) One cement tub 20' × 6' × 3' at Re. 1 a sq. ft. of plinth with a leading channel	130 0 0
(2) One thatched shed 30' × 15' at 2 as. a sq. ft.	55 0 0
(3) One Picottah for the dry land plot	30 0 0
(4) One dozen sickles	5 0 0
(5) Mallets, Wooden planks, etc.	5 0 0
Total	<u>225 0 0</u>
<i>(b) Recurring expenditure per year—</i>	
<i>1. Supervision—</i>	
Literate assistance in Experimental work at Rs. 20 per mensem	240 0 0
<i>2. Cultivation expenses per acre—</i>	
Preparatory cultivation—3 ploughings	5 0 0
Seed and sowing at 65 lb. at 1 anna a lb.	5 0 0
Manure—compost	3 0 0
Harvesting, retting preparation of fibre, etc.	42 0 0
	<u>55 0 0</u>
For three acres at Rs. 55	165 0 0
<i>3. Miscellaneous charges—</i>	
Insect pests, control, etc.	10 0 0
Ry. freight on seed, sample fibre, etc.	10 0 0
Total	<u>425 0 0</u>
Recurring expenditure for three years	<u>1,275 0 0</u>
GRAND TOTAL	<u>1,500 0 0</u>

ANNEXURE III.

No. 5989 of 1933

Poona, 18th November 1933

From
The Deputy Director of Agriculture,
South Central Division, Poona :

To
The Director of Agriculture,
Bombay Presidency, Poona.

SUBJECT :—*Recommendations contained in the Report on Hemp Marketing in India by Mr. T. S. Subnis.*

Sir,

With reference to your letter No. 639, dated the 15th November 1933, (not printed) I have the honour to submit herewith the Scheme for investigations of problems in Sunn Hemp cultivation in Ratnagiri District, (Enclosure) for putting the same before the Bombay Provincial Agricultural Research Committee and The Imperial Council

of Agricultural Research, for approval and sanctioning an yearly grant of Rs. 500 for a period of three years. I have not included the cost of Establishment, in this Scheme, as the Imperial Council of Agricultural Research has clearly mentioned in their letter No. F/137-33A, dated 29th June 1933, (Annexure I) that the Imperial Government will offer only a small grant of Rs. 500 per annum for a period of three years, for carrying out most urgent experiments to each Province concerned.

I have etc.,

(Signed) V. V. GADGIL,

Deputy Director of Agriculture,
S. C. D., Poona.

Enclosure to Annexure III.

APPLICATION TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A GRANT-IN-AID OF RS. 500 PER ANNUM FOR A PERIOD OF THREE YEARS.

The Devgad and Rajapur Talukas in the Ratnagiri District of the Bombay Presidency grow the best quality of Sunn Hemp fibre in the whole of India. Besides this is the only money crop here. The whole of the land revenue of these two talukas was equivalent to the prices realised from this crop before the present slump, worth about Rs. 3—4 lacs. Mr. T. S. Sabnis, Hemp Marketing Officer appointed by the Imperial Council of Agricultural Research, had visited in 1931 important centres of cultivation and has made some valuable suggestions regarding improvement in the cultivation of this crop. The tract where at present this crop is taken is rocky, full of hills and there is very little of level land where any crops of importance can be taken. Under the circumstances it is well worth to encourage this cultivation by bringing to the notice of the agriculturists that the area, quality and quantity of this crop can be greatly increased and thereby a substantial increase in their outcome can be brought about. The Imperial Council of Agricultural Research have also decided to investigate the recommendations of Mr. T. S. Sabnis. In addition to the above recommendations it is requested that some other problems as given below may also be tackled in order to increase the area under the crop as well as to improve the quality and quantity of the hemp fibre.

The chief objects of this scheme are in brief :

- (1) To study the possibility of an increase in the present area under this crop.
- (2) To see if the present yields of fibre per acre can be increased.
- (3) To find out whether the quality of the fibre can be improved.
- (4) To study the possibility of producing the seed locally instead of importing it every year from Gujarat. If the scheme is properly worked out it will greatly help to solve the various problems before the cultivators of this tract. The detailed items of investigation will be :—
 - (1) To see if the present practice of burning the land before sowing can be done away with by use of sulphate of ammonia and thus make it possible to increase the area under this crop.
 - (2) To find out whether higher yields would be obtained by (a) sowing the crop in June instead of in August as is done at present and also (b) by using different seed rates.
 - (3) To see if the seed required can be locally grown instead of importing it from distant places in Gujarat.
 - (4) To study whether the quality of fibre can be improved by :—
 - (a) harvesting the crops earlier, and also
 - (b) by changing the periods required for rotting as well as,
 - (c) by cutting the roots of the crop.

It is proposed to conduct these trials except item No. 3 at two suitable centres one in each of the Rajapur and Devgad Talukas. The raising of Sunn seed will be done at Chiplun.

Expenditure.

	Rs.
Cost of cultivation on 4 acres at Rs. 100 per acre for raising sann for fibre in the Rajapur and Devgad talukas	400
Cost of cultivation of sann for seed at Chiplun on one acre	30
Supervision charges at Rajapur where there is no Departmental man to look after the crops	25
Wages of a watchman at 2 places for about 1½ months from harvesting till end	25
Miscellaneous	20
Total	500

It is estimated that about 1,700 lbs. of fibre and 400 lbs. of seed will be the yields per annum worth Rs. 170 at the present low prices.

(Signed) V. V. GADGIL.

Deputy Director of Agriculture,
South Central Division, Poona

ANNEXURE IV.

RESEARCH SCHEME ON SANN HEMP.

Sann hemp is next to jute and cocconut, the most important fibre crop in India and it is certain that India could obtain a larger share of the trade with the United Kingdom if more attention were paid to the better marketing of the crop. The Imperial Council of Agricultural Research has already done something to bring this aspect to the notice of the provinces where the crop is of importance. India had a golden opportunity to capture the English market when Russian hemp was temporarily out of the market but unfortunately this was not taken advantage of. It may now be uphill work to supplant Russian hemp in the English market but any improvement in the crop will redound to the benefit of the grower and for this reason alone is worth attempting. The Central Provinces is particularly interested in the betterment of the crop—both agriculturally and commercially, firstly because the Central Provinces grows a very large area of Sann and secondly because certain grades of Central Provinces hemp are well known in the market and fetch special premia over hems grown in most other parts of India.

In the agricultural year ending 31st May 1932 the total area of fibre crops in the Central Provinces and Berar was 95,138 acres. This is composed mainly of Sann (*Crotalaria juncea*). The only other fibre crop of any importance is *ambadi* (*Hibiscus cannabinus*) which is grown sometimes on the "bunds" of rice fields and mixed with tur (*Cajanus indicus*) to divide the plants in the cotton fields. *Ambadi* is grown entirely for domestic use and its area is not calculated so that the figure given above may be taken as wholly "sann".

Spasmodic attempts have been made by the Central Provinces Department of Agriculture in the past to improve the retting and presentation of samples of sann hemp for valuation and sale but much more intensive work is necessary if the fibre is to take the place it should as one of the exportable commodities of India. Unfortunately the Department cannot spare the special staff necessary to do this work more thoroughly and hence this appeal for funds from the Imperial Council of Agricultural Research.

The main complaints regarding Indian hemp in the London market are—(1) its dirty condition and (2) its lack of uniformity. Spinners in England have been compelled by law to instal special machinery to deal with dirty raw products and it is therefore understandable why sann hemp is not popular with the manufacturers. Italian and Russian hemp do not require special treatment and they have therefore a special advantage over "sann". The Seoni and Itarsi grades of Central Provinces sann hemp are much sought after by buyers because of their greater cleanliness.

Sann is usually retted in stagnant pools or tanks and the grower believes that the more mud that adheres to it, the more money he obtains for it. In Seoni and Betul districts, sann is retted in running water—usually in a stream or river—and no mud and dirt adhere to the fibre which accounts for the enhanced price for samples from these districts.

The first essential in dealing with sann hemp is to find out the best method of retting it and experiments will have to be carried out with this end in view. Some work has already been done. It is proposed to construct small pucca retting tanks and to study the optimum conditions for retting with special reference to the temperature of the water and its bacteriological content.

The department has a scutching machine which however has not been an unqualified success. Other machines—worked by hand and by small oil engines—need to be tried and provision is being made for them in the scheme.

There is great scope for work in the preparation of the fibre for the market. Experiments are necessary to find out the losses incidental to hackling, scutching and other methods of cleaning the fibre. This is one of the commercial aspects of the investigation.

On the agricultural side, the botany of the crop requires working up. Nothing has been done in the Central Provinces to isolate and test the component races which comprise the commercial crop. There is a virgin field ready for the worker.

In order to carry out the work briefly outlined above, I estimate the following grant will be necessary :—

	First year.	Second year.	Third year.	Fourth year.	Fifth year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. The Botanical Assistant on Rs. 70—70—75—80—85 .	840	840	800	960	1,020	4,560
2. Travelling allowance	300	300	300	300	300	1,500
3. Contingencies	800	800	800	800	800	4,000
4. Non-recurring expenditure for machinery and retting tanks.	10,000	..	..	..	..	10,000
Total	11,940	1,940	2,000	2,060	2,120	20,060

The Central Provinces Government will provide all the land and laboratory accommodation required for carrying out the research which will be carried out by the Agricultural Chemist.

APPENDIX XXXI

NOTE DATED THE 3RD FEBRUARY, 1934, BY SECRETARY, ON SUBJECT No. 37.—QUESTION OF DURATION OF APPOINTMENT OF MEMBERS OF SUB-COMMITTEES OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Rules 30 and 48 of the Rules and Regulations of the Imperial Council of Agricultural Research which are reproduced in the margin provide, for the appointment of sub-committees by the Governing Body and the Advisory Board of the Council for the purposes stated therein.

2. The sub-committees hitherto appointed by the Advisory Board under Rule 48 have been *ad hoc* committees appointed to examine particular schemes and have dissolved after finishing their work. The sub-committees appointed under Rule 30 are standing committees and the following 7 such committees have so far been appointed :—

- (1) Sugar Committee appointed in 1929.
- (2) Locust Committee appointed in 1930.
- (3) Indian Oil Crushing Industry Committee appointed in 1931.
- (4) Fertilisers Committee appointed in 1930.
- (5) Animal Nutrition Committee appointed in 1933.
- (6) Cattle Breeding Committee appointed in 1933.
- (7) Dairying Committee appointed in 1933.

It will be seen that some of these committees have been in existence for more than three years already and all of them are likely to continue for several years. The question has been raised whether the duration of appointment of members of these committees should be fixed. In this connection, Rule 5 (extract enclosed—Annexure) of the Rules and Regulations of the Imperial Council of Agricultural Research governs the duration of the appointment of members of the Council, but Rule 30 under which sub-committees are appointed by the Governing Body does not specifically fix the period of membership. The Governing Body is, however, empowered under that rule to appoint by Resolution sub-committees for such purposes and with such powers as the Governing Body may think proper.

3. The views of the Advisory Board are requested as to whether the period of membership of these sub-committees should be fixed and if so, whether this should be done by an amendment of the Rules and Regulations or whether the Governing Body should provide for this under the powers vested in it under Rule 30.

ANNEXURE.

DURATION OF APPOINTMENT.

5. (1) Where a member of the Society becomes a member by reason of the office or appointment he holds, his membership of the Society shall terminate when he ceases to hold that office or appointment.

(2) The members of the Society elected by the Council of State and the Legislative Assembly respectively shall cease to be members on the dissolution or expiration of the council or Assembly by which they were elected or on ceasing to be members of that Council or Assembly.

(3) Unless their membership of the Society is previously terminated as provided in Rule 5 (4) all other members of the Society shall relinquish their membership on the expiry of three years from the date on which they became members of the Society but shall be eligible for reappointment to it.

* Rule 30. The Governing Body may by Resolution appoint Sub-Committees for such purposes and with such powers as the Governing Body may think proper.

Rule 48. The Advisory Board may by Resolution appoint sub-committees of its members for the carrying out of the objects of the Advisory Board. Such sub-committees shall work under the direction of the Advisory Board.

(4) All members of the Society elected, appointed or nominated shall cease to be such members on the happening of any of the following events:—

If they shall die, resign, become of unsound mind, become insolvent or be convicted of a criminal offence involving moral turpitude.

(5) A resignation of membership shall be tendered to the Society in the person of its Secretary and shall not take effect until it has been accepted on behalf of the Society by the Chairman.

(6) Any vacancy in the membership of the Society caused by any of the reasons mentioned in Rule 5 (4) shall be filled up by election, appointment or nomination by the authority or association, as the case may be, entitled to make such election, appointment or nomination provided that the said authority or association shall not proceed to fill up the vacancy until moved to do so by the Secretary acting on behalf of the Society.

APPENDIX XXXII.

NOTE DATED THE 17TH JANUARY 1934, BY SECRETARY ON SUBJECT NO. 38, RELATION OF THE PROVINCIAL GOVERNMENTS AND THE PROVINCIAL AGRICULTURAL AND VETERINARY DEPARTMENTS TO SCHEMES FINANCED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH AND CONDUCTED IN THE PROVINCES.

Attention is invited to the attached letter from the Director of Agriculture, Bombay Presidency, No. 493-A., dated the 30th June 1933, and to the endorsement of the Government of Bombay thereon (Annexure) on the subject noted above.

The subject is for the consideration of the Advisory Board.

ANNEXURE.

COPY OF LETTER NO. 493-A., DATED THE 30TH JUNE 1933, FROM THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, POONA, TO THE SECRETARY IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA.

Schemes financed by the Imperial Council of Agricultural Research.

At the Fourth Meeting of the Bombay Provincial Agricultural Research Committee held in Poona on June 7, 1933, I put before the Committee for discussion the following subject :—

"The relation of the Provincial Government and the Provincial Agricultural Department to schemes financed by the Imperial Council of Agricultural Research and located in this Province but either (a) managed by personnel not belonging to any Bombay Government Department or (b) not under the control of the Director of Agriculture, Bombay Presidency, Poona."

The Committee considered this and decided that I should present a note to the next meeting of the Advisory Board in order that the situation might be clarified. The general opinion of the Committee was that there should be some relation between the local Director of Agriculture and all schemes within his territory. I believe a similar question arises in all Provinces.

2. In the Bombay Presidency there are two schemes financed by the Imperial Council of Agricultural Research which are not under the control of the Director of Agriculture, Bombay Presidency. These are :—

- (1) The Rice Physiological Scheme under Professor R. H. Dastur, Royal Institute of Science, Bombay, and
- (2) the Scheme for research on Milk products at Anand (Gujarat) under the Imperial Dairy Expert.

The Rice Physiological Scheme was sanctioned in 1931 and its conditions were accepted by Professor Dastur, who is the responsible Officer, with the Bombay Education Department as the controlling authority. The scheme itself came through the Provincial Agricultural Research Committee, Bombay Presidency.

The Anand Scheme was sanctioned last year, but has not yet started. I understand that the Imperial Dairy Expert is in charge and that he is under the control of the Director of the Agricultural Research Institute, Poona.

3. It is certain that other schemes from private individuals or from people not connected with Departments of Agriculture will be submitted from time to time and it is highly desirable that the Imperial Council should come to some clear understanding as to the relation between these schemes and the Director of Agriculture in whose territory they are located. There are various possibilities. For example, it might be decided that all schemes would be under the control of the Director of Agriculture. This would mean a good deal of additional work to the Director's office. The main worker in the scheme not being appointed by the Director of Agriculture, the Director would have very little power over him and there might be unnecessary friction. On the other hand it is undesirable that the schemes financed by the Imperial Council should be entirely isolated from the local Department of Agriculture. There must be some middle way. At present, individuals in charge of these schemes present their reports which are then criticised in the Advisory Board. I suggest that it would be

very useful to have a second opinion from the Director of Agriculture or an officer appointed by him who should be authorised to inspect the work of the schemes in question at least once and not more than twice a year and submit an independent report. In addition, friendly interchange of visits between the person in charge of these independent schemes and the officers of the Provincial Agricultural Department should be encouraged. I present the matter, therefore, for discussion.

COPY OF ENDORSEMENT No. 1156-A/28, DATED THE 7TH AUGUST 1933, FROM THE SECRETARY TO THE GOVERNMENT OF BOMBAY, REVENUE DEPARTMENT.

Forwarded to the Secretary, Imperial Council of Agricultural Research.

2. The Government of Bombay consider that if the Imperial Council see no objection, it is desirable that the provincial Director of Agriculture should be brought into closer relation with schemes financed by the Imperial Council and located in the province but not under the Director's control. It is suggested that perhaps the Director or any officer deputed by him might be authorised to inspect the work done under such a scheme and to submit an independent report on the result of such inspection to the Advisory Board.

APPENDIX XXXIII.

NOTE DATED THE 8TH FEBRUARY 1934, BY SECRETARY, ON SUBJECT No. 39, PROPOSED CONTRIBUTION BY INDIA OF A SUM OF Rs. 14,500 DURING THE PERIOD 1ST OCTOBER 1933 TO THE 31ST MARCH 1935 TOWARDS (i) THE MAINTENANCE OF THE LABORATORY FOR COLLECTING, BREEDING AND DESPATCHING BENEFICIAL PARASITES AT FARNHAM HOUSE, FARNHAM ROYAL, AND (ii) THE INVESTIGATION INTO THE CONTROL OF INSECTS AND MOULDS INJURIOUS TO STORED PRODUCTS AT SLOUGH.

The question of economic consultation and co-operation within the Empire was considered at the Imperial Economic Conference held at Ottawa in 1932 and after considering the constitution and functions of existing agencies operating in these fields the Conference made the following recommendation :—

“That a committee should be appointed forthwith, consisting of not more than two representatives of each of the participating Governments to consider the means of facilitating economic consultation and co-operation between the several Governments of the Commonwealth, including a survey of the functions, organisation and financial bases of the agencies specified in the annexed report (not printed) and an examination of what alterations or modifications, if any, in the existing machinery for such co-operation within the Commonwealth are desirable; and “that it shall be an instruction to the Committee to elect their own Chairman from among their members and to report to the several Governments represented thereon not later than the 31st May next, with a view to the consideration of their report by the several Governments not later than September 1933”. The Conference was given to understand by the representatives of the United Kingdom that, in order that the necessary time might be available for the preparation and consideration of the report of the Committee concerning the existing and future machinery for economic co-operation within the Commonwealth, the Government of the United Kingdom would continue to furnish any funds which may be required to finance essential work of the Empire Marketing Board until the end of September 1933.

2. The ‘Imperial Committee on Economic Consultation and Co-operation 1933’ was accordingly set up and it met in London early in the year. Relevant extracts from its report, dealing with the research activities of the Empire Marketing Board and also the Committee’s recommendations on the methods of carrying out future research activities which are of mutual interest to the Empire countries, are attached (Annexure I). These recommendations were generally accepted by the Government of India. It will be seen that in para. 358 (1) (c) of its report the Imperial Committee on Economic Consultation and Co-operation recommended that the Executive Council of the Imperial Agricultural Bureaux should be entrusted with the supervision of such research activities in the United Kingdom as the participating Governments may agree should be conducted on a co-operative basis in future. The Executive Council of the Imperial Agricultural Bureaux have recently examined the question of financial support for the research activities which had hitherto been assisted by the Board, with special reference to schemes other than those in regard to which “absolute commitments” of the character mentioned in paragraph 352 of the committee’s report (Annexure I) existed and which were receiving financial assistance from the Empire Marketing Fund in 1933. The Council’s intention was to classify such schemes into two classes, namely (i) those which should be recommended for the general support of all the Empire Governments and (ii) those which should be recommended for the support only of the Empire Governments interested. Sir B. N. Mitra, the High Commissioner for India in London, who is the representative of India on the Executive Council, was present at the meetings of the Council at which this question was examined.

3. The attached extracts (Annexure II) from the report of the Executive Council of the Bureau show that the Council considered fifteen schemes in all of which none was recommended for the support of all the Empire Governments but the two schemes noted below were recommended for wide co-operative support by most of the Empire Governments including India and in the case of one other scheme, the Low Temperature Research Station at East Malling, proposals for financial support are expected from a limited number of Empire countries excluding India. Details relating to the two schemes which concern India, viz., Farnham House Parasite Laboratory and the Slough investigations, will be found in Annexure II.

1. Laboratory for collecting, breeding and despatching beneficial parasites, at Farnham Royal.
2. Investigations at Slough into the control of insects and moulds injurious to stored products.

4. It will be observed that, according to the recommendation of the Executive Council of the Imperial Agricultural Bureaux, India is asked to contribute to the two schemes mentioned in the preceding paragraph a sum of £1,087-10-0 or Rs. 14,500 spread over a period of one and half years, i.e., from the 1st October 1933 upto the 31st March 1935. The question of further grants beyond the 31st March 1935 will be examined by the Imperial Agricultural Bureaux during 1934-35.

5. The High Commissioner for India, as the representative of India on the Executive Council of the Imperial Agricultural Bureaux, has strongly urged the desirability and the importance of India implementing her acceptance of the recommendation of the Imperial Committee on Economic Consultation and Co-operation, by agreeing to pay her share of the contributions mentioned above. The Vice-Chairman to the Imperial Council is in agreement with the High Commissioner and is of opinion that India should not stand out of an Empire co-operative effort of this character and that both the schemes in question will be of great value to India. The Farnham House Laboratory is considered to be of special importance at present in view of the recommendations of the Sugar Committee regarding the study of the insects parasites of cane and the cane borers. As regards the Slough investigations, a confidential report of the Advisory Committee on Infestation of Stored Products (appointed by the Empire Marketing Board) is circulated for perusal (Annexure III). It will be noted that in both cases the grants from countries of the Empire are to cover the minimum essential expenditure and are to be supplemented by a system of fees for all specific work done.

6. The proposal for the contribution of a sum not exceeding Rs. 14,500 towards (i) the maintenance of the Farnham House Laboratory for the breeding of beneficial parasites, and (ii) the cost of the Slough investigations into injurious insects, during the period 1st October 1933 to the 31st March 1935 is now accordingly for the consideration of the Advisory Board.

ANNEXURE I.

THE EMPIRE MARKETING BOARD.

(f) *The research expenditure of the Board.*

214. For accountancy purposes, the Board's expenditure on research falls into three categories. In the first are included grants administered by Government Departments in the United Kingdom. These are either grants made direct to United Kingdom Departments for extensions of their own work, or grants made to such departments as intermediaries between the Board and research institutes, the normal financial provision for which appears on their votes.

215. The second category consists of a relatively small number of grants either to research institutions not directly dependent on a United Kingdom Department, or in respect of *ad hoc* investigations which it was thought convenient should be administered through the agency of some United Kingdom Government Department.

216. The third category consists of grants made direct from the Empire Marketing Fund. These in most cases consist of grants made to Government Departments or institutions in the several Dominions, India, and the Colonial Empire.

217. One of the general principles followed by the Board in making grants for scientific research is that the proposed grant should be of interest to more than one Empire country and to as large a group of producers as possible. Over the wide range of subjects in respect of which grants have been made by the Board, it has naturally not been possible to apply this principle with equal rigidity in every case, and a number of important grants of a national, as opposed to Imperial, character have been made by the Board. Subject to the exception of grants of this character, the grants provided for research by the Board may in most cases be regarded as funds which would not have been available if the Board had not existed.

218. The Board maintains close contact in regard to its research work with the trades interested (e.g., the fruit trade, the wool trade, etc.) and with producers' boards (e.g., in the case of Australia and New Zealand). These appreciate the economic importance of the research work made possible by the Board's grants and in a number of cases they have themselves made suggestions for further research which have been adopted by the Board.

219. As explained in paragraph 203 above, the Board does not normally undertake research direct, but works through some existing research organisation. Where the Board has actually established what amounts to a new research institution, e.g., that in regard to stored products at Slough, it has arranged for some existing body (in this case the Imperial College of Science and Technology) to assume charge of the new station.

220. When grants have been made for research, the Board, while abstaining from interference with the technical conduct of the research, has taken all steps in its power to keep itself informed by means of written reports, personal visits and otherwise, of the progress of the investigations which it has assisted. A further check of value is provided by the fact that grants are only made for a limited period and are not renewed unless the institution is able to demonstrate to the Board the value of the work done and the need on economic grounds for further assistance.

221. At different times the Empire Marketing Board has provided small sums to enable leading scientific workers in the United Kingdom to visit the Dominions, or similar workers in the Dominions to visit the United Kingdom. These grants cover travelling expenses and subsistence, but not the salaries of the officials concerned. In a number of other cases the Board has paid the travelling expenses of marketing officers from the Dominions, who have thus been enabled to visit the United Kingdom, study at first hand the conditions under which the products of their Dominion are marketed, and on their return home, in conjunction with their trades, to effect important improvements in marketing methods which would not have been possible on the basis of information received without a personal visit.

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MEANS FOR FACILITATING ECONOMIC CONSULTATION AND CO-OPERATION BETWEEN THE SEVERAL GOVERNMENTS OF THE COMMONWEALTH.

B.—Methods of consultation and co-operation.

316. We have shown in our survey how in their several fields the existing inter-Imperial agencies are engaged on a co-operative basis in work of value in varying degrees to the several parts of the Commonwealth. For the most part, the continued existence of these bodies in some form is not in question and our suggestions for alterations and modifications have been directed more toward their organisation and financial basis than to the scope of their activities. There is, however, one important exception and that is the Empire Marketing Board. Here we have a body established in 1926 by His Majesty's Government in the United Kingdom, charged with the duty of promoting the sale of Empire produce within the United Kingdom. The sum placed at the disposal of this body was intended to represent the money equivalent of the advantages which would have been conferred on the Empire overseas by the preferential duties, proposed by the Imperial Economic Conference of 1923, which His Majesty's Government in the United Kingdom subsequently felt themselves precluded from granting.

317. The conditions that led to the establishment of the Board have passed away with the extension in the last eighteen months of the fiscal preferences granted by the United Kingdom to the other parts of the Empire. His Majesty's Government in the United Kingdom indicated at the Imperial Economic Conference held at Ottawa that though they would continue to furnish any funds that might be required to finance essential work of the Board up to the end of September next, they did so only in order that the necessary time might be available for the preparation and consideration of our report on the existing and future machinery for economic co-operation within the Commonwealth. We are, therefore, faced with the position that the Board in its present form is due to pass out of existence in six months' time and we are called upon to consider what method should be adopted to discharge such of the functions of the Board as the governments of the Commonwealth may decide, as a result of our recommendations, to continue on a co-operative basis.

318. The Empire Marketing Board, though from the financial point of view a purely United Kingdom organisation, has always set before itself the aim of acting not in the interests of any one single member of the Commonwealth, but in the interests of the Commonwealth as a whole. We are glad to pay a warm tribute to the vision that has inspired the Board in its activities, to the devotion with which it has sought to further the ideal of co-operation, and to the excellent work accomplished by Sir Stephen Tallents and the members of his staff and by the large number of voluntary

workers who have given long hours to the Board's service. In the seven years that have elapsed since its foundation, there has been a notable advance in inter-Imperial co-operation in the economic field and in regard to applied agricultural research. This has been due in considerable part to the Board. We refer in particular to the marked growth in recent years in the United Kingdom of sentiment in favour of Empire produce which we feel is largely the result of its work. Certain of its grants in aid of the research or economic services of one or other parts of the Empire were, however, not of a character which we anticipate would be made by an inter-Imperial body jointly financed and controlled by the several members of the Commonwealth. This does not mean that the services aided were not of Imperial significance but rather that in some cases their interest and value were in the main limited to a part of the Empire only. In making this comment we do not wish to detract from the value of the work of the Board, but merely to draw attention to a tendency that was natural, and, indeed, perfectly legitimate, having regard to the circumstances in which the Board was brought into existence. It is necessary for us to do this, as the point is of first-class importance in relation to the questions to be discussed later of organisation for future co-operative effort.

319. At the moment the question before us is what form inter-Imperial co-operation should take in the fields at present covered by the Board. The problem with which we are confronted is thus one both subtle and far-reaching. It is how best in existing conditions the peoples of the British Commonwealth can arrange by free association to work together in the pursuit of objects of common interest to them all. The value of co-operation in the field of scientific investigation and economic inquiry is admitted on all hands but the method by which such co-operation should be effected raises important questions on which there is room for some divergence of opinion.

* * * * *

C.—General Conclusions on Consultation and Co-operation.

339. There remains for us to consider the method by which co-operation should be effected in the field of scientific investigation. This might take several forms. Thus, two or more governments of the Empire might make *ad hoc* arrangements among themselves for the conduct, in any part of the Empire, of research schemes of mutual interest. On the other hand, specified research projects of wide Empire interest might be conducted on a general co-operative basis and financed from a common fund.

340. We have been impressed by the evidence that we have received regarding the importance of much of the research now being conducted with an inter-Imperial object. In the new circumstances which will arise on the termination of the support hitherto given by the Empire Marketing Fund, the continuance of such work must depend on the support of the various governments interested, and these governments we consider, should be advised by the responsible administrative heads of the research organisations as to what branches of scientific research are of a type which could advantageously be conducted co-operatively.

341. It has been suggested therefore that a conference, representative of the various parts of the Commonwealth and consisting partly of the responsible administrative and scientific heads of research organisations and departments in those countries and partly of such other persons as the several governments may select, should be summoned at an early date for the purpose of formulating a programme of such forms of research as it may be considered should be conducted on an inter-Imperial basis. We welcome this suggestion, and we hope that it will be possible for the several governments of the Empire to appoint representatives to attend the proposed conference. We realise, however, that in the case especially of Australia, New Zealand, and India there are practical difficulties in this suggestion. Its adoption would involve the absence from their several countries of the leading scientific authorities for a period of several months, and in countries such as Australia and New Zealand where the scientific staffs are necessarily limited in size, this presents a serious administrative problem. While, therefore, we hope that the proposed conference will be held at an early date, we feel some doubt as to whether it could take place in time to deal with the pressing problems arising from the fact that financial provision by His Majesty's Government in the United Kingdom for the continuance of the Empire Marketing Board expires at the end of September next. Since the difficulties to which we have referred may make it impossible for the conference to be arranged before that date we recommend that the Executive Council of the Imperial Agricultural Bureaux should be invited by the governments of the Empire to consider immediately the question of what research activities should, in its opinion, be conducted

on a co-operative basis and to prepare a report on this question for presentation to the conference suggested above. If it is not possible for this conference to meet within a brief period after the completion of its report, we recommend it should be presented direct to the governments of the Empire.

342. As the result of the recommendations of the proposed conference or of the Executive Council of the Imperial Agricultural Bureaux, we assume that the governments of the Empire will agree that there are certain research activities of general interest which can most effectively and most economically be conducted on a co-operative basis in the United Kingdom or other parts of the Commonwealth, their cost being met by subscriptions from such governments as may decide to participate. As regards such schemes as the governments may consider could best be carried out in the United Kingdom, we feel that it would be of advantage if there were some inter-Imperial organisation that could receive the subscriptions from the governments concerned and exercise some general supervision of the work on behalf of those governments. We do not consider that it is necessary to establish a new body for this purpose, but we are of opinion that this duty should be entrusted to the Executive Council of the Bureaux.

343. In respect to the initiation of additional proposals for co-operative research in the future, we recognise that the proposed conference would be the appropriate body to put forward such proposals, but in view of the difficulties of holding such conferences frequently, we recommend that it should be within the competence of the Executive Council of the Imperial Agricultural Bureaux to submit proposals to governments on this matter. The advantages of this system are that it provides full opportunities for each government to consider participation, complete freedom to decide whether to participate or not, and every opportunity to review the work done and the results secured.

344. Turning to economic as opposed to scientific questions, our view is that consultation and co-operation between the several governments of the Empire could be best effected by the continuance of the Imperial Economic Committee which should, however, in future be financed, as well as constituted, inter-Imperially. Subject to what we say in paragraphs 346 and 347 below, we do not think that any extension of the terms of reference of that committee as defined by the Imperial Conference of 1930 is required.

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350. As regards such scientific research as it may later be decided should be undertaken in the interests of the Commonwealth or of a number of its parts, we do not feel that it is possible to suggest any scale of contribution until the amount to be expended on such research has been determined. We therefore recommend that the basis of contribution towards the cost of agreed scientific research projects should be fixed by the governments of the Empire at the time when, in the light of the report either of the proposed conference or of the Executive Council of the Imperial Agricultural Bureaux, they decide what research services should in future be so conducted.

351. Before we pass from the consideration of scientific research, there are two matters on which we think it convenient to give our view. In the first place, as regards such research as the governments may agree should be undertaken co-operatively and which is now being financed by the Empire Marketing Board, we recommend that they should agree that such contributions as they may decide to make should commence on 1st October 1933, the day after the expiry of the present financial provision for the Empire Marketing Board. We hope that it may be possible for this to apply both to such schemes as it may be agreed before 30th September next should be so continued, and also to those on which agreement may be reached in the period immediately following that date. As regards schemes for which at the end of September next there appear reasonable grounds for hoping that agreement will be secured for their continuance on a co-operative basis, we have received with great satisfaction an assurance by His Majesty's Government in the United Kingdom that they will be prepared to continue such services for a brief period to enable such discussions to be brought to a conclusion.

352. There is one other matter in relation to the research grants of the Empire Marketing Board to which we desire to refer, namely the position which will arise after September next in regard to the absolute commitments entered into by the Board. We understand that His Majesty's Government in the United Kingdom, who

take full responsibility for these particular commitments, will take the initiative in approaching each of the governments of the Commonwealth in regard to grants to institutions in their countries.

* * * * *

SUMMARY OF PRINCIPAL RECOMMENDATIONS.

358. We summarise our principal recommendations as follows :—

(a) Scientific information services and research activities.

(1) We recommend that the Executive Council of the Imperial Agricultural Bureaux should be entrusted with the supervision of :—

- (a) the administration and financial control of the eight Imperial Agricultural Bureaux ;
- (b) the administration and finances of the Imperial Institute of Entomology, and the Imperial Mycological Institute ;

(NOTE.—We recommend that, should it be so desired, there should be constituted also in respect of each of these Institutes a scientific advisory committee to assist the Director on scientific, as opposed to administrative and financial, questions.)

- (c) such research activities in the United Kingdom as the participating governments may agree should in future be conducted on a co-operative basis.

(2) We recommend that the question of what research activities should in future be carried out co-operatively should be considered at a conference to be summoned as early as possible, consisting partly of the administrative and scientific heads of national research organisations and departments, and partly of such other persons as the several governments may select. We recognise, however, that there are difficulties in the way of the meeting of such a conference in the immediate future and we accordingly recommend that the Executive Council of the Imperial Agricultural Bureaux should be invited by the governments of the Commonwealth to consider immediately the question of the research activities which should, in its opinion, be conducted on a co-operative basis and to prepare a report for presentation to the conference referred to above. If it is not possible for that conference to meet within a brief period of the completion of its report, we recommend that it should be presented direct to the governments of the Empire.

(3) We recognise that conferences of the type proposed would be the appropriate body to initiate additional proposals for co-operative action in regard to scientific research, but owing to the difficulties of holding such conferences frequently, we recommend that it should be within the competence of the Executive Council of the Imperial Agricultural Bureaux from time to time to submit proposals on this matter.

ANNEXURE II.

Introduction.

Under paragraphs 341, 342 and 358 (a) (2) of the report of the Imperial Committee on Economic Consultation and Co-operation, the duty has devolved on Council to consider which research schemes hitherto receiving financial support from the Empire Marketing Fund "should, in its opinion, be conducted on a co-operative basis" by governments of the British Commonwealth.

2. Time and circumstances have, as was feared, prevented the immediate assembly of a science conference constituted as laid down in paragraph 341 of that report. Under the same paragraph it therefore falls on Council to submit its conclusions direct to governments for their consideration. His Majesty's Government in Canada had

hoped that this science conference might assemble in the spring of 1934, but in the circumstances which have arisen has acquiesced in the present procedure.

3. In reaching the conclusions set out below certain members made it clear that they were concerned in presenting to their governments detailed information of particular schemes for consideration with, in selected cases, such proposals for finance as after discussion in Council secured consent. The decision as to whether a scheme justifies the financial support of a particular government, and to what extent, rests with that government.

III. Main Points.

7. Of the nine schemes considered in details :

- (i) No scheme is put forward by Council for financial support by all parts of the Empire.
- (ii) Two schemes—*viz.*, Farnham House and Slough are put forward by Council for wide financial support (paragraphs 9—21).
- (iii) In regard to one scheme of special interest to certain countries, *viz.*, Low Temperature Research, the representatives of the countries interested are submitting to their own governments proposals for financial support. These proposals are reported (paragraphs 22—24).
- (iv) In regard to two institutions, *viz.*, the Forest Products Research Laboratory at Princes Risborough and the Imperial College of Tropical Agriculture at Trinidad, financial arrangements are envisaged which should ensure the continuance of the service those institutions have hitherto been rendering the Empire countries (paragraphs 25—28).
- (v) Early intimation is sought in regard to one scheme—the Grassland Officer—as to whether facilities which might be made available by His Majesty's Government in the United Kingdom would in fact be used (paragraphs 29-30).
- (vi) The bearing of two, *viz.*, Biological Control of insect pests in the West Indies and Low Temperature Research at Trinidad, on the other schemes put forward by Council is explained (paragraph 31).
- (vii) One case—Wool research is deferred for further examination (paragraph 32).

Budgetary Provision.

8. All estimates in this report and also contributions where those are suggested are given on an annual basis. In paragraph 351 of its report the Imperial Committee on Economic Consultation and Co-operation recommended that financial liability for schemes co-operatively supported should date from the 1st October 1933. Therefore, in all cases in which contributions may be made, provision sufficient to cover eighteen months' costs would have to be made in the estimates for 1934-35, or special grants provided by the governments concerned in 1933-34 to meet the expenditure for six months of that year. To obviate this necessity which might prove a difficulty to overseas governments, the representative of His Majesty's Government in the United Kingdom made a statement which Council is glad to be able to place before governments.

So far as concerns the amount of the liability of overseas governments which will fall to be discharged in the course of the financial year 1934-35 in respect of the Farnham Royal, Slough and Low Temperature schemes, it is understood that the representative of His Majesty's Government in the United Kingdom will recommend to his Government to concur in an arrangement under which contributions from overseas governments during the year 1934-35 will be based on a period of twelve months as from 1st October 1933. In other words, the annual contributions of governments overseas will be some months in arrear, and will be paid over as soon as possible in the next financial year.

IV. Schemes proposed by Council for wide financial support.

9. The two schemes which come under this heading are :—

Scheme.	Location.	Institute to which attached.	Recent Annual Grant from the Empire Marketing Fund.
			£
1. Laboratory for collecting, breeding and despatching beneficial parasites.	Farnham House, Farnham Royal.	Imperial Institute of Entomology.	5,500
2. Investigations into the control of insects injurious to stored products.	Slough, Bucks	Imperial College of Science and Technology.	4,000

(For the sake of brevity these will be referred to hereafter as Farnham House and Slough respectively).

In addition to these grants the Empire Marketing Board has also spent on capital account sums of the order of £15,000 on Farnham House and of £11,000 on Slough, and at one period, the grant to Farnham House reached £7,000 a year.

10. A statement of the reasons which have influenced Council in putting these schemes forward for wide co-operative support, together with budget estimates in each case, is given in Appendix B. Proposals in regard to finance in each case are dealt with in the following paragraphs.

Farnham House.

11. The reasons for recommending wide co-operative support are very briefly :—

- (i) Farnham House is the only centre for knowledge, information and training in the Empire in a specialised branch of entomological work to which entomologists in many parts of the Empire are giving increasing attention.
- (ii) Farnham House is equipped for, has done and is able to do specific work in the collection, breeding and despatch of beneficial parasites or in securing them when required by entomological departments and should be able to do that work more cheaply than if undertaken directly.
- (iii) Calls on the services of Farnham House have been made in the past and are forecasted for next year from several widely separated parts of the Empire.

Finance.

12. Council has examined the estimates in detail. It considers that £5,035 a year will be required to ensure the retention of a competent organisation and staff.

13. Council considers it desirable to work towards a system whereby adequate fees are charged for work done. Such a system cannot, however, come into operation for some time. When Farnham House was first started the Empire Marketing Fund met all costs. Later, charges were made for specific services but the charges did not fully cover even out-of-pocket expenses. In the sums charged nothing was included for the times of the regular staff nor for overhead expenses. A sudden change to a basis relying solely on fees would lead to practical difficulties. For one thing the service which Farnham House can render does not yet appear to be fully realised by entomological departments in all Empire countries. For another, departments which intend to use Farnham House will wish to know the scale of charges. For a third, the working of any system of fees must be tested by experience. It is obviously

impossible in the short time available to solve all those points. Yet unless some certainty of income is definitely assured the trained scientific staff will not be there when demands for their services are received.

14. After full consideration of all relevant facts and benefits received or likely to be received, Council proposes for the consideration of governments that £5,035 a year be provided for Farnham House for a period of eighteen months by the following contributions :—

	£
From the United Kingdom	700
„ Canada	950
„ Australia	800
„ New Zealand	750
„ South Africa	750
„ India	600
„ Southern Rhodesia	110
„ the Colonial Empire	375
	5,035

15. A system of fees for all specific work done on request should be introduced with effect from 1st April 1934. Council proposes to institute charges for all work involving more than two days of the time of any of the regular scientific and technical staff who are provided for in the above estimate. The charges made will cover (a) all travelling and subsistence allowances; (b) all other out of pocket expenses specifically incurred by the Institution in doing such work; (c) half the salaries of the regular assistants for the time they are engaged on that work; and (d) a small charge towards overheads. The latter will be 5 per cent. on the total of (b) and (c).

16. If the arrangement referred to in the second sub-paragraph of paragraph 8 is approved by His Majesty's Government in the United Kingdom and the proposal in paragraph 14 is accepted by the governments concerned, provision in their Budgets for 1934-35 of sums totalling £5,035 in all will retain the services of Farnham House till March 1935, and the governments concerned will be able to decide in the light of experience gained during the ensuing year whether any, and if so, what provision should be made on account of future expenditure of the Institution in future Budgets.

Slough.

17. The reasons which have influenced Council to put forward this scheme for wide co-operative support are very briefly as follows :—

- (i) At no other research institute in the Empire—and some independent witnesses have said at none other in the world—is such systematic and comprehensive work being done on the whole range of problems associated with the attacks of insects on stored products.
- (ii) Improvements in methods of preventing or checking insect infestation of stored products are of direct economic importance to numerous interests in all parts of the Empire.
- (iii) The work has reached the stage of practical application, as will be seen from the instances given in Appendix B; but to obtain results of general application the research work must be continued.

18. The research work is concerned with the insects and fungi which affect stored products, the study of methods of fumigation, the penetrating power of fumigant gases, the concentration of gases in small spaces, and the risks of fire attendant on fumigation.

These are all questions of direct practical importance to many diverse interests, producers, port authorities, health authorities, manufacturers, etc.

Financial Proposals.

19. The proposals Council puts forward relate solely to the research work, the whole cost of which has hitherto been met from the Empire Marketing Fund. In

the early days that Fund also bore the whole cost of practical applications of the results attained from this research. Later, charges were made for such *ad hoc* pieces of work, but, most frequently, at rates barely sufficient to cover out of pocket expenses. Council considers that, in future adequate fees should be charged for all such *ad hoc* work sufficient to cover all out of pocket expenses and to meet in so far as may prove practicable the cost of the essential research work.

20. The intention to introduce such a system of fees clearly affords no security for the immediate continuance of the research. The present position is critical. The cost is estimated at £4,000 a year. The Council understands that the continuance of this research work would be assured if the governments of the Empire were prepared to provide funds at the rate of £2,000 a year, for the period October 1933 to March 1935. In the estimates for 1934-35 sums totalling only £2,000 need be provided under the proposals set out in paragraph 8. Council suggests provision for a period of eighteen months for only half the estimated cost because it is given to understand that a private benefaction will supply the other half. The position will have to be reviewed before the end of the calendar year 1934.

21. After full consideration of the wide applicability of this work and the varying methods and articles of trade in the Empire, Council suggests for consideration that the £2,000 from the governments towards the research work calculating as always on an annual basis, be provided in the following manner. Instead of making a specific contribution, Council understands that the Government of Canada prefers to guarantee work to the Laboratory which on a system of fees will provide at least £150 a year. This leaves £1,850 a year to be provided which, on the consideration given, Council suggests might be distributed thus :—

United Kingdom	£
Australia	500
New Zealand	125
South Africa	225
India	125
Southern Rhodesia	250
Colonial Empire	275
	<hr/>
	1,850

Conclusions.

33. (i) There is no scheme which the representatives of all governments are prepared to recommend to their governments for financial support [paragraph 7 (i)].

(ii) Two schemes—Farnham House and Slough—are put forward by Council for wide co-operative support.

(iii) The contributions for these two schemes are suggested for a period of eighteen months from 1st October 1933, at the following rates per annum :—

	Farnham House (para. 14).	Slough (para. 21).
	£	£
United Kingdom	700	350
Canada	950	150*
Australia	800	500
New Zealand	750	125
South Africa	750	225
India	600	125
Southern Rhodesia	110	250
Colonial Empire	375	275
	<hr/>	<hr/>
	5,035	2,000

*The Canadian contribution takes the form of a guarantee of work which will provide at least £150 a year.

(iv) In regard to one scheme of special interest to certain countries—Low Temperature research—the representatives of those countries are submitting to their governments proposals for financial support as follows:—

	£
Australia	4,500
New Zealand	3,000
South Africa	1,700
Southern Rhodesia	500
Colonial Empire	100
	9,800

Although the grant from the Empire Marketing Fund to this work was £30,000 a year, the work will be continued without curtailing those aspects in which overseas Dominions are particularly interested on the understanding that approximately £10,000 a year is provided by overseas governments (paragraph 24).

(v) No other contributions are suggested, though it is proposed that with effect from 1st April 1934 adequate fees be charged in future in a number of cases.

(vi) The figures given above are on an annual basis. Under paragraph 351 of the report of the Imperial Committee on Economic Consultation and Co-operation financial liability is contemplated from 1st October 1933. His Majesty's Government in the United Kingdom will, it is understood, be recommended to concur in an arrangement whereby contributions from overseas governments will be some months in arrear, obviating thereby the necessity of making either provision for eighteen months in the estimates of 1934-35, or special grants in 1933-34 to meet the expenditure for the six months of that year (paragraph 8).

(vii) All cases in which contributions are proposed will have to be reviewed before the end of the financial year 1934-35.

(viii) Early intimation is requested of any decision to utilize the services of the grass land officer Mr. W. Davies during 1934-35 (paragraph 30).

(ix) The assistance rendered by the representative of His Majesty's Government in the United Kingdom is acknowledged in particular in regard to the financial arrangement proposed in paragraph 8 of the report, in regard to the preservation of the Imperial aspect of the work at Aberystwyth, East Malling and Long Ashton and also in regard to the proposals made affecting Low Temperature Research.

NOTES ON AND BUDGET ESTIMATE OF (I) FARNHAM HOUSE; (II) SLOUGH.

1. Farnham House.

Farnham House Laboratory was started in 1927 by the Imperial Institute of Entomology, by means of a grant from the Empire Marketing Board, in order that entomologists in the various parts of the Empire might have at their disposal a properly equipped central station, staffed by scientists specially trained in methods of biological control of insect pests and noxious weeds; that is, in the methods of controlling by means of beneficial parasites and predators the insect pests which damage agricultural crops and forest growth.

2. The purpose of the laboratory is to study these beneficial parasites, and to do all in its power to supply them when demands are received from entomologists for the supply of parasites to combat a particular pest. This last involves a knowledge of the parasite, the localities in which it can be found, its collection at the suitable seasons, possibly its multiplication under laboratory conditions, and finally its despatch in conditions permitting its release in its new country.

3. Progress at first was inevitably slow, but Farnham House and the service it can render is getting known among entomologists in the Empire. Up to September 1933, over 300 shipments had been made involving approximately two million beneficial parasites. All these were sent in answer to specific requests. The number of requests from different parts of the Empire has naturally varied, but the parts from which no requests have so far come are very few—certain of the colonies.

4. In addition to this specific work, Farnham House is rapidly becoming recognised as the centre in the Empire for this specialised branch of knowledge, and for training in this work. Two of its trained men are at work in the Colonies; an Australian entomologist is now at work at Farnham House, and a request has been received to train an Indian entomologist.

5. The operative head of the Station is Dr. W. R. Thompson, F.R.S., a Canadian who has obtained experience in this class of work whilst with the United States Department of Entomology. Sir Guy Marshall, head of the Imperial Institute of Entomology exercises general supervision.

6. Farnham House has in the last few years received requests for beneficial parasites on pests attacking cereals, forage crops, deciduous fruits, vegetables, forest trees, shade trees, tropical crops, and for parasites on pests troubling domestic animals and man. In search of these parasites it has had to send its assistants to many parts of the United Kingdom, to France, to Czechoslovakia, to Hungary.

7. The reason for suggesting Farnham House for co-operative support are as follows:—

Entomologists in all parts of the Empire are continuously engaged in finding means to control insect pests. Meanwhile, improvements in world communications are constantly increasing the risk of introduction into countries of new pests or of the introduction of insects which in their new environment become pests.

In certain cases chemical, mechanical and cultural methods of control prove impracticable, being either too costly or ineffective. Striking results have, in certain cases, been obtained by searching for, finding and introducing parasites which prey upon the insect which has become or threatens to become an economic pest.

This search for beneficial parasites, their collection and despatch form a specialised branch of entomological work and its economical conduct demands a specialised technique.

Council has received evidence that entomologists in many parts of the Empire are giving increasing attention to the possibilities of biological control of insect pests.

Farnham House is the only Institute in the Empire specialising in the biological control of insect pests. It has now developed its technique. Beneficial parasites are usually to be found in localities in which the pests occur but are comparatively harmless. The attention of entomologists, however, is inevitably directed rather to the local pests of crops and trees than to the local parasites which keep possibly pests in check. It follows that when beneficial parasites are needed special search for them has usually to be made in other—and not infrequently distant—localities. Presumably economy ought often to be secured by using an organisation specially trained for that purpose.

As the centre for knowledge, information and training in this work, Farnham House is of service to all parts of the Empire.

In the past Farnham House has rendered and, if continued, can render special and direct service to official entomologists in several Empire countries, by, on request searching for, collecting and despatching beneficial parasites for which those entomologists are seeking.

Owing to its geographical location Farnham House can perform such specific services on a larger scale for those portions of the Empire situated in the temperate zones than for those in the tropics, but by its specialised connections and knowledge it has shown that it can also serve tropical countries.

8. The cost of Farnham House has hitherto been borne exclusively by the Empire-Marketing Fund. The estimated cost is:—

<i>Salaries—</i>	£	£
(i) <i>Directional Staff—</i>		
Sir Guy Marshall	190	
Dr. W. R. Thompson, F.R.S.	1,143	1,333
(ii) <i>Office Establishment—</i>		
Secretary, accountant, librarian	285	
3 laboratory boys, carpenter, gardener, cleaner, <i>plus</i> insurance	636	921

	£	£
(iii) <i>Trained Assistants</i> —		
3 Scientific and 1 trained technically	1,505	1,505
Provident Fund contributions . . . . .	..	210
<i>Maintenance Charges</i> —		
Rates, fuel, insurances, painting, repairs, petrol, gas plant, etc.	494	} 1,036
Printing	119	
Postage and stationery	75	
Books	60	
Garden tools, seeds, casual lab, labour	84	
Travelling	50	
Laboratory maintenance, chemicals, refrigerators, stores	193	
Total . . . . .	..	5,035

II. Slough.

9. This laboratory is attached to and under the general supervision of the Imperial College of Science and Technology. It was established in 1927 by Empire Marketing Fund grants, and except for receipts from charges for *ad hoc* pieces of work done, these grants form its sole support.

There are two aspects of the work, *viz.*, research and the tests of its practical application. The research staff includes entomologists, chemists and physicists. As is described in the body of the report the research work is directed not only to the reaction of insects to certain fumigants, but also to the behaviour and control of fumigants. The practical applications are carried out in warehouses, etc., under ordinary practical conditions. It is for these practical applications that Council considers full charges should be made in future.

10. Business interests are undoubtedly beginning to take notice of the work done by this laboratory. For instance, in the last four years the receipts for particular pieces of work have risen from £233 to £2,375. Instances of these particular pieces of work are as follows:—

Work on:	At the instance of:
Pests attacking stored cocoa	Gold Coast, Nigeria and the West Indies.
„ „ copra	New Zealand, Malaya, the Gold Coast.
„ „ dried fruits	Australia.
„ „ tobacco	Southern Rhodesia, Australia, The Imperial Tobacco Co.
„ „ nutmegs	Grenada.
„ „ kola nuts	Sierra Leone.
Mould damage on dairy produce	New Zealand.
The use of ethylene oxide as a fumigant.	Cyprus.
A standard method for fumigating products stored in small quantities.	Trinidad.
The physiology of mould fungi on timbers.	Forest Products Laboratory, Princes Risborough, U. K.
The fumigation of rags	Woollen Research Association, U. K.
The fumigation of second-hand clothing and blankets.	Crown Agents for the Colonies.
The resistance of insects to chemical fumigants.	Imperial Chemical Industries.
The deratisation of ships by fumigants	Ministry of Health U. K.

These instances also illustrate the wide practical applicability of this research work.

11. The work is under the immediate control of Professor J. W. Munro, who occupies the Chair of Entomology at the Imperial College of Science and Technology. He receives an honorarium for his service.

12. The work will collapse unless provision is made to continue the essential research work. The annual cost of this research work is estimated as follows:—

<i>Staff.</i>	£	£
(i) <i>Directional</i> —		
(Professor Munro)	150	150
(ii) <i>Scientific Staff</i> —		
2 Chemists, 2 Entomologists, 2 assistants	1,935	} 2,083
Provident fund	148	
(iii) <i>Non-technical Staff</i> —		
Clerk (1), 3 Laboratory boys, cleaning, insurance	531	531
(iv) <i>Maintenance Charges</i> —		
Rates, taxes	137	} 1,234
Gas, light, heat, electric current	350	
Repairs and maintenance	107	
Stationery, postage and administration	110	
Laboratory apparatus and stores	480	
Travelling	50	
Total		3,998

ANNEXURE III.

Empire Marketing Board.

REPORT OF THE ADVISORY COMMITTEE ON INFESTATION OF STORED PRODUCTS.

1. The Advisory Committee on Infestation of Stored Products was set up in 1927 to assist in developing investigations into the infestation of stored products by insects and fungi and to advise on research work designed to solve some of the problems presented by that infestation. As long ago as 1920 a special Committee of the Royal Society, which considered the pests of grain, recommended in its tenth and final report that the study of the infestation of grain by insects should be continued and extended to include other products. The Imperial College of Science and Technology took up this suggestion and some preliminary work had already been done on a small scale by Professor J. W. Munro. This work showed the desirability of extending the investigations and basing them on a systematic study of the pests concerned. With the aid of a grant from the Empire Marketing Fund, a country house near Slough was bought and fitted up as a Field Biological Station, and Professor Munro was enabled to begin an examination of certain products warehoused in the Port of London. The Advisory Committee was appointed by the Empire Marketing Board to advise on the research thus inaugurated. The Biological Field Station at Slough has been supported by further grants from the Empire Marketing Fund up to the dissolution of the Empire Marketing Board.

2. The first main problem undertaken was a study of the insects infesting cocoa in store. This involved a thorough examination of the conditions under which cocoa was warehoused and of the goods which were stored near enough to it to be possible sources of insect infestation. Further work at the docks involved examinations of dried fruits—particularly Australian sultanas—copra, tobacco, certain nuts and spices. After this work had been going on for about a year, it was found that the chief pest

of stored cocoa—the moth *Ephestia Elutella*—had begun to infest tobacco and, at the request of the Southern Rhodesian Government, an investigation was started into the problem thus presented.

3. Two points emerged from these early studies, viz.,—

- (a) that the existing knowledge of the pests detected was insufficient to allow of adequate control measures being devised, and
- (b) that it became more and more desirable to have information as to the conditions affecting the infested goods during transport and in their countries of origin.

4. The work of the Biological Field Station thus fell under three main headings:—

- (a) a continuous research into the ecology and physiology of the principal insect pests infesting stored products;
- (b) continuous research on the physical and chemical problems underlying the sterilisation of infested produce by heat, and by cold and by fumigant gas;
- (c) a number of special surveys of particular products, with a view to finding immediate measures for checking damage by insects and mould fungi.

5. The whole of the work on special problems depends, ultimately, on the continued progress of the fundamental research programme. It is only through a knowledge of the life cycles and the peculiarities of the insects concerned, that it is possible to devise effective means of controlling them. This knowledge has, in the past, been fragmentary and uncertain and has not been sufficient to give a reliable lead towards practical measures of improvement, as was shown at an early stage of the investigations into the infestation of cocoa and tobacco by *Ephestia*. It was necessary, at one stage, for the whole systematic arrangement of this species to be revised and gaps still exist in the knowledge of its life history and habits. The investigations set on foot at the Biological Field Station thus represent a new departure in applied entomology. If the fundamental knowledge which is now being sought at the Field Station and in the warehouses had been available in the past, it is likely that vast losses arising from insect infestation might have been avoided.

6. The work of the Field Station falls into three branches of science—entomological, mycological and physico-chemical. The basic problems calling for study in this field, as in all biological research, are concerned with the reactions of living organisms to their environment,—in this case particularly to changes in temperature and humidity—and to causes inhibiting or deterring biological processes. This fundamental research work is essential to the practical services which the Biological Field Station is designed to render and, unless arrangements can be made for the continuation of this research programme, the utility of the Station in investigating special and urgent problems and in suggesting methods of control, will rapidly be diminished to vanishing point.

7. On the entomological side the work has been concerned with the insects infesting cocoa, dried fruit and tobacco in the first place. Other investigations have dealt with the insect pests of nutmegs, kola nuts, copra, with the furniture mite and with the general question of insect respiration.

Copra, cocoa, kola nuts and upholstery fibres subject to the attack of the furniture mite have also been the subjects of mycological investigations.

8. The physical and chemical side of the work includes a study of the methods of fumigation, the penetrating power of fumigant gases, the concentration of gases in small spaces and the risks of fire attendant on fumigation.

In this field of work the Station has made notable progress by devising apparatus and methods whereby for the first time in history of fumigation the behaviour and effects of the gases used can be accurately determined.

9. Up to the present, the chief Empire countries which have asked for the help of the Biological Field Station in special pieces of work are:—the Gold Coast, Nigeria and the West Indies (cocoa); Malaya, the Gold Coast and New Zealand (copra); Australia (dried fruits and tobacco); Southern Rhodesia (tobacco); Grenada (nutmegs) and Sierra Leone (kola nuts).

The work is, however, of general importance to all Dominions and Colonies, particularly in view of the fact that the Slough Station is the only one of its kind in the world performing this special function. Apart from the need throughout the

Empire of improved methods of sterilising foodstuffs and other produce, special problems have arisen in some of the Dominions (notably in South Africa, Australia and Southern Rhodesia) and the Slough Laboratory has been called upon to help in dealing with these problems. The Australian Dried Fruit Board have now entrusted the whole work of fumigating their produce to the Laboratory and propose to increase their contribution for the coming year. Certain South African organisations interested in problems affecting fruit and tobacco have obtained information from time to time, but, so far, *ad hoc* problems calling for special investigation have not been sent from South Africa. The Southern Rhodesian Government has, for some few years past, contributed, together with the Imperial Tobacco Company, towards an investigation of tobacco pests and these contributions are assured for the next two years. The Australian tobacco industry is also contributing to this investigation. New Zealand has requested help in research on mould damage to dairy produce and also on the infestation of copra. Both Nigeria and the Gold Coast, which have been co-operating in the study of problems affecting cocoa, have recently asked for help in dealing with the *Ephestia* moth and moulds, the importance of which in the country of origin was first realised as the result of work at Slough. Through the Trade Commissioner of Cyprus an investigation of ethylene oxide as a fumigant for potatoes infested by tuber moth was carried out on behalf of the Cyprus Government and yielded practical results of the highest importance. The Director of Agriculture in Trinidad has asked for assistance in devising a standard method of fumigating stored products in small quantities. The West Indies are also interested in research work on cocoa, copra and tobacco. Other Colonies have consulted the Station on various problems.

10. The unique service rendered by the Slough Station is thus of interest and importance to all countries in the Empire. Although specific problems have not yet been put forward by Canada or India, it seems clear that the work is likely to be of value to both those countries. The point that most needs underlining is that special *ad hoc* investigations, which seem likely to become more numerous as the Station becomes more widely known, depend for their solution on the carrying out of a continuous programme of fundamental research.

11. It has for some time been evident that the services of the Laboratory have the highest practical value, not only for imported products, but in various branches of home production and in public health. The Ministry of Agriculture is interested in the methods whereby potential insect pests may be excluded from entry into the United Kingdom. The Ministry of Health is concerned with the effects which measures of sterilisation or protection from attack by insects may have on the deterioration or adulteration of foodstuffs. The same Department is interested in the bed bug problem and its relationship to slum clearance and also in methods for the destruction of rats in ships as a safeguard against the spread of plague. The work is of interest to the Department of Scientific and Industrial Research, as an element in food preservation and also on account of the studies on the infestation of timber, which have been carried out in conjunction with the Forest Products Research Laboratory. At present this Department contributes £450 a year to the Station for research on the physiology of the mould fungi.

12. As regards Cocoa, the Biological Field Station has co-operated with the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades Laboratory, and with the Cocoa Associations of London and Liverpool. It is of interest to note that these last two Associations are now combining with the Confectioners Alliance to carry out researches of their own, bearing on the infestation of cocoa. The Station has also co-operated with the Woollen Industries Research Association in connection with the fumigation of rags and with the Crown Agents for the Colonies in connection with the fumigation of secondhand clothing and blankets exported to certain Colonies and with the design and construction of fumigant plant for agricultural produce.

13. Mention has already been made of the assistance both practical and financial given by the Imperial Tobacco Company and Imperial Chemical Industries. It should be emphasised, however, that, with the exception of these two contributions, the support given by industry is definitely intended for *ad hoc* investigations and not for the carrying out of the general research programme. This programme is quite different from the special studies which are undertaken to deal with urgent individual problems and, although it is of the highest value—and is indeed the essential foundation of the whole work—it is evident that the stage has not yet been reached at which industry can be convinced of this. The questions with which it deals seem, at first sight, to be remote from the immediate interests of industry and commerce. When merchants and others are bitterly complaining of insect infested fruit and threatening

to break their contracts for this reason, it is difficult to persuade the selling firm to provide funds for the study of the partial vapour pressure of fumigant gases or of the causes of infertility in certain insects. Nevertheless, the apparently academic studies of the behaviour of gases and of the habits of insects and their varying fertility under different conditions have led to a better understanding of the problems of infestation and—to quote the single example of the work on Australian dried fruit—to a great improvement in practical treatment.

14. To sum up, the Committee is strongly of the opinion that, unless the fundamental research programme can be adequately provided for, the *ad hoc* work will, in a short time, become virtually impossible and must soon come to an end, when the power of the Station to be of service to Governments and firms in Empire countries would be exhausted. They consider that the services available at the Biological Field Station are such as cannot be obtained from any other institution in the Empire or outside it; and that it is to the interests of all countries in the Empire to support the existing organisations for the conduct of the fundamental research on which the practical services of the Biological Field Station must be based. They consequently regard it as of the highest importance that the nucleus of staff, organisation and equipment should be kept in being and that the Station should be assured of support over a sufficient period of years, not less than five in the first instance.

15. The present position of the Biological Field Station as regards Finance may be summarised as follows. The grant received from the Marketing Board during the past six months was reduced from £4,000 to £3,000 per annum. This entailed the reduction of the mycological work, which is much regretted. Payments from outside sources for *ad hoc* research continue to increase and the following record shows that steady progress is being made in interesting industry in the work of the Field Station. The amounts received from industry for such work during the past four years are as follows:—

	£
1929 to 1930	233
1930 to 1931	734
1931 to 1932	781
1932 to 1933	1,711
1933 to 1934	2,375 (promised).

While these records are encouraging they cannot replace grants formerly made by the Empire Marketing Board and the main difficulty in continuing the research work will be to obtain funds for general research work. This matter is giving serious concern to the College Authorities.

It is estimated that the bare minimum which will be needed to keep the nucleus organisation in being and to continue the fundamental research programmes is £3,000 per annum. A fuller financial statement from the Imperial College of Science and Technology is appended.

16. The Committee accordingly recommend—

- (1) that every effort be made to provide proper financial support for the fundamental research work of the Biological Field Station, and
- (2) that the Empire Marketing Board should bring this recommendation, together with this Report of the Committee, to the notice of the Executive Council of Imperial Agricultural Bureaux and of the British Departments interested.

E. M. H. LLOYD,

Chairman of the Committee.

September, 1933.

FINANCIAL STATEMENT FROM THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

The following statement shows the cost of upkeep and maintenance of the Biological Field Station at Slough and in particular the relationship between the grants hitherto received from the Empire Marketing Board and those received for *ad hoc* purposes.

The original grant from the Empire Marketing Board over a five year period was a sum of £3,500 per annum rising to £4,500. The maximum of £4,500 was never reached but was approached in 1930-31 when a total grant of £4,420 was received from the Board. In the following year the grant was reduced to £3,650 and in 1932-33 was reduced to £3,000. Because of the reduction in 1932 the mycological work had to be abandoned and, except for certain researches financed by the Department of Scientific and Industrial Research on the physiology of moulds, this mycological work has ceased. The sum of £3,000 was completely used up in maintaining the chemical and entomological sections of the Laboratory.

The following statement of accounts for the year 1931-32 shows the general nature of the expenditure:—

Expenditure.

	£	s.	d.
To excess of Expenditure over Income brought forward from last account	87	7	0
* To Salaries and Superannuation Contributions	3,949	12	7
To Wages and National Insurance	375	17	11
To Travelling Expenses, Laboratory Materials, Stationery, Glassware, etc.	596	17	9
To Rates and Taxes	103	17	6
To Lighting, Heating, Water and Power	317	4	8
To Maintenance of Buildings	114	4	2
To Administrative Expenses	90	0	0
Total	5,619	14	7

*This covers the expenditure on the following staff:—2 Research Entomologists, 2 Field Entomologists, 2 Chemists, 2 Mycologists and 2 Research Assistants.

Income.

	£	s.	d.	£	s.	d.
By Cash per Empire Marketing Board				3,300	0	0
By Grants—						
Australian Dried Fruits Board	580	10	6			
High Wycombe and District Furniture Manufacturers Federation	280	13	8			
High Commissioner for Southern Rhodesia.	201	0	0			
Imperial Tobacco Company	197	12	0			
Imperial Chemical Industries	300	0	0			
Trade Commissioner for Cyprus	50	0	0			
Societe des Crins, Averseng, Brussels	25	0	0			
Messrs. Weber, Smith and Hoare, Ltd.	6	5	0			
				1,641	1	2
By Excess of Expenditure over Income to date				678	13	5
Total				5,619	14	7

From the above statement it will be seen that the net cost of the Station to the College, when special grants for *ad hoc* research are subtracted, is approximately £4,000 per annum. It is estimated that if the mycological section of the Laboratory is closed and other work is somewhat restricted it should be possible to maintain the general research for approximately £3,000 per annum but to go below this would seriously endanger the work of the Station as a whole. In these estimates the salary of the Director of the Station, Professor Munro, is not included as it is borne on other votes of the College.

As has been pointed out in the Committee's report the *ad hoc* grants hitherto received do no more than cover the actual expenditure on salaries, wages and materials required by the work itself and in some cases, as in the work for the Australian Dried Fruits Board, the sum does not cover the whole of these services rendered. Thus the grant of £580 from the Australian Dried Fruits Board covered the salaries of two entomological research assistants and their travelling expenses but the services of the two chemical assistants who are engaged half-time on the work had to be provided at the expense of the general research programme. In this particular case the action was justified only because the Australian dried fruit problem afforded facilities for special work on the physics of fumigation which could not have been done otherwise.

It is evident that if the Station is to be in a position in future to carry out a large volume of *ad hoc* research work, often at short notice, it will be necessary to keep a small permanent staff for such purposes, in addition to the nucleus staff employed mainly on general research. Charges for *ad hoc* research must therefore in future include an overhead charge so as to enable the financial position to be sound even if demands for such work fall off temporarily.

H. T. TIZARD,
Rector,
Imperial College.

The 18th October 1933.

APPENDIX XXXIV.

NOTE, DATED THE 9TH FEBRUARY, 1934, BY SECRETARY, ON SUBJECT NO. 3.—RECOMMENDATIONS OF THE LOCUST COMMITTEE AT ITS FIFTH MEETING HELD IN JANUARY 1934. PROPOSALS FOR CONTINUANCE AND FURTHER PROGRAMME OF WORK.

In February 1933 the Advisory Board approved of the recommendations of the fourth meeting of the Locust Committee for the extension of research work on Locusts for one year from the 1st April 1933 and the lines on which that work should be carried on [page 2, para. 6 of the printed proceedings of the meeting of the Advisory Board held on the 16th February 1933 (not printed)]. Briefly, the recommendations were that Locust Research work should be carried on at Pasni and other places under the Imperial Council of Agricultural Research under the charge of Rao Sahib Y. Ramachandra Rao as Locust Research Entomologist with headquarters at Karachi, and that the work at Lyallpur should be confined to the study of the biology and bionomics of the locust for which a suitable grant should be made to the Punjab Government in the usual way, the work to be done by Mr. Afzal Husain. These recommendations have been given effect to and work has been carried on accordingly during the year 1933-34.

2. The present sanction for the scheme expires on the 31st March 1934. The Locust Committee met on the 15th and 16th January 1934 to review the work done, during the year, under the Locust Research Entomologist, Karachi, the Assistant Locust Research Entomologist (Pasni) and Mr. Afzal Husain (Lyallpur) and to consider the future of the two schemes. Attention is invited to the reports of the work done by the Locust Research Entomologist, Assistant Locust Research Entomologist and Mr. Afzal Husain and other papers circulated to the Committee (Annexures II-IV--not printed).

3. From the proceedings of the fifth meeting of the Locust Committee (Annexure I--not printed) it will be seen that the Committee recommends the continuance of the Locust Research Scheme for another year with effect from the 1st April 1934 and has made the following recommendations on the more important points of detail:—

(1) The present system of extensive survey of the Baluchistan and Sind-Rajputana potential breeding grounds should be continued during the year 1934-35 and in addition intensive survey work should also be carried out in a small area: the area for intensive work to be selected by the Vice-Chairman, in consultation with the Locust Research Entomologist.

(2) Work at Pasni should be continued with the two additional observation posts sanctioned last year, viz., at Gwadar and Turbat.

(3) The work on the biology and the bionomics of the locust carried out at Lyallpur under Mr. Afzal Husain should be continued during the year 1934-35 at a cost not exceeding Rs. 5,660. It is expected that the work will be completed during 1934-35.

(4) The following additional staff should be engaged:—

(a) Two fieldmen and two messengers for the Survey Party.

(b) Two fieldmen for the intensive survey work referred to above.

5. In view of the fact that a desert laboratory for Locust research work at Pasni is likely to be required for at least three years from now, better accommodation than the present mat huts is necessary for the laboratory and staff. The Committee recommends that the following simple buildings should be constructed at *Sadirek* (about 2.3 miles from Pasni Town). Pucca building for the locust research laboratory and mud building and out-houses for the residential accommodation of the staff and inferior servants respectively in the vicinity of the laboratory at an estimated cost of Rs. 6,000 in all.

(6) The Locust Research staff should be given increments as proposed in para. 9 of the proceedings of the meeting of the Committee held on the 16th January 1934 (not printed).

4. The total cost of continuing the schemes during 1934-35 as recommended by the Committee is estimated at Rs. 83,606, i.e., Rs. 77,946 for the scheme under the Locust Research Entomologist *vide* the statement (Annexure I) appended to the proceedings of the meeting of the Committee held on the 16th January 1934 (not printed) and Rs. 5,660 for the work on the biology and bionomics of the locust to be carried out at Lyallpur.

5. From Enclosure IV to the note circulated to the Locust Committee on subject No. 1 [Annexure No. 11 (a)] it will be seen that the total cost of the Locust Research Scheme up to the end of the year 1933-34 will come to about Rs. 2,87,380. At its meeting held in November last the Governing Body approved of an expenditure of Rs. 63,000 to meet the cost of the scheme if it is extended in 1934-35. As stated in the preceding para. the cost of extending the scheme during 1934-35 comes to Rs. 83,606 or Rs. 83,600 (round). If the Committee's recommendations are approved by the Advisory Board sanction of the Governing Body will be obtained to the higher figure (Rs. 83,600) by circulation.

6. The recommendations of the Committee are now for the consideration of the Advisory Board.

(ANNEXURE I.)

Budget estimates of the office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1934-35.

LOCUST RESEARCH SCHEME.

	Rs. a. p.	Rs.
A.—HEADQUARTERS—		
1. Pay of officer (Locust Research Entomologist) at Rs. 1,000 p. m. . . . .	..	12,000
Karachi Local Allowance to L. R. E., at Rs. 70 p. m. . . . .	..	840
2. Pay of Establishment :—		
1 Locust Research Assistant at Rs. 160 p. m.	1,920 0 0	
1 Head Clerk at Rs. 115-3 p. m. up to 8th June and Rs. 124-13 from 9th June 1934	1,464 0 0	
1 Second clerk at Rs. 52 p. m.	624 0 0	
1 Typist at Rs. 37 p. m.	444 0 0	
2 Compiling Assistants at Rs. 67* p. m. each	1,608 0 0	(*Karachi Local allowance has been provided separately.)
2 Fieldmen at Rs. 31 p. m. each	504 0 0	
1 Lorry Allowance to Fieldman at Rs. 10 p. m.	120 0 0	
2 Peons at Rs. 18 p. m. each	432 0 0	
Karachi Local Allowance to Superior Establishment . . . . .	..	7116
.. . . .	..	762
3. Travelling Allowance of Officer . . . . .	..	2,500
4. Travelling Allowance of Establishment . . . . .	..	1,600
5. Leave and Pension Contributions :—		
(a) Officers . . . . .	..	2,760
(b) Establishment . . . . .	..	535
6. Contingencies, Supplies and Services . . . . .	..	4,500
Total . . . . .	..	22,613

B.—SURVEY PARTIES—

1. Pay of Establishment:—

	Rs.	a.	p.	Rs.
1 Locust Research Assistant at Rs. 336 p. m. up to 7th June and Rs. 350 p. m. from 8th June 1934	4,134	0	0	
1 Locust Research Assistant at Rs. 160 p. m.	1,920	0	0	
4 Fieldmen at Rs. 31 p. m. each	1,488	0	0	
2 Fieldmen at Rs. 30 p. m. each	720	0	0	
6 Messengers at Rs. 12 p. m. each	864	0	0	
2 Peons at Rs. 15 p. m. each	360	0	0	
				9,506
2. Travelling allowance of establishment . . . . .	..			4,500
3. Leave and Pension Contributions for one Locust Research Assistant . . . . .	..			775
4. Contingencies, Supplies and Services . . . . .	..			3,000
Total . . . . .	..			17,781

C.—PASNI—

1. Pay of establishment:—

I.—Pasni.

	Rs.	a.	p.	Rs.
1 Assistant Locust Research Entomologist at Rs. 370 per mensem	4,440	0	0	
1 Locust Research Assistant at Rs. 160 p. m. plus Rs. 75 per mensem	2,820	0	0	
1 Clerk at Rs. 52 p. m.	624	0	0	
4 Fieldmen at Rs. 41 p. m. each	1,968	0	0	
2 Fieldmen at Rs. 21 p. m. each	504	0	0	
3 Messengers at Rs. 12 p. m. each	432	0	0	
2 Peons at Rs. 18 p. m. each	432	0	0	
1 Water Carrier at Rs. 10 p. m.	120	0	0	
				11,340

II.—Ambagh.

1 Locust Research Assistant at Rs. 125 p. m.	1,500	0	0	
1 Fieldman at Rs. 41 p. m.	492	0	0	
1 Fieldman at Rs. 30 p. m.	360	0	0	
1 Messenger at Rs. 12 p. m.	144	0	0	
1 Peon at Rs. 18 p. m.	216	0	0	
				2,712
2. Travelling allowance of establishment . . . . .	..			4,000
3. Contingencies, Supplies and Services . . . . .	..			3,500
4. Construction of a Laboratory and Quarters at Pasni . . . . .	..			6,000
Total . . . . .	..			27,552

Summary.

	Rs.
A.—Headquarters	32,613
B.—Survey Parties	17,781
C.—Pasni, etc.	27,552
Grand Total	<u>77,946</u>

 ENCLOSURE IV TO ANNEXURE II (d).
Cost of the Locust Research Scheme.

	Rs. a. p.
1930-31 (actuals)	19,065 4 7
1931-32 (actuals)	98,467 14 7
1932-33 (actuals)	97,324 15 3
1933-34 (probable)	72,522 0 0
Total	<u>2,87,380 2 5</u>

APPENDIX XXXV.

REPORT OF THE FRUIT RESEARCH COMMITTEE HELD ON 21ST FEBRUARY 1934.

Present—

Dewan Bahadur Sir T. Vijayaraghavacharya (Chairman).
 Rao Bahadur D. Ananda Rao.
 Mr. R. G. Allan.
 Dr. W. Burns.
 Mr. B. C. Burt.
 Mr. P. H. Carpenter.
 Dr. P. S. Hudson.
 Mr. S. K. Mitra.
 Mr. A. M. Mustafa.
 Dr. S. S. Nehru.
 Mr. Nizamuddin Hyder.
 Mr. J. H. Ritchie.
 Mr. C. V. Sane.
 Mr. H. R. Stewart.
 Mr. G. T. Tait.

Subject 34 (i).—Paluchistan fruit canning scheme.—Appendix XXXV-A. The Committee have considered the revised scheme submitted in accordance with the recommendations made by last meeting of the Advisory Board and, after consideration of details, recommend the scheme for sanction.

Subject 34 (ii).—Application from the Government of the Central Provinces for a grant for a scheme for research on the orange crop of the Central Provinces.—XXXV-B. The Committee consider that the scheme will be of benefit to a number of provinces and that the Central Provinces is the most suitable centre for work on the "Santra" type of orange. With reference to the programme of work, they recommend that due attention should be paid to the work which has already been done in India on citrus fruits notably on the effect of different root stocks, on the die-back disease and on certain pests. It is considered that the grading and packing experiments should be carried out in consultation with the Expert Adviser in Marketing to be appointed by the Imperial Council of Agricultural Research. This suggestion was accepted by the Director of Agriculture who explained that this item did not affect the cost of the scheme as he hoped that the Central Provinces Marketing Branch of the Agricultural Department would be restored at an early date. The Committee consider that the proposed experiments on fruit and fruit products preservation should be omitted from this scheme.

While this scheme will be essentially for work on the loose-skinned type of orange, it is suggested that a small amount of work on the tight-skinned Malta type should also be carried out to ascertain the effect of environment on the different varieties which will be worked with in the Punjab scheme. This was accepted by the Director of Agriculture.

The Committee recommend the scheme for sanction for a period of five years.

Subject 34 (iv).—Application from the Government of the Punjab for a grant of Rs. 57,430 for a scheme of research work on citrus stocks and grape vines in the Punjab. (Appendix XXXV-D.)

This scheme is mainly complimentary to the Central Provinces scheme of research work on the "Santra" type of orange as it will deal mainly with the Malta type although other citrus fruits will be included. The Committee suggest that the various "Santra" type which are being worked within the Central Provinces should also be grown in the Punjab to ascertain the effect of environment on quality and yield. The Committee consider that special attention should be paid to the question of flavour and quality both from the varietal and environmental aspects.

The Committee suggest, both in regard to this scheme and the Central Provinces research scheme on "Santra" oranges that as soon as financial sanction has been

communicated, a full technical programme of work should be submitted for consideration and discussion. This was accepted by the Directors of Agriculture concerned.

Subject 34 (III).—Application from the Government of His Exalted Highness the Nizam for a grant of Rs. 74,300 for a fruit research scheme. (Appendix XXXV-C.)

The Committee are of opinion that, in view of the work in progress at Poona and the schemes sanctioned for Madras and Bihar for work on mangoes and recommended for work at Nagpur and Lyallpur on citrus fruits, it is not necessary to finance another research scheme for work on these fruits in Hyderabad. It is suggested that the scheme should be withdrawn and a scheme of work for research on those fruits for which Hyderabad is specially suitable and which are not already covered by research schemes might be put forward. As tentative suggestions for consideration, the following fruits were mentioned :—

The custard apple, grapes, the papaya. The Committee did not consider Hyderabad a suitable centre for research work on dates. The Director of Agriculture, Hyderabad, agreed to re-examine the scheme in the light of these suggestions.

Subject 34 (V).—Application from the Government of the Punjab for a grant of Rs. 35,052 for San Jose Scale survey in the Punjab. (Appendix XXXV-E.)

The Director of Agriculture, Punjab, explained to the Committee that wherever the Punjab Department had located this pest in fruit-growing areas, they had started demonstrations on the control measures and these had been successful. As the Committee were aware, the Kashmir State had introduced quarantine regulations since the last meeting of the Advisory Board in the hope of bringing the pest under control in their fruit growing areas. It was essential to ascertain definitely how far the pest had spread; it was known to have been found as low as Kalka but it was not known whether it had reached the plains.

The Committee agree that this survey is essential and urgent and they recommend that the scheme be sanctioned for a period of two years and that every effort should be made to complete the survey within that period. With regard to the programme of work (paragraph 9 of the scheme) they realise that items (c) and (d) could not be completed within a two year period nor for the matter of that could such work be completed in three year period. During the period of the scheme, the necessary preliminary information can be obtained as to whether this line of research is worth following up. The Committee recommend that this scheme should be given priority in view of the importance of preventing the spread of this pest to other provinces and the recommendations which the Council has already made to local governments regarding quarantine arrangements.

CHARAN DAS,
Secretary.

NEW DELHI,
The 22nd February 1934.

APPENDIX XXXV-A.

NOTE, DATED THE 22ND JANUARY 1934, BY SECRETARY, ON SUBJECT No. 34 (i).—APPLICATION FROM THE BALUCHISTAN ADMINISTRATION FOR A GRANT OF RS. 49,600 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME FOR ESTABLISHING A "CANNING AND FRUIT PRESERVING RESEARCH LABORATORY" AT THE FRUIT EXPERIMENT STATION, QUETTA.

Attention is invited to the attached letter from the Baluchistan Administration No. 42/R. C., dated the 8th January 1934 (Annexure) forwarding the scheme mentioned above. It will be remembered in this connection that a scheme on the same subject was submitted by the Baluchistan Administration in February 1933 (*vide* paragraph 15 of the proceedings of the meeting of the Advisory Board, held in that month, page 18 and Appendix XXII, pages 193-199) which was referred to the committee of the Council which had examined other fruit growing schemes. The committee which met at the time of the meeting of the Advisory Board held in August 1933 considered that the Agricultural Officer, Baluchistan, should be invited to draw up a new scheme for experimental work involving only a small-scale plant but including adequate provision for a properly qualified whole-time Research Assistant. After discussion the report of the committee was adopted by the Advisory Board.

2. The present scheme involves a total expenditure of Rs. 49,600 (Rs. 12,500 initial expenses and Rs. 37,100 recurring) spread over a period of five years as compared to Rs. 67,000 (non-recurring Rs. 22,000 and Rs. 45,000 recurring) for the original scheme.

If and when the scheme is approved by the Council the Local Administration will consider the possibility of contributing Rs. 4,000 towards building required to house the experimental plant. In that event the grant required from the Council would be Rs. 45,600 only spread over a period of five years. All receipts from the sale of canned fruits and vegetables, which are estimated at Rs. 3,000 per annum would also be credited to the Council.

3. The Vice-Chairman to the Council considers that it will be an advantage to have the revised scheme examined in the first instance by the Committee which examined the original scheme and which consisted of the following gentlemen:—

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Directors of Agriculture, Madras, Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad, and Baroda.
4. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
5. The Chief Publicity Officer, Indian State Railways.
6. The Agricultural Officer, Baluchistan.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The Committee will meet at 2-45 P.M. on Wednesday, the 21st February 1934 in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

ANNEXURE.

COPY OF A LETTER No. 42/R. C., DATED THE 8TH JANUARY 1934, FROM THE SECRETARY TO THE HON'BLE THE AGENT TO THE GOVERNOR-GENERAL IN BALUCHISTAN, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

SUBJECT.—Scheme for establishing "Canning and Fruit Preserving Research Laboratory" at the Fruit Experiment Station, Quetta.

I am directed to refer to the correspondence ending with your letter No. F. 221/33-A. G., dated the 17th October 1933 and to forward for favourable consideration and the allotment of funds proposals for establishing a "Fruit Canning and Preserving Research Laboratory" at the Fruit Experiment Station, Quetta. These proposals have been revised by Mr. A. M. Mustafa, Agricultural Officer in Baluchistan in the light of your letter referred to above.

2. The Hon'ble the Agent to the Governor-General is of opinion that important commercial results would be likely to follow on the successful establishment of fruit canning enterprises in Baluchistan and the laboratory now proposed is a necessary preliminary to their establishment.

3. If and when the scheme is approved by the Imperial Council of Agricultural Research the local Government will consider the possibility of contributing Rs. 4,000 towards buildings required to house the experimental plant.

SCHEME FOR ESTABLISHING A "FRUIT CANNING AND PRESERVING RESEARCH LABORATORY" AT THE FRUIT EXPERIMENT STATION AT QUETTA.

Introduction.

In British India there is perhaps no place so eminently suited for the production of better quality and bigger sized peaches, plums, pears, apricots, apples, grapes, quinces, cherries, figs, strawberries and many kinds of bush fruits such as gooseberries, blackberries, raspberries, etc., as are in some parts of this province. Apricots grow almost wild in many places. The fame of Baluchistan fruit has spread far and wide. One of the best known nectarines exported from here some years ago, known as "Quetta Nectarine" and renowned for its quality, flavour and precocity is now extensively grown in California and is very much appreciated. Quetta fruits are the best for eating fresh and the most suitable of all the Indian fruits for preservation.

2. During the past ten years there has been a steady increase of the area under fruit cultivation in various parts of the province and it has increased from 2,536 acres in 1920 to 4,573 acres in 1930-31. This area is indeed extremely small as compared with the size of the province. There are, however, thousands of acres of land in the Pishin Sub-Division and in the Zhob Valley and other parts of the province, which are commanded by perennial supply of water (by Karezes) and which can easily be brought under fruit cultivation provided:—

A.—There is an intensive propaganda in this direction.

B.—There is a provision for a sure and steady market at home.

3. It is in connection with the last item that this scheme is being submitted. The provision for a sure and steady market at home above all other things will go a long way to help to bring a greater area under fruit cultivation, thereby bringing increased prosperity to the people and additional revenue to Government. This requirement can best be met, though to a limited extent, by establishing in the first instance a small but fairly well equipped Fruit Canning and Preserving Research Laboratory at the Fruit Experiment Station at Quetta on the lines of Campden Research Station, Gloucestershire, England. It is essential that work of this nature should, to begin with, be undertaken under Government auspices because if it be started by private enterprise and if by any chance it fails for lack of proper research on the subject, it will be the death-knell of this industry for many many years to come.

4. There are numerous Government gardens in this province where efforts will be made to produce the very best fruits possible. Considerable areas of land have been suggested to be laid out under fruit cultivation by the Irrigation Department. A certain amount of fruit from these gardens will be sold fresh while the surplus will be canned at the Laboratory. A fairly large quantity of fruit will be bought also for canning purposes. It is necessary that research work should be done to find out which of our local varieties of fruits are most suitable for canning and what time they require in the different stages of processing. In the meantime canning varieties of fruits which have established themselves in the canning centres of California and which are known for their quality and firmness of flesh and for which there is a potential world market are now being imported. It is hoped that once the growers know that there is a demand for them, they will be extensively propagated and grown. If the researches in canning are successful as there is every hope that they will, private enterprise will not be lacking and within the next few years Baluchistan may yet see the dawn of a new industry which will open a new era of hope and prosperity for its people. The canning factories once established will tend to bring a greater area under fruit as the growers will then have a sure market at home and this in its turn will see the rise of more canning factories. Incidentally as the canners will require fruit of specific standard and possibly of particular varieties, it will encourage the production of better quality fruit.

5. In England during the past few years the canning industry has made such great strides that today no less than 50 factories are working in small areas of Newham, Gloucestershire and Kent, and a few more factories are being opened this year.

6. The United States of America consumed about 700,000 tons of tin plates in 1913 but today that production is doubled (1,400,000 tons). That is a measure indicating the enormous increase of world business brought about by the distribution of foods packed in tin-plate containers. According to the U. S. A. Government census for 1927 there was a production of canned foods alone worth over £200,000,000 (1,000,000,000 Dollars).

7. Today in our Empire (excluding the United Kingdom and the Dominions of Canada, Australia, New Zealand and South Africa) only 20,000 tons of tin-plates are consumed per annum apart from the quantity used in the distribution of Koresine.

8. That part of our Empire contains 380,000,000 people and an unparalleled variety of products.

9. There are extensive areas in the United States maintaining prosperous agricultural communities owing to large, regular consumption of products by canning factories that sell their products in markets spread over the whole world. Without the canning industry these prosperous districts could never have attained their prosperity and could not sustain it.

10. There are factories in the United States employing many thousands of people because their products are sold in tins in shops and bazars in every corner of the globe. These products are entering in increasing quantities and are being consumed more and more by the population of India, Africa and the East and other parts of the Empire.

11. Many of these products and particularly those mentioned above are and can be successfully grown in Baluchistan to a certain extent and there is no reason why they should not be canned and possibly marketed more advantageously.

12. The first essential for starting canning factories is to overcome the basic obstacle as to supplies of cans. Thanks to the Empire Canning Council, cans of varying standard marketing sizes in flattened forms in nests can now be delivered to Empire points at a cost as low as that which would have to be charged by a local can-making factory. The flattened bodies can be reformed by an Automatic Reforming Machine which also flanges them ready for use. With the invention of this machine canners can obtain supplies of cans of exactly the same quantity, design and reliability as the large canners of England and America and at competitive prices. If and when one or more large factories have established themselves and have reached a scale of production running to millions of cans, it will then obviously lead to the local erection of a can-making factory.

13. The Agricultural Department, Baluchistan, with its limited staff of an Agricultural Officer and two Assistants, and with a total budget of not exceeding Rs. 27,000 annually, is not in a position to start work of this nature, however essential and important it may be.

14. The scheme for establishing a "Fruit Canning and Preserving Research Laboratory" is submitted to the Imperial Council of Agricultural Research for favour of consideration and allotment of necessary funds. The details of expenditure and the equipment required are attached herewith, along with a sketch showing the suggested lay-out of the plant. It is requested that the scheme may kindly be sanctioned for a period of five years in the first instance.

15. The following fruits and vegetables will be canned :—

Peaches, plums, greengages, aluchas, apricots, cherries, nectarines, pears, peas and tomatoes.

16. The chief problems that are proposed to investigate will be as under :—

(a) Fruit variety trials.

Exhaustive experiments will be undertaken to determine which of our fruits and what varieties of them are best for canning purposes.

(b) Pea variety trials.

(c) Lacquer Tests—Fruit.

Work on the protective action of various types of lacquers will be undertaken.

(d) Lacquer Tests—Vegetables.

Certain type of sulphur-resisting lacquers to prevent blackening of cans will be tested.

(e) Chemical spoilage tests.

Experiments on the time and temperature of the exhaust, the action of oxygen, acidity and the natural colouring matters, the effect of tin-plate and lacquer will be undertaken to determine the relative importance of the various factors on subsequent production of hydrogen swells and perforations.

(f) Syrup Densities.

Extensive tests on a large number of fruits will be done to ascertain the relation between the final cut-out densities and the original solid and liquid contents of the cans

(g) Fruit Syrups and Juices.

Experiments for making syrups and juices from such fruits as grapes and pomegranates will be carried out.

17. Any income made from the sale of canned fruits and vegetables will be credited to the Imperial Council of Agricultural Research. It is, however, very difficult to say at this stage as to what will be our income without any previous experience. Apart from it a considerable number of these cans will be utilized in the laboratory for cut-out experiments. Further, I do not consider it advisable to place our canned fruits and vegetables on the market for the first two years until we have gained experience and are sure of their keeping quality. In view of all this, income of about Rs. 3,000 or possibly a little more may be expected. Attempt will, however, be made to make as much income as possible.

(Sd.) A. M. MUSTAFA,
Agricultural Officer in Baluchistan.

EQUIPMENTS.

INITIAL EXPENSES—

1. One Semi-automatic Reforming machine (for flattened cans) £30 about Rs. 490
From :—The Metal Box Company of India, Ltd., P. O.
Box No. 2123, CALCUTTA.
 2. One Semi-automatic Closing machine £30 about Rs. 490
From :—The Metal Box Company of India Ltd., P. O.
Box No. 2123, CALCUTTA.
 3. One Boiler—Capacity 500 lb. to 750 lb. of water to evaporate per hour Rs. 1,500
 4. (a) One aluminium syrup mixing tank complete with coil—Capacity 50 gallons }
 (b) One aluminium syrup storage tank Capacity 50 gallons }
 (c) One automatic syruper }
 (d) One galvanised iron Exhaust tank, 3' 9" long, 2' 6" wide, 1' 6" deep } Inside measurement.
 (e) " " " " Cooking }
 (f) " " " " Cooling } £130 about Rs. 1,620
 (g) 36 wire baskets, 13 inches square and 4 inches deep with long wire handles }
- From :—G. C. Engineering Co.,
24 Railway Approach, LONDON
BRIDGE, S. E.

5. (a) Two Druggist Box Balance which weigh upto 1100 grammes	} about Rs. 500	
(b) A few brix hydrometers graduated 0 to 20, 20 to 40 and 40 to 60 degrees		
(c) A few 200 C. C. measuring cylinders for holding syrup		
(d) A few thermometers		
(e) A few bowls and jars		
6. Electric Switch gear, wiring, Electric Motors fixing up of steam pipes etc. etc.		Rs. 1,500
7. 5000 Flattened cans inclusive of tops and bottoms C. I. F. Karachi		about Rs. 400
8. Transporting charges on canning out-fit and custom duty		Rs. 1,000
9. Contingencies—		
Fitting up of laboratory and any other miscellaneous expenses		Rs. 1,000
10. A factory measuring 50' × 25' with an 8' Veranda on the south side of it, laid out with water to house the Experimental plant		Rs. 4,000
NOTE.—The estimate of the building is prepared by the Public Works Department.		
Total Initial Expenses		<u>Rs. 12,500</u>

RECURRING EXPENSES—

1. Staff—	Rs.
(a) One Research Assistant on Rs. 250—25—350	3,600
(b) One Laboratory Assistant on Rs. 50—5—70	720
2. Temporary Staff for five months during the fruiting season about 4 Laboratory Workers at Rs. 20 p.m. each and one Mechanic on Rs. 40 p.m., for five months	60 0
Total	<u>4,920</u>
3. Contingencies—	
Purchase of sugar, fruit, cans, chemicals, coal, consumption of electricity, overhaul of machinery and any other sundry and miscellaneous expenses	2,500
Total Annual Recurring Expenses	<u>7,420</u>
Total Recurring Expenses for five years	<u>37,100</u>

Total Expenses for five years :—

1. Initial Expenses	12,500
2. Recurring Expenses	<u>37,100</u>
Grand Total	<u>49,600</u>

APPENDIX XXIV-B.

NOTE, DATED THE 22ND JANUARY 1934, BY SECRETARY ON SUBJECT No. 34. (ii).—APPLICATION FROM THE GOVERNMENT OF THE CENTRAL PROVINCES FOR A GRANT FOR A SCHEME FOR RESEARCH ON THE ORANGE CROP OF THE CENTRAL PROVINCES.

Attention is invited to the attached letter (Annexure I) from the Government of the Central Provinces No. 48-1052-XIV, dated the 8th January 1934, and enclosures on the subject mentioned above. The scheme involves an expenditure of Rs. 71,160 spread over a period of five years. This does not however take into account the cost of machinery, etc., required for experiments on fruit and fruit preservation in which connection it is stated that a supplementary grant will be necessary if this receives the sanction of the Imperial Council of Agricultural Research. It is stated that a scheme of this nature will require to be financed for a longer period than the usual five years; and it has accordingly been proposed that a sum of Rs. 78,480 should be provided for the second period of five years. On this basis the scheme will involve, in so far as the Council is concerned, an expenditure of Rs. 1,49,640 spread over a period of ten years. The Central Provinces Government will provide the necessary land (15-20 acres), laboratory accommodation, all the stocks on hand, material for building and all the "Santra" plants required to start the work.

2. The Vice-Chairman to the Council considers that this scheme may appropriately be examined in the first instance by the Committee which examined other fruit research schemes and which consisted of the following gentlemen :—

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Directors of Agriculture, Madras, Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad and Baroda.
4. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
5. The Chief Publicity Officer, Indian State Railways.
6. The Agricultural Officer, Baluchistan.

3. The Committee will meet at 2.45 P.M. on Wednesday, the 21st February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

ANNEXURE I.

COPY OF LETTER No. 48-1052-XIV, DATED THE 8TH JANUARY 1934, FROM THE REVENUE SECRETARY, GOVERNMENT OF THE CENTRAL PROVINCES, AGRICULTURAL DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Grant in aid from Imperial Council of Agricultural Research for certain schemes of research in the Central Provinces.

I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward a copy of letter No. 5551, dated the 12th/13th December 1933, from the Director of Agriculture, Central Provinces (Annexure II), together with the undermentioned six schemes and to recommend them for the favourable consideration of the Imperial Council of Agricultural Research. The schemes are being printed and 150 copies of them will be furnished to you in due course.

(1) Scheme for research on the Orange Crop.

2. The scheme has been considered by the Provincial Agricultural Research Committee on the 9th December 1933, and approved by that body. The local Government has also accepted it. I am accordingly to request that they may be placed before the Advisory Board of the Imperial Council of Agricultural Research at its next meeting to be held in February 1934.

ANNEXURE II.

COPY OF LETTER NO. 5551, DATED THE 12/15TH DECEMBER 1933, FROM THE OFFG. DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES, TO THE SECRETARY TO GOVERNMENT, AGRICULTURE DEPARTMENT, CENTRAL PROVINCES.

I have the honour to attach herewith six schemes of research (Annexure II) which were placed before the Provincial Agricultural Research Committee on the 9th December 1933, and recommended for transmission to the Imperial Council of Agricultural Research for the provision of funds. The Provincial Agricultural Research Committee placed them in the following order of importance :—

- Schemes for Research on the Orange Crop. A.
- Schemes for Research on the Oilseeds. A.
- Schemes for Research on Potato Storage. B.
- Schemes for Research on Gangai pest of rice. B.
- Schemes for Research on Sann Hemp. C.
- Schemes for Research on Pan Cultivation. C.

The scheme for research on the Orange Crop (Annexure III) will form part of the All-India scheme for Fruit already sanctioned by the Imperial Council of Agricultural Research.

ANNEXURE III.

SCHEME FOR RESEARCH ON THE ORANGE CROP OF THE CENTRAL PROVINCES.

The orange is the most important fruit crop of the Central Provinces and Berar and one could almost say of India, for the Nagpur "Santra" is known all over the country from Peshawar to Comorin and from Bombay to Calcutta. Although it is grown in many parts of India, it reaches its greatest perfection in and around Nagpur and the nurseries situated in the vicinity derive a thriving trade in preparing budded plants to start orchards in different parts of the country. The area under the crop in the Central Provinces is

annually. This area is capable of considerable expansion though several factors militate against this happening, viz., the haphazard way propagation is done in the nurseries, resulting in large numbers of shy bearing trees being sold; the crude methods of marketing employed and the faulty packing and transport, all of which affect considerably the price obtained by the grower for his crop.

Owing to the absence of a horticulturist on the staff of the Agriculture Department, practically no work has been done on the orange, and very little is really known about it. The grower carries on in the way his father did before him and the Agriculture Department has not been able to help him. He buds any budwood on to "Jamheri" or "sweet lime" and the resultant plant is sold, probably to produce a tree giving a small number of inferior oranges. No care whatsoever is taken to select budwood from trees of quality or from trees of high productivity.

A scientific study of the 'Santra' or Nagpur orange is necessary in order to get the best out of the tree and it is for this reason that the following programme is put up to the Imperial Council of Agricultural Research for the provision of the necessary funds. The Nagpur orange is not confined to the Central Provinces and I therefore suggest that the work on citrus fruit be concentrated at Nagpur where the conditions are ideal for this particular research.

Two crops of oranges are produced in a year—one in the cold weather and the other in the hot weather. Both these will be the subject of investigation.

1. *The scheme.*—Investigation into root stocks and the effect of the latter on the quality of the fruit and the productivity of the tree. The orange is usually budded on to Jamheri (sour lime) stocks and sometimes on to sweet lime. Many other citrus stocks are available for this investigation and trials of different stocks will be made.

2. *Vegetative reproduction of the Orange.*—This will standardize the trees sent out and get over the difficulty of variation caused by propagation from seedlings.

3. *Trials of different varieties of citrus obtained from reliable nurseries abroad.*

4. *Manuring of oranges.*—The practices established in other orange growing countries will be tried experimentally to find out the best.

5. *Irrigation experiments.*—The orange grower gives about 20 irrigations to his crop which appear to be far too much. The optimum number of irrigations will be found out and the best time to apply them.

6. *Pruning.*—The orange tree is supposed to prune itself by die back. The effect of pruning on the subsequent crop will be studied. Thinning of the fruit will also be tried to obtain a standard size.

7. *Investigations into methods of preventing and curing die back* which attacks most trees after a certain age. This is mostly physiological and an effort will be made to find the cause and a remedy. One cause of "die-back" may be the heavy root pruning given to trees to induce fruiting in the hot weather. This also requires investigation.

8. *Investigation into pests and diseases of oranges* and methods of combating them.

9. *Grading and packing experiments.*—Cheap wooden crates of pine wood similar to those used in transporting oranges for export in other countries can be obtained in India and it is intended to carry out work with these and other containers. The baskets used at present are very unsatisfactory.

Closely related to this are the questions of storage and export. These will be carried out in co-operation with the Bombay Scheme for Cold Storage—*vide* page 395 of Proceedings of the meeting of the Advisory Board of the Imperial Council of Agricultural Research held in July 1932.

*10. Experiments on fruit and fruit product preservation.

Cost of the Scheme.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Central Provinces Agriculture Class I Horticulturist Rs. 250— 250—275—300—325	3,000	3,000	3,300	3,600	3,900	16,800
Entomological Assistant Rs. 70— 70—75—80—85	840	840	900	960	1,020	4,560
Mycological Assistant Rs. 70— 70—75—80—85	840	840	900	960	1,020	4,560
Horticultural Assistant Rs. 70— 70—75—80—85	840	840	900	960	1,020	4,560
Clerk—Rs. 30—2—38	360	384	408	432	456	2,040
2 Laboratory Assistants at Rs. 25	600	600	600	600	600	3,000
1 Head Mali at Rs. 25	300	300	300	300	300	1,500
3 Malis at Rs. 16	576	576	576	576	576	2,880
1 Peon at Rs. 11	132	132	132	132	132	660
Watchman at Rs. 10	120	120	120	120	120	600
Travelling Allowance	600	600	600	600	600	3,000
Laboratory Requisites and books Contingencies (labour, manure, purchase of stock, etc., and wells)	1,000	1,000	1,000	1,000	1,000	5,000
	8,000	3,500	3,500	3,500	3,500	22,000
Total	17,208	12,732	13,236	13,740	14,244	71,160

The Central Provinces Government will provide the necessary land (15–20 acres) laboratory accommodation, all the stocks on hand, material for budding and all the "Santra" plants required to start the work.

*The cost of machinery etc., for this item has not been included in the scheme. A supplementary grant will be necessary if this receives the sanction of the Imperial Council of Agricultural Research.

NOTE.—A scheme of this nature will require to be financed for a longer period than the usual 5 years. I have therefore attached a statement showing the expenditure required for a further 5 years.

	6th year.	7th year.	8th year.	9th year.	10th year.	To tal.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Horticulturist Rs. 350—25—450	4,200	4,500	4,800	5,100	5,400	24,000
Entomological Assistant Rs. 90— 95—100—100—105	1,080	1,140	1,200	1,200	1,260	5,880
Mycological Assistant Rs. 90— 95—100—100—105	1,080	1,140	1,200	1,200	1,260	5,880
Horticultural Assistant Rs. 90— 95—100—100—105	1,080	1,140	1,200	1,200	1,260	5,880
Clerk Rs. 40—2—48	480	504	528	552	576	2,640
2 Laboratory Assistants at Rs. 25	600	600	600	600	600	3,000
1 Head Mali at Rs. 25	300	300	300	300	300	1,500
3 Malis at Rs. 16	576	576	576	576	576	2,880
1 Peon at Rs. 12	144	144	144	144	144	720
Watchman at Rs. 10	120	120	120	120	120	600
Travelling allowance	600	600	600	600	600	3,000
Laboratory requisites, etc.	1,000	1,000	1,000	1,000	1,000	5,000
Contingencies, etc.	3,500	3,500	3,500	3,500	3,500	17,500
Total	14,760	15,264	15,768	16,092	16,596	78,480

APPENDIX XXXV-C.

NOTE, DATED THE 20TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 34 (iii).—APPLICATION FROM THE GOVERNMENT OF H. E. H. THE NIZAM FOR A GRANT OF Rs. 74,300 SPREAD OVER A PERIOD OF FIVE YEARS FOR A FRUIT RESEARCH SCHEME.

Attention is invited to the attached letter (Annexure I) from the Government of H. E. H. the Nizam No. 7724, dated the 20th July 1933 forwarding the scheme (Annexure II) mentioned above. As the scheme was not received in time for the last meeting of the Board and in view of the heavy agenda for that meeting it was held over for consideration at the present meeting. The scheme in question involves a total expenditure of Rs. 84,300 (Rs. 28,300 non-recurring and Rs. 56,000 recurring) spread over a period of five years out of which the Government of H. E. H. the Nizam have agreed to bear Rs. 10,000 on account of 40 acres of land which will be provided by the State.

2. The Vice-Chairman to the Council considers that it will be an advantage to have the present scheme examined in the first instance by the Committee which considered other fruit research schemes and which consisted of the following gentlemen :—

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (*ex-officio*).
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Directors of Agriculture, Madras, Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad and Baroda.
4. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
5. The Chief Publicity Officer, Indian State Railways.
6. The Agricultural Officer, Baluchistan.

The Secretary, Imperial Council of Agricultural Research, Secretary (*ex-officio*).

3. The Committee will meet at 2.45 P.M. on Wednesday, the 21st February 1934 in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

(ANNEXURE I.)

COPY OF A LETTER NO. 7724, DATED THE 20TH JULY 1933, FROM CAPTAIN NAWAB RAIS JUNG BAHADUR, OFFG. SECRETARY TO GOVERNMENT, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD-DECCAN, TO THE SECRETARY IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA.

SUBJECT :—Re. *Hyderabad Fruit Research Scheme*.

I am directed to forward herewith 100 printed copies each of the Hyderabad Fruit Research Scheme and Hyderabad Fruit Survey Report (not printed), for submission to your Council and to request that this subject may kindly be included in the Agenda of the next meeting.

Kindly acknowledge receipt.

ANNEXURE III.

HYDERABAD FRUIT RESEARCH SCHEME.

The Dominions of His Exalted Highness the Nizam include within their boundaries soils of many different kinds, and possess a moderate climate. A great variety of trees grow there successfully, therefore, and fruit trees of a very large number of different kinds are seen growing scattered here and there, beside numerous regular gardens. Parts of the State have been famous and are still well known for some

particular fruits, for instance, the Malghoba mango of Hyderabad and the Santra orange of the Aurangabad district. But, in spite of this, the fact is that the Hyderabad State, instead of being an exporter is an importer of fruit. It imports fresh fruit alone to the value of about twelve lakhs of rupees annually. To investigate the reasons and to find out the possible lines of development, the Hyderabad Government decided in 1930 to make a survey of the fruit growing industry in the State. A fairly detailed enquiry was made, which took about two years to complete and cost the Government about Rs. 14,000. The printed report of this survey is attached. At the same time, another attempt was made in 1931 to gauge the interest of the farming and cultivating classes in fruit culture and actually to see what sort of fruit is now produced by holding a horticultural show in 1931. The show was a success beyond expectations, so much so that it had again to be repeated in 1932. A great variety of fruits, some of them very good ones, were brought for competition from all parts of the State. The show has become an annual function now, and the third was held about the end of January 1933. The public in general and the farming and gardening classes in particular are aroused and are taking more and more interest in fruit, because they have actually seen what possibilities there are for development. The detailed study in connection with the fruit survey has brought to light the fact that there is a very great scope for development. Great facilities are available now for irrigation from the large reservoirs which the Government has constructed at an expense of some crores of rupees. The Nizamsagar reservoir alone is expected to irrigate about 2,25,000 acres. The State is now in possession of definite information about the present condition of the industry, the scope for its development and definite lines on which improvement is possible. The enquiry has shown that the chief thing which is required is technical guidance and technical workers and a supply of good reliable stock. There is a very great demand for this already, but unfortunately the State Agricultural Department is not sufficiently equipped to meet it. No technical advice can safely be given until experience has been gained by practical research, no technical workers can be made available until training is given, and no reliable stock can be supplied until such stock has been searched out and propagated.

The Hyderabad Agricultural Department is in possession of the services of a trained horticulturist. One of the members of its Subordinate Agricultural Service, who is a Licentiate in Agriculture of the Nagpur Agricultural College, went to America after serving in the department for about 12 years in various capacities upto the Superintendent of a Government farm and garden. On his return from America, where he obtained the M.Sc. degree in Horticulture, he was deputed to Poona for six months for further practical training in the same subject under the Horticulturist of the Bombay Government. He has returned after completing this training also. This officer has now been given charge of all horticultural work in the State.

It will be seen from the above that the Hyderabad Agricultural Department is now fully prepared to embark on a scheme of serious horticultural development, if it can secure necessary funds. But, we are unfortunately faced now with unfavourable financial conditions, and the Government is unable to give effect to any new scheme. It is under these circumstances that the Imperial Council of Agricultural Research is being approached for help.

The State Agricultural Department is already employing four junior assistants with the necessary amount of money for their travelling allowance, etc., for horticultural propaganda work. No money is asked for this which is a local matter. The Council is asked to sanction a grant for a garden for research work in connection with fruit growing. This garden will be established in Hyderabad at the headquarters of the Horticulturist so that it may be under his direct control.

Work proposed to be undertaken.

For the present it is proposed to concentrate work on mangoes, citrus, dates, pine-apples and custard-apples. Mangoes are grown in all parts of the dominions, and hundreds of varieties are known to exist. Citrus is at present largely grown in the northern districts of the State, and some of the produce is already exported to Bombay. It is also grown in a scattered fashion in other parts, and enquiries have shown that it can be grown in most parts successfully. Dates are also grown in some parts of the State, but in a very scattered fashion. The State has now got a special assistant for this work, who was trained at Government expense in Iraq. Pine-apples are at present grown in a few gardens, and enquiry has shown that they can be grown on a much larger scale successfully. The Custard-apple is a common fruit in the granite area of the State. It is growing in a wild form on the poorest stony

land, which is unfit for most other crops. It is produced in such abundance that it goes to waste unused in very large quantities. The development of this fruit and finding out of methods of utilising the surplus produce will not only make otherwise waste lands productive, but will also provide means of livelihood for the poorer class of the rural population. The details of the problems of research proposed to be taken up are given below. Excepting the classification and identification of local varieties and the selection of types which has been approved by the Council as an important piece of work for all the provinces, such fundamental problems as have already been approved for other provinces have been left out as far as possible, so as to avoid duplication of work.

PROBLEMS FOR INVESTIGATION.

Mangoes.

1. Identification and classification of local varieties.
2. Selection of types.
3. Propagation of a few improved varieties from different parts of India, with a view to compare them with the best of the local ones.
4. Selection of the best varieties for commercial purposes.
5. Identification and testing of stock, and investigation into the possibility of producing dwarf stocks.
6. Experiments in pruning to see if annual fruiting is possible and to try to secure more compact trees.
7. Study of flowering periods of each variety in relation to cropping properties.
8. Study of the ripening periods and ripening habits of each variety.
9. Study of the keeping properties and shipping qualities of each variety in co-operation with the Bombay Department of Agriculture.
10. Study of the different local methods of storing the produce with a view to improve them.

Citrus.

(With special reference to grape-fruit and oranges.)

1. Classification of local varieties.
2. Selection of types.
3. Propagation of improved imported varieties with a view to compare them with the best of the local ones.
4. Selection of the best varieties for commercial purposes.
5. Classification and propagation of any local stock.
6. Trial of stock for different conditions with special reference to yield and quality of fruit and resistance to disease.

Dates.

1. Classification of local varieties.
2. Selection of types.
3. Propagation of improved imported varieties with a view to compare them with the best of the local ones.
4. Improving the local varieties by means of crossing with suitable imported varieties.
5. Study of flowering periods of each variety in relation to cropping properties.
6. Study of ripening periods and ripening habits of each variety.
7. Study of the different methods of treatment of the date fruit for rendering it into the different marketable products.

Pineapples.

1. Classification of local varieties.
2. Selection of types.
3. Propagation of improved imported varieties with a view to compare them with the best of the local ones.
4. Selection of the best varieties for commercial purposes.
5. Experimenting with different methods of planting, in open situations as well as in mango plantations.

Custard Apples.

1. Classification of local varieties.
2. Selection of types.
3. Propagation of improved varieties from different parts of India, with a view to compare them with the best of the local ones.
4. Selection of the best varieties for commercial purposes.
5. Study of different methods of propagation with a view to evolve seedless varieties.
6. Study of the different methods of utilisation of the surplus produce, for instance, drying, manufacture of flour from pulp.

General.

1. Trial of different catch-crops, with a view to reduce the running cost of the orchards.
2. Studies with reference to all the above fruits of the problems of tillage, drainage, manuring, irrigation, weathering, thinning, pruning, training, grading, packing, marketing and control of insect pests and diseases.

BUDGET ESTIMATE.

Non-recurring.

	Rs.
1. Land 40 acres at Rs. 250 per acre	10,000
2. Laying out of plots, channels, etc.	1,000
3. Fencing	3,000
4. Buildings and sheds :—	
(a) Office and store	2,500
(b) Implement and cartshed	800
(c) Cattle shed	500
(d) Supdt.'s quarters	3,500
(e) Head Gardener's quarters	1,000
(f) Quarters for malies, coolies and peon	1,000
(g) Shed for potting, grafting and packing	1,000
(h) Oil-engine shed	500
5. Dead stock :—	
(a) Pump and oil-engine	1,500
(b) Implements and tools	1,000
6. Live stock, 2 pairs of bullocks at Rs. 250 per pair	500
7. Furniture for office and packing shed	500
Total	28,300
<i>Deduct</i> on account of land to be provided by the State	10,000
Actual amount required from the Council	18,300

Recurring.

Particulars.	Amount in rupees.					Total.
	I year.	II year.	III year.	IV year.	V year.	
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
<i>Salaries.</i>						
(a) Superintendent at Rs. 250—15 —210 per mensem	3,000	3,180	3,360	3,540	3,720	16,800
(b) Assistant at Rs. 110—5—130 p.m.	1,320	1,380	1,440	1,500	1,560	7,200
(c) Clerk at Rs. 30—2—38 p.m.	360	384	408	432	456	2,040
(d) Head Mali at Rs. 30—2—38 p.m.	360	384	408	432	456	2,040
(e) Peon at Rs. 12 p.m.	144	144	144	144	144	720
(f) Malies 4 at Rs. 15 p.m. each	720	720	720	720	720	3,600
(g) Travelling Allowance	600	600	600	600	600	3,000
Working charges (Cattle-food, La- bour, seed, plants, manure, etc.)	4,000	4,000	4,000	4,000	4,000	20,000
Office Contingencies	120	120	120	120	120	600
Total	10,624	10,912	11,200	11,488	11,776	56,000

The total cost of the scheme amounts to Rs. 28,300 non-recurring and Rs. 56,000 recurring spread over five years. The Hyderabad State will contribute Rs. 10,000 non-recurring on account of cost of land. It is not possible for the State to provide any more money at present, because of the general financial stringency and the large amount of expenditure which it is meeting and has to meet in connection with the development and expansion of its Agricultural Department. The State will, however, lend the services of its Horticulturist for supervision of the execution of the scheme and of its Botanical, Chemical and Entomological sections for work in connection with the same.

The budget estimates submitted have been drawn up on practically the same lines as those already sanctioned by the Council for other provinces. The actual amount required from the Council is non-recurring Rs. 18,300 and recurring Rs. 56,000. The receipts on account of the produce will be credited to the Council.

NIZAMUDDIN HYDER,

Offg. Director of Agriculture,

*H. E. H. the Nizam's Government,
Hyderabad Deccan.*

APPENDIX XXXV-D.

NOTE DATED THE 23RD JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 34 (IV).—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF Rs. 57,430 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME OF RESEARCH WORK ON CITRUS STOCK AND GRAPE VINES IN THE PUNJAB.

Attention is invited to the attached letter (Annexure) from the Government of the Punjab, No. 51-D., dated the 6th January 1934, forwarding *inter alia* the scheme mentioned above. The scheme involves an expenditure of Rs. 57,430 (non-recurring Rs. 4,050 and recurring Rs. 53,380) spread over a period of five years. It is stated that it would be impossible to obtain final results within this time and that the period would have to be extended later.

2. The Vice-Chairman to the Council considers that it will be an advantage to have the present scheme examined in the first instance by the Committee which considered other fruit research schemes and which consisted of the following gentlemen:—

1. The Vice-Chairman Imperial Council of Agricultural Research, Chairman, *ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Directors of Agriculture, Madras, Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad and Baroda.
4. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
5. The Chief Publicity Officer, Indian State Railways.
6. The Agricultural Officer, Baluchistan,
The Secretary, Imperial Council of Agricultural Research. Secretary, *ex-officio*.

The Committee will meet at 2-45 p.m., on Wednesday, the 21st February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

ANNEXURE.

EXTRACT FROM LETTER No. 51-D., DATED THE 6TH JANUARY 1934, FROM THE DEPUTY SECRETARY TO THE GOVERNMENT OF THE PUNJAB, DEVELOPMENT DEPARTMENT, LAHORE, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT.—*Punjab schemes for consideration at the ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.*

With reference to the correspondence ending with your letter No. F-6 (S.)/33/G., dated 22nd December 1933 (not printed), I am directed by the Punjab Government (Ministry of Agriculture) to forward, for consideration of the Imperial Council at the ninth meeting of its Advisory Board to be held from the 19th to 24th February 1934, the following five schemes which have obtained the approval of the Punjab Council of Research:—

-
3. Scheme for research on Citrus Stock and Grape Vines in the Punjab.
-

2. Details of the schemes are fully discussed in the attached notes, 150 printed copies of each of which will be forwarded to you under separate cover shortly.

SCHEME OF RESEARCH ON CITRUS STOCK AND GRAPE VINES IN THE PUNJAB.

Citrus Fruit.

The Punjab is an important citrus growing tract. The canal colonies in particular, and most parts of the province generally, possess ideal conditions of soil and climate for the cultivation of citrus fruits. Due to these favourable natural conditions, a large increase has taken place in recent years in the area under commercial citrus orchards, and already the acreage under these fruits equal that of all other fruits combined in the Province. It has also been found from a consignment of Punjab malta, which was sent to England in 1931, that their quality can stand competition with that of any produced in other parts of the world.

2. The future development of the Citrus fruit industry in North-West India and the possibilities of this fruit capturing the foreign market depend on the production of fruit of standard grades in large quantities. To produce such fruit the standardization of citrus fruit stock on which the various varieties are budded is one of the most important factors, for it is well known that the quality and yield of fruit, the longevity of trees, their disease resistance, etc., are influenced by the stock used. The exhaustive work on citrus stock carried out in California has rendered inestimable benefit to the citrus industry there. In England also the activities of the East Malling and Long Ashton Research Stations have been concentrated for a considerable period on the standardization of root stocks of particular fruits and this work is considered to be the foundation of all other fruit research work.

3. An exact knowledge of the merits and demerits of the various citrus root stocks used in Northern India is of fundamental importance, not only for the purpose of finding out the stocks on which important commercial varieties of citrus fruits do best, but also as a preliminary step in the standardization of the quality of the fruit put on the market. Apart from this, the average yields of citrus trees in India are very low in comparison with those obtained in California, South Africa and other citrus producing countries.

4. So far no work of any importance has been carried out in India in the field of citrus root stocks. A very large number of citrus types is used at present as root stocks by Punjab and other nursery men, and, as a result, the variation in the yields of orchards and in the quality of the fruit produced is enormous. Detailed research on all the important indigenous and foreign root stocks is of immediate necessity in connection with malta, santra oranges, lemons, grape fruit and other citrus fruits grown in the Punjab and adjoining territories.

Grape Vines.

5. In the Punjab, both in the plains and in the sub-montane tract, climatic conditions are most suitable for the growing of grape vines, but the amount of good fruit supplied to the market is very small, as most of the vines are either of inferior quality or ripen their fruit irregularly. Many of the varieties which grow well are unable to mature their fruit properly owing to the occurrence of rain, and the work that has been done so far shows that to be successful the fruit must be ripe before the rains set in.

6. On the Punjab Agricultural Department's farms at Lyallpur, Gurdaspur and elsewhere extensive trials of grape vines have been carried out during the last six years and the grape vine area at Lyallpur contains a collection of about 100 varieties which have been imported from California, Australia and other important vine growing parts of the world. Very valuable results have already been achieved from these trials and several very promising types have been selected. Some of them are very early ripeners, the fruits of which mature long before the rains set in, whilst several others possess very good characters, such as heavy bearing and fruit of good quality, but are unsuitable for the climatic conditions prevailing, on the score of their late ripening. If, therefore, a combination of high yield and good quality, linked with early maturing, can be produced by hybridization, a very distinct and valuable service to the fruit industry will have been achieved and the present scheme is submitted with this object in view.

Facilities required.

7. *Land and buildings.*—It is proposed that a part of the area of the canal irrigated Experimental Farm at Montgomery should be utilised for the purpose of this scheme. A block of 25 acres will be required for the trial of citrus stock, about 20 acres for grape breeding work and 5 acres for nursery and other purposes, making a total of 50 acres. This farm possesses the necessary housing accommodation for farm animals, farm labour, offices, etc. All these facilities will be made available free of cost by the Punjab Government.

8. *Plants.*—As already stated, all the material required for starting hybridization work on grapes is already available at Lyallpur, so that research in this connection can be started immediately. Further, citrus stocks of all available types, not only from the Punjab, but from other parts of India, have been collected already and have been put down in the nursery, and will be available for planting out during the next year. No time will, therefore, be wasted in obtaining the necessary material.

The scheme will be carried out under the supervision and guidance of the Fruit Specialist in the Punjab Agricultural Department. This officer is highly qualified to undertake the work proposed as, in addition to his experience in his present appointment, he has spent about 7 years, on specialised study of fruit cultivation in California.

9. *Staff required.*—In view of the importance of the work and the fact that it will be carried out at a centre away from the headquarters of the Fruit Specialist, the officer in immediate charge of the scheme must be a well qualified man, capable of assuming complete responsibility, and it is essential that he should be of the Class II, Punjab Agricultural Service grade. He will require the help of one Assistant for field and breeding work. One Assistant is also required to deal with the investigation and control of the various fungal diseases which attack these fruits and on many of which very little research has been carried out so far.

10. *Cost.*—The total cost of the scheme is estimated to be:—

	Rs.
Non-recurring	4,050
Recurring over a period of five years	53,380

In view of the nature of the scheme the income from the area devoted to it during the initial period of five years is expected to be negligible. It is requested that the Imperial Council of Agricultural Research should provide funds to enable the scheme to be carried through. The scheme has been prepared for a period of five years in the first instance but it should be stated that it will be impossible to obtain final results within this time and that the period will have to be extended later.

EXPENDITURE.

(a) *Non-recurring.*

	Rs.
Bullocks—three pairs	1,050
Implements and garden tools	750
Equipment for vineyards such as poles, wire, for training vines, etc.	1,250
Fencing	1,000
Total	4,050

(b) *Recurring.*

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1 Assistant Horticulturist on Rs. 200—200—250—25—300 less 15 per cent.	2,040	2,040	2,640	2,940	3,240	12,900
1 Agricultural Assistant on Rs. 100—10—140 less 15 per cent.	1,020	1,140	1,280	1,380	1,500	6,300
1 Mycological Assistant on Rs. 100—10—140 less 15 per cent.	1,020	1,140	1,280	1,380	1,500	6,300
1 Clerk on Rs. 40—2—48 less 15 per cent.	408	432	456	480	504	2,280
2 Malis on Rs. 30—2—38	720	768	816	864	912	4,080
7 Beldars on Rs. 18 each	1,260	1,260	1,260	1,260	1,260	6,300
1 Chowkidar on Rs. 13	156	156	156	156	156	780
1 Peon on Rs. 14	168	168	168	168	168	840
Travelling Allowance	200	200	200	200	200	1,000
Casual labour	500	300	300	300	300	1,700
Water rates	600	600	600	600	600	3,000
Manures	500	500	500	500	500	2,500
Upkeep of bullocks	1,080	1,080	1,080	1,080	1,080	5,400
Total	9,672	9,784	10,696	11,308	11,920	53,380

APPENDIX XXXV-E.

NOTE, DATED THE 1ST FEBRUARY, 1934, BY SECRETARY, ON SUBJECT No. 34 (V).—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF RS. 35,052 SPREAD OVER A PERIOD OF THREE YEARS FOR A SAN JOSE SCALE SURVEY IN THE PUNJAB.

Attention is invited to the attached scheme (Annexure) submitted by the Government of the Punjab for a grant for a San Jose Scale survey in the Punjab. The scheme which has obtained the approval of the Punjab Council of Research involves a total expenditure of Rs. 35,052 spread over a period of three years.

2. The Vice-Chairman to the Council considers that it will be an advantage to have the scheme considered in the first instance by the committee of the Council which examined fruit research schemes and which consisted of the following members :—

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *Ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Directors of Agriculture, Madras, Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad and Baroda.
4. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
5. The Chief Publicity Officer, Indian State Railways.
6. The Agricultural Officer, Baluchistan.

The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

The committee will meet at 2-45 P.M. on Wednesday, the 21st February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

ANNEXURE.

A SCHEME FOR A SAN JOSE' SCALE (COMSTOCKASPIS PERNICIOSA MACGILLVRAY) SURVEY IN THE PUNJAB.

According to Dr. Marlatt, Chief of the Bureau of Entomology, Washington, San Jose' Scale is a native of Northern China. It was introduced into California on the flowering Chinese peach probably about 1870 and spread rapidly in orchards along the Pacific coast of America. By 1892 this dreaded orchard pest was well established even in the orchards of the Eastern States of America. This is enough to indicate the potentialities of rapid distribution of this destructive insect.

2. Since the discovery of San Jose' Scale in destructive numbers in California, this pest has been recorded from almost all the apple and peach growing tracts of the world. Improved transport facilities and the enormous powers of multiplication possessed by this scale insect are factors which have made it a more or less cosmopolitan pest which has amply demonstrated its destructive potentialities wherever it has gone, and has earned for it the reputation of being the most ruinous of all the insect pests of the orchard, hence the name 'perniciosa'. According to Metcalf and Flint, San Jose' Scale killed more than 1,000 acres of mature apples in Southern Illinois (U. S. A.) in 1922 alone.

3. The exact date of its introduction into the orchards of North-Western India is not known. Mr. Bainbrigge Fletcher considers that it entered Kashmere on infested nursery stock from Europe in 1913. How, when and from where this pest entered Kulu and the Simla Hills is not known, but when its presence was brought to the notice of the Department of Agriculture, Punjab, in 1924, it was already thoroughly established in the orchards of these hills.

4. Outside the Punjab the pest has been recorded from Kashmere and Abbottabad, whilst its presence in Quetta is strongly suspected. In the Punjab it has been found so far in destructive numbers in 37 places in the Simla Hills from Kalka upwards and in 18 places in the Kulu Sub-Division of the Kangra District. There is every reason to believe that this pest is also present in the hilly territories of Patiala and Mandi States. Its presence at Kalka at the foot of the hills is of very great significance and it remains to be seen how far down in the plains it has arrived or is likely to arrive. The situation is serious and calls for immediate action.

5. So much interest has been aroused amongst fruitgrowers and various Governments in the control of this pest that San Jose' Scale has been the subject of much legislation throughout the world, *e.g.*, in the 16 States of the United States of America, in Canada, in Germany, in Austria-Hungary and in Great Britain. Recently in North-West India the Government of Jammu and Kashmere have promulgated the "Crop and Plant Regulation (Act No. 1 of 1933)," under a section of which the competent authority has notified that San Jose' Scale is an insect pest in the State and certain tehails have been placed under quarantine for five years.

6. In August, 1928, the Punjab Agricultural Department allotted staff consisting of two Agricultural Assistants, four Fieldmen and four Mukaddams for making investigations on and conducting control measures against San Jose' Scale at Kulu and Kotgarh (Simla Hills) and subsequently Government created new posts to investigate and control this and other pests of fruit trees. The insect was studied from various aspects, *e.g.*, its life history, the nature and extent of damage, the rate of multiplication, control, etc., and from 1928 up to the present time the Department has sprayed some 50,000 fruit trees in Kulu and the Simla Hills and has fought this insect effectively and successfully. This work is still being conducted in these localities.

7. At the August 1933 meeting of the Advisory Body of the Imperial Council of Agricultural Research an application from the North-West Frontier Province Government for a grant for an entomological survey in that province was approved. The Sub-committee appointed to consider that scheme drew attention to the importance of this pest, and the serious loss which it entails in fruit-growing areas, and considered it a matter of extreme urgency to take all possible measures to control and confine the local attacks, thus preventing the further spread of the pest. The Sub-Committee reported that a thorough survey is required of the areas in British India known or suspected to be infested and of the varieties of plants which serve as hosts for the pest. They recommended that the survey of the distribution of this insect should be pressed forward in the North-West Frontier Province and the Punjab and that areas to which it is desirable to apply quarantine orders should be finally determined from the results of the survey.

8. To indicate the importance and difficulty of making a complete survey of this pest it may be stated that this insect is polyphagous—a fact which is not only of great importance in its control but at the same time adds greatly to the difficulty of a thorough survey. In the United States of America it has been found on 72 different species of food plants. In Kashmere Fletcher found it on apple, pear, cherry, plum, peach, greengage, grape-vine, almond, quince, apricot, walnut, rose, mulberry, willow and poplar; whilst in Kulu and the Simla Hills it has been found so far on apple, pear, peach, plum, Japanese plum, rose, apricot, cherry, walnut, Kaits (wild pears), Palti (wild apple) and Sirhis (wild *khurmani*).

9. The survey work carried out by the Punjab Agricultural Department so far has been done satisfactorily, but for obvious reasons the whole of the ground could not be covered. It is proposed now that a thorough survey will be carried out with a view to study:—

- (1) the food plants of San Jose' Scale, both wild and cultivated,
- (2) the distribution of the pest:—
 - (a) localities where it is present,
 - (b) localities from which it is being regularly sent out on infested fruit or nursery stock,
 - (c) the chances of its thriving in introduced localities,
 - (d) the reasons for its failure to establish itself in certain localities.

10. The result of this survey combined with that already approved by the Advisory Board of the Imperial Council of Agricultural Research for the North-West Frontier Province will be that the infested and uninfested localities in North-West India will be known and it will then be possible to consider where quarantine and other preventive measures should be introduced in order to confine the pest within its present limits and to prevent its further spread in India. In affected areas vigorous action to eradicate the pest can also be taken.

11. For the purpose of this survey the Punjab will be divided into the following four zones:—

- (1) the Simla Hills, British territory and Simla Hill States,
- (2) Kangra (including Kulu),
- (3) the Murree Hills,
- (4) the plains and Indian States in the Punjab.

12. The staff which has already been sanctioned and employed by the Punjab Government during the past five years will continue its work on this pest, but the time of this staff must be devoted mainly to control measures in areas within which the pest has been discovered already, and they cannot undertake the proposed intensive survey in more than one of the four zones already indicated. Consequently, additional staff is required to carry out the survey in three of the zones. The attached statement shows the further requirements for a survey extending over a period of three years and it is requested that the Imperial Council of Agricultural Research may kindly provide funds to enable this survey to be carried out. The scheme has been based and modelled on the suggestions made by the Sub-Committee of the Imperial Council of Agricultural Research which considered the application of the North-West Frontier Province for a similar grant in August 1933. The work will be carried out under the supervision of the Entomologist to Government, Punjab, and all possible help and facilities, which the Entomological Section of the Research Institute at Lyallpur can provide, will be given. The staff for which sanction is asked will confine their operations entirely to the proposed survey. The special staff sanctioned by Government for San Jose Scale work and the Entomological Section generally will continue to carry out control operations, and, as stated already, will undertake the survey in one of the four zones. No non-recurring expenditure is involved and the grant which the Imperial Council of Agricultural Research is requested to make is Rs. 35,052, spread over a period of three years.

	1st year.	2nd year.	3rd year.	Total.	Remarks.
	Rs.	Rs.	Rs.	Rs.	
1. One Assistant Entomologist on Rs. 200—200—250 less 15 per cent.	2,040	2,040	2,640	6,720	Headquarters, Kulu.
2. Three Entomological Assistants (Graduates with Entomology as major subject) each on Rs. 100—10—120 less 15 per cent.	3,060	3,420	3,780	10,260	One at Murree. One at Kulu. One at Simla.
3. Six Fieldmen each on Rs. 20—1—22	1,440	1,512	1,584	4,536	Two at each sub-station.
4. One Clerk on Rs. 40—2—44 less 15 per cent.	408	432	456	1,296	
5. Rental of buildings, Simla, Kulu, Murree, Rs. 30 each	1,080	1,080	1,080	3,240	
6. Laboratory equipment and collecting material	500	500	500	1,500	
7. Travelling allowance for Senior Assistant	1,000	1,000	1,000	3,000	
8. Travelling allowance for others	1,500	1,500	1,500	4,500	
Total	11,028	11,484	12,540	35,052	

APPENDIX XXXVI.

NOTE DATED THE 21ST FEBRUARY 1934 BY SECRETARY, ON SUBJECT No. 25.—REPORT OF THE EDITORIAL COMMITTEE OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Attention is invited to the (i) agenda of business for the meeting of the Editorial Committee of the Imperial Council of Agricultural Research, held on Saturday, the 17th February, 1934 and the papers circulated to the Committee on the occasion [Annex. I] and (ii) proceedings of the meeting [Annex. II].

2. The recommendations made by the Editorial Committee are briefly as follows:—

(1) That the "Instructions to Authors of Publications of the Imperial Council of Agricultural Research" be published in the first number of each Journal every year and that a notice be inserted in a prominent place in all the issues of the Journals drawing attention to the issues in which they were last published.

(2) That the quality of the illustrations in the Council's publication should be maintained at a high level, and, as far as possible, should be the best available in India.

(3) That the efforts now being made to improve the get-up of the publications be continued; also that such paper be used for the publications that the text would not show through on the reverse.

(4) That the 'List of Referees' as revised by the Committee be adopted.

(5) That the starting of the new series of Miscellaneous Bulletins of the Imperial Council of Agricultural Research was very desirable.

(6) That in the case of the 'Indian Journal of Veterinary Science and Animal Husbandry,' it would be preferable to enlarge the size of the present quarterly issues rather than increase the number of issues per annum.

(7) That the 'Indian Journal of Veterinary Science and Animal Husbandry' should not accept clinical articles but that suitable clinical notes coming from Veterinary Colleges in India be collected together periodically and published as a 'Miscellaneous Bulletin of the Imperial Council of Agricultural Research.'

(8) That arrangements be made, as a trial for a year, for publishing in the Indian Journal of Veterinary Science and Animal Husbandry, abstracts of selected articles of general practical interest appearing in foreign literature that would assist field workers to keep in touch with current developments; that as a general standard, the abstractors of such articles be remunerated at the rate of about Rs. 15 for a 200-word abstract.

(9) That for 'Agriculture and Livestock in India', without excluding the kind of material now being published in it, special popular articles on agricultural and animal husbandry subjects be invited from suitable writers; that such contributions be paid for, up to a total of Rs. 100 for every issue; and this arrangement be tried for a year in the first instance.

(10) That an endeavour should be made to secure for 'Agriculture and Livestock in India', original contributions from practical farmers on topical subjects.

(11) That papers in pure botany which are of interest to Agricultural workers in India should not be excluded from the 'Indian Journal of Agricultural Science'.

(12) That free copies of the Council's journals be supplied to important publishers of agricultural and veterinary books in India and abroad, with a view to making the Journals better known among such publishers.

(13) That with a view to introducing the Council's Journals to as large a number as possible of those interested in such subjects in other countries, arrangements be made through Messrs. Thacker Spink and Co., Calcutta, for the issue of a circular notice to interested publishers, libraries, etc., giving particulars of the Council's Journals, together with suitable specimen articles from each Journal. The estimated cost would be from Rs. 400 to 500 per Journal.

The recommendations are for the consideration of the Advisory Board.

ANNEXURE I.

AGENDA FOR THE MEETING OF THE EDITORIAL COMMITTEE OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, HELD ON THE 17TH FEBRUARY 1934.

1. (a) To review the present position of the Council's publications.

(b) Proposal for increasing the subscription circulation of the Council's Journals.

2. To consider whether papers in pure botany should be published in the Indian Journal of Agricultural Science.
3. To consider the recommendations made by the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held in February 1933, in regard to the Journals dealing with livestock matters.
4. The 'Miscellaneous Bulletin of the Imperial Council of Agricultural Research'.
5. Revision of the 'List of referees'.
6. Question of improving the illustrations in the Council's publications.
7. Proposal to print the 'Instructions to authors of publications of the Imperial Council of Agricultural Research', in the Council's Journals at the commencement of every year or once in two years.

SUBJECT No. 1 (a) TO REVIEW THE PRESENT POSITION OF THE COUNCIL'S PUBLICATIONS,
(b) PROPOSAL TO INCREASE THE SUBSCRIPTION CIRCULATION OF THE COUNCIL'S JOURNALS.

In regard to item (a), attention is invited to the attached statements I-VIII (Enclosure I) furnishing particulars in regard to the working of the publications of the Imperial Council of Agricultural Research during the last two years. The Committee is requested to make such comments, suggestions etc., on the subject as it may think fit.

2. As regards item (b), which arises from a review of the present position [Item (a)] a note by the Animal Husbandry Expert to the Council is attached (Enclosure II), in which he suggests that, with a view to introducing the Council's journals to as large a number as possible of those interested in such subjects in other countries, Messrs. Thacker Spink and Co., Calcutta may be authorized to issue a notice to interested publishers, libraries, etc., giving particulars of the Publications together with suitable specimen articles from each journal. If this proposal finds favour with the Committee, it is further suggested that suitable specimen articles may be selected for each journal, in order that in estimate of the cost involved might be worked out and the proposal might be submitted to the Governing Body for approval.

The proposals are now for the consideration of the Editorial Committee.

CHARAN DAS.

Secretary.

ENCLOSURE I.

STATEMENT I.

Number of papers published in each Journal during 1932 and 1933, classified by subjects.

Indian Journal of Agricultural Science.

	1932.		1933.	
	Original articles.	Selected articles.	Original articles.	Selected articles.
	1	2	3	4
Plant and Soil Chemistry	2	4	4	..
Physical Chemistry	5	1	1	..
Agricultural bacteriology	1	..	2	..
Botany—Genetics	11	..	28	..
Botany—General	2	..	8	..
Plant Physiology	4	..	6	..
Mycology	4	..	8	..
Entomology	4	2	8	1
Statistical treatment of experimental data	7	..	9	..
Cotton Technology	1	..	3	..
Total	41	7	77	1

	1932.		1933.	
	Original articles.	Selected articles.	Original articles.	Selected articles.
	1	2	3	4
<i>Indian Journal of Veterinary Science and Animal Husbandry.</i>				
Veterinary Surgery	3	1	..	..
Veterinary Medicine . . . . .	..	2	2	1
Veterinary Pathology and bacteriology	7	3	2	1
Protozoology	1	..	1	..
Virus Diseases and serum preparation	3	1	4	..
Helminthology	10	..	12	..
Veterinary entomology	2	..	1	..
Animal biochemistry	8	..	1	3
Animal breeding	1	1	2	1
Dairying . . . . .	..	..	1	..
Miscellaneous	4	..	2	1
Total	39	8	28	7
<i>Agriculture and Livestock in India.</i>				
General Agriculture	1	2	2	..
Soils and manures	7	1	7	..
Plant breeding	2	..	2	..
Plant diseases	1	1	..	..
Plant pests	2	..	4	1
Agricultural engineering	1	..	2	..
Agricultural economics, marketing etc.	2	1	2	..
Statistical treatment of experimental data.	1	..	2	..
Cattle breeding	1	3	3	2
Cattle diseases and pests . . . . .	..	2	2	2
Feeding and feeding stuffs	7	4	8	2
Dairying	4	5	1	3
Poultry . . . . .	..	4	..	5
Miscellaneous	4	1	4	1
Total	33	22	39	16

STATEMENT II.

Referees employed during 1932 and 1933 and number of papers sent to each.

AGRICULTURAL SIDE.

	<i>Botanical.</i>	
	1932.	1933.
Dr. F. J. F. Shaw	4	10
Dr. G. P. Hector	3	3
Mr. D. N. Mehta	5	5
Dr. W. Burns	3	3
Dr. M. A. Sampathkumaran	4	2
Dr. S. P. Agharkar	6	3
Dr. Birbal Sahni . . . . .	..	1
Mr. M. Alam	2	1
Professor Parija	3	1
Dr. T. Ekambaram	1	..

		1932	1933
<i>Chemical.</i>			
Prof. V. Subrahmanyan		1	2
Rao Bahadur Vishvanath		7	5
Mr. M. Carbery		2	1
Prof. J. C. Ghosh		1	3
Mrs. Dorothy Norris . . . . .		..	2
Mr. J. Charlton . . . . .		..	1
Mr. D. V. Bal . . . . .		..	1
Prof. H. E. Watson		1	..
Mr. P. H. Carpenter		2	..
Mr. F. J. Warth . . . . .		..	1
<i>Bacteriological.</i>			
Mr. N. V. Joshi . . . . .		..	1
<i>Mycological.</i>			
Dr. W. McRae		5	12
Mr. S. Sundararaman		1	..
Dr. B. N. Uppal		1	..
<i>Entomological.</i>			
Mr. Afzal Hussain		1	4
Mr. P. B. Richards		4	3
Rao Sahib Y. Ramachandra Rao . . . . .		..	1
Dr. B. N. Chopra		5	1
Mr. P. V. Isaac		1	4
Mr. T. B. Fletcher		2	..
Mr. J. C. M. Gardner		1	..
<i>Cotton Technology.</i>			
Dr. Nazir Ahmad		6	2
<i>Statistical.</i>			
Prof. Mahalanobis		2	5
<i>Sugarcane.</i>			
Rao Bahadur T. S. Venkatraman . . . . .		..	3
<i>Sugar Technology.</i>			
Mr. R. C. Srivastava . . . . .		..	1
<i>Meteorological.</i>			
Dr. Mackenzie Taylor . . . . .		..	1
Dr. C. W. B. Normand . . . . .		..	2
<i>General.</i>			
Mr. J. H. Ritchie		1	2
Dr. G. S. Cheema . . . . .		..	1
Mr. D. R. Sethi . . . . .		..	1
Mr. J. C. McDougall . . . . .		..	1
Mr. Wynne Sayer . . . . .		..	2
Mr. R. G. Allan . . . . .		..	1
Mr. H. R. Stewart . . . . .		..	1

Livestock Side.

	1932.	1933.
Mr. G. D. Bhalerao	4	1
Mr. F. J. Warth . . . . .	..	5
Mr. M. Ananthnarayana Rao	1	2
Mr. W. Taylor	2	1
Capt. C. E. Macguckin	1	1
Mr. J. F. Shirlaw	4	..
Dr. Maplestone . . . . .	..	3
Mr. J. R. Haddow	1	..
Lt.-Col. R. N. Chopra . . . . .	..	1
Mr. S. K. Sen	2	2
Mr. P. J. Kerr	2	..
Mr. F. Ware	1	..
Dr. P. E. Lander . . . . .	..	1
Mr. Z. R. Kothawala . . . . .	..	3

STATEMENT III.

Particulars of abstracts published in each Journal during 1932 and 1933.

Indian Journal of Agricultural Science.

	1932.	1933.
Abstracts of Provincial publications (which were paid for)	1	5
Others	6	5
	<hr/> 7	<hr/> 10

Indian Journal of Veterinary Science and Animal Husbandry.

Abstracts of papers in foreign publications (which were paid for)	4	9
Others	6	1
	<hr/> 10	<hr/> 10

Agriculture and Livestock in India.

Authors' abstracts of papers published in the scientific journals	85	55
Abstracts of provincial publications (which were paid for) . . . . .	..	4
Others	5	20
	<hr/> 90	<hr/> 79

STATEMENT IV.

No. of books reviewed in each Journal during 1932 and 1933.

Indian Journal of Agricultural Science	1	..
Indian Journal of Veterinary Science and Animal Husbandry	1	3
Agriculture and Livestock in India	12	9

STATEMENT V.

Number of papers received for each Journal during 1932 and 1933 and how they were disposed of.

<i>Indian Journal of Agricultural Science.</i>	1932.	1933.
Number of papers received	91	86
Number of papers accepted for the Indian Journal of Agricultural Science	63	48
Number of papers accepted for Agriculture and Livestock in India	11	3
Number of papers refused	17	13
Number of papers returned to authors for minor revision and not yet received back . . . . .	..	4
Number of papers under consideration . . . . .	..	18
<i>Indian Journal of Veterinary Science and Animal Husbandry.</i>		
Number of papers received	54	22
Number of papers accepted for the Indian Journal of Veterinary Science and Animal Husbandry	40	15
Number of papers accepted for Agriculture and Livestock in India	4	2
Number of papers refused	10	2
Number of papers under consideration . . . . .	..	3
<i>Agriculture and Livestock in India.</i>		
Number of papers received	52	76
Number of papers accepted for Agriculture and Livestock in India	32	39
Number of papers refused	20	11
Number of papers under consideration . . . . .	..	18
Number of papers returned for minor revision and not yet received back . . . . .	..	8

STATEMENT VI.

List of Scientific Monographs of the Imperial Council of Agricultural Research so far published or accepted for publication.

- No. 1. The Fungi of India, by Dr. Butler, C.I.E., D.Sc., M.B., F.R.S., and Dr. Bisby, Ph.D.
2. Life-histories of Indian Microlepidoptera (Second series). Alucitidae (Fterophoridae) Tortricina and Chelechiadae, by T. Bainbrigg Fletcher, R.N., F.L.S., F.E.S., F.Z.S.
3. The Open Pan System of White Sugar Manufacture by R. C. Srivastava, B.Sc.
4. Life-histories of Indian Microlepidoptera (Second Series). Cosmopterygidae to Neopseutidae, by T. Bainbrigg Fletcher, R.N., F.L.S., F.E.S., F.Z.S.
5. The Bombay Grasses, by E. Blatter, S. J., Ph.D., F.L.S., and C. McCann, F.L.S.
6. The Helminth Parasites of the Domesticated Animals in India, by G. D. Bhalerao, M.Sc.
7. Influence of Manures on the Wilt Disease of *C. Indicus* Spreng, and the Isolation of types resistant to the Disease, by Dr. W. McRae, M.A., D.Sc., (Edin.), F.L.S., and Dr. F.J.F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S.
8. The Silk Industry of Japan, with notes on observations in U. S. A., England, France and Italy by C. C. Gosh, B.A., F.E.S.

[Nos. 5 and 6 are still in the press.]

STATEMENT VII.

List of Miscellaneous Bulletins accepted for publication.

No. 1. List of Publications on Indian Entomology, by the Imperial Entomologist	1930
2. List of Publications on Indian Entomology, by the Imperial Entomologist	1931
3. List of Publications on Indian Entomology, by the Imperial Entomologist	1932
4. Host Plant Index of Indo-Ceylonese Coccidae, by S. Ramachandran and T. V. Ramakrishna Ayyar . . . . .	..

STATEMENT VIII.

I. The sizes of editions for the various publications.

(Number printed.)

Indian Journal of Agricultural Science	950
Indian Journal of Veterinary Science and Animal Husbandry	900
Agriculture and Livestock in India	1,250
Scientific Monographs. All 500 except No. 3 of which 1,000 copies were printed.	
Miscellaneous Bulletins. All 500.	

STATEMENT VIII—*contd.*

II. Showing circulation figures for the three Journals and Scientific Monographs.

	In India.				Outside India.				Total circulation.			
	Ag. & Live-stock in India.	Ind. Jour. of Ag. Sc.	Ind. Jour. of Vety. Sc. & A. H.	Sc. Mono-graph.	Ag. & Live-stock in India.	Ind. Jour. of Ag. Sc.	Ind. Jour. of Vety. Sc. & A. H.	Sc. Mono-graph.	Ag. & Live-stock in India.	Ind. Jour. of Ag. Sc.	Ind. Jour. of Vety. Sc. & A. H.	Sc. Mono-graph.
	1	2	3	4	5	6	7	8	9	10	11	12
1. No. of regular subscribers . . . . .	..	..	..	..	..	..	..	..	161	140	82	47
2. Casual sales . . . . .	..	..	..	..	..	..	..	..	64	18	17	36*
3. Free exchange issues to Universities, Chambers of Commerce, Research Institutes and Libraries	49	36	27	24	75	80	85	30	124	116	112	54
4. Free supplies to Provinces in connection with the scheme of free interchange of Publications	134	110	101	119	..	..	..	..	134	110	101	119
5. Free supplies to Newspapers, Periodicals, etc.	63	33	17	11	3	2	13	1	66	35	30	12
6. Total number of copies distributed free and exchange by the Imperial Council of Agricultural Research	265	196	171	161	59	65	72	24	324	261	243	185
7. Copies distributed by the Director, Pusa, for his Library exchange	15	8	9	..	114	53	35	..	129	61	44	..

*Average number of copies sold per part.

ENCLOSURE II.

COPY OF A NOTE DATED THE 5TH JANUARY 1934, BY THE ANIMAL HUSBANDRY EXPERT TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

The proposal is that the Editorial Committee should authorise Messrs. Thacker Spink & Co., of Calcutta, to issue a notice to publishers, libraries, etc., giving particulars of the different publications issued by this Council, similar to the notice which they have issued regarding the publications of the Indian Research Fund Association.

In this notice, particulars were given of the subjects dealt with by the different journals, with specimen articles, to show the class of material produced, with a view to introducing our journals to as large a number as possible of those interested in similar subjects in other countries.

I discussed this matter with Mr. C. F. Hooper of Messrs. Thacker Spink and Co., of Calcutta, and attach a copy of his reply. I have ascertained from the Publication Section that the cost of 500 copies of a selected article, such as Captain Datta's article on Bovine Nasal Granuloma, with illustrations, would probably be from Rs. 350 to Rs. 400. The cost of the selected article would however, vary according to its length and the number of illustrations. Similar articles would be required for the other journals. In addition to the inclusive charge of Rs. 50 for addressing and posting the envelopes, mentioned in Messrs. Thacker Spink and Co.'s letter, the cost of heavy envelopes would have to be borne by this Council.

I understand that the issue of this notice resulted in a considerable increase in the circulation of the Indian Research Fund Association publications, and it is for consideration whether this Council would be justified in issuing a similar notice.

COPY OF A LETTER DATED THE 5TH APRIL 1933, FROM MESSRS. THACKER SPINK & Co., PUBLISHERS IN LIQUIDATION, 3, ESPLANADE EAST, CALCUTTA, TO COLONEL A. OLVER, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

In reply to your letter of the 29th ultimo, I shall be glad to undertake the work you mention. You can reckon out the cost better yourself as the heaviest item would probably be the printing.

I can send out 500 copies with postage at nine pies each.

You could print your own circular the wording for which we could settle in consultation when you come to see me.

I would have the envelopes addressed and posted for an inclusive charge of Rs. 50.

SUBJECT No. 2.—TO CONSIDER WHETHER PAPERS IN PURE BOTANY SHOULD BE PUBLISHED IN THE "INDIAN JOURNAL OF AGRICULTURAL SCIENCE".

A paper entitled "Studies in the Development of Female Gametophyte of some Leguminous Plants of India", by Mr. Basu Dev Roy, was received for publication in the "Indian Journal of Agricultural Science" and was referred to Dr. F. J. F. Shaw, Imperial Economic Botanist, Pusa, for opinion. Dr. Shaw's comments on the paper (Enclosure I) raised a question of general principle as to whether or not papers in pure botany should be published in the "Indian Journal of Agricultural Science". The opinions of the members of the Editorial Committee (Agricultural Section), were obtained on this question of policy (Enclosure II), and as the members were in favour of publishing such articles in the Council's Journal, the paper in question was published in December (1933) Number of the "Indian Journal of Agricultural Science". The question of the general policy to be adopted in such cases in future is now for the consideration of the Editorial Committee.

CHARAN DAS,
Secretary.

ENCLOSURE I.

REMARKS OF DR. F. J. F. SHAW.

I have read Mr. Roy's paper on the female gametophyte of some leguminous crop plants and in my opinion it is not suitable for any of the Imperial Council of Agricultural Research publications. I base this opinion not on any defects in the paper but on the nature of the subject. The subject is one of interest to pure botany and is not agricultural. The paper would do, admirably for the annals of Botany or some such Journal in Europe and I would urge the author to send it to such a journal for publication. The paper is a good paper of its kind but the wrong kind for an agricultural journal which I think has plenty of material for publication.

ENCLOSURE II.

REMARKS OF MR. B. C. BURT.

Dr. Shaw raises a point of principle of considerable importance. Personally I would adopt a rather different policy and encourage the publication of papers of this type in the Indian Journal of Agricultural Science at least when they deal with crop plants. The opinion of all members of the Editorial Board on the paper and Dr. Shaw's comments should be obtained.

REMARKS OF DR. W. MCRAE.

Seeing that the Council finances a few pure research schemes it would seem natural to publish the results in the 'Indian Journal of Agricultural Science' published by the Council. If this be done care should be taken to have extracts published in botanical journals devoted to the particular type of research. On the other hand any research worker looking for information on pure research such as is contained in this paper on the description of the female gametophyte of some leguminous plants, though they happen to be crop plants, would naturally consult the botanical magazines devoted to such work. For the convenience, then, of botanical workers it would appear more convenient to publish papers of this type in the 'Journal of the Indian Botanical Society', though it must not be forgotten that the distinction between pure and other research is an arbitrary one and would have to be left to the discretion of the Agricultural Expert to the Council.

REMARKS OF DR. M. A. SAMPATHKUMARAN.

As regards the policy I consider the boundary between pure and applied science does not exist. One easily encroaches on the other. It is not desirable that we should live in such water-tight compartments. I am asking some of my research students to work on plants of economic importance and I should like to get them published in this Journal. I fully agree with Mr. Burt's idea that we should encourage such publication in our Journal.

SUBJECT No. 3.—TO CONSIDER THE RECOMMENDATIONS OF THE ANIMAL HUSBANDRY WING MEETING OF THE BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY, HELD IN FEBRUARY 1933, IN REGARD TO THE JOURNALS DEALING WITH LIVESTOCK MATTERS.

The question as to the best arrangements which should be made for the future to insure prompt publication of original work and for keeping field workers in touch with important advances in animal husbandry matters was considered by the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry at its meeting held in February 1933. A note by Col. A. Olver, Animal Husbandry Expert, Imperial Council of Agricultural Research, on the subject was circulated on the occasion. It has now been brought up-to-date and is attached. (Enclosure I).

2. The subject before being taken up by the Animal Husbandry Wing of the Board of Agriculture was considered by the sub-committee on Veterinary Education; the recommendations of this sub-committee were placed before and adopted by the Animal Husbandry Wing. Relevant extracts from the report of the sub-committee and the Proceedings of the Animal Husbandry Wing meeting are enclosed (Enclosure II). It will be seen that the sub-committee reviewed the position as it then

was, of the two journals 'Indian Journal of Veterinary Science and Animal Husbandry' and 'Agriculture and Livestock in India' which contain matters relating to Animal Husbandry and made the following recommendations, which were adopted by the Animal Husbandry Wing.

3. As regards the 'Indian Journal of Veterinary Science and Animal Husbandry', the sub-committee recommended:—

- (1) That it would be preferable to enlarge the size of the present quarterly issues rather than to increase the number of issues per annum.
- (2) That it should not accept clinical articles.
- (3) That its abstracting section should be enlarged as a medium for disseminating the results of scientific work carried out in other tropical countries.

4. In regard to the 'Agriculture and Livestock in India', it recommended—

- (1) That it should cater almost entirely for the non-scientific practical man.
- (2) That an endeavour should be made to secure original contributions from practical farmers on topical subjects.

These recommendations are now for the consideration of the Editorial Committee.

CHARAN DAS,
Secretary.

ENCLOSURE I.

A NOTE BY COLONEL A. OLVER, C.B., C.M.G., F.R.C.V.S., ANIMAL HUSBANDRY EXPERT
TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH DEPARTMENT.

The third volumes of the Council's two journals, in which Animal Husbandry subjects are dealt with, viz., "The Indian Journal of Veterinary Science and Animal Husbandry" and "Agriculture and Livestock in India" are now complete on the circular letter addressed to local Governments, announcing the publication of the Council's three journals, it was explained that the former is intended essentially for scientific and technical matter and the latter for articles of more general interest. It was also announced that the Council would supply free a reasonable number of copies of its publications for the use of Provincial Agricultural and Veterinary Departments in exchange for their publications, and it was decided that the scientific journals should each consist of two parts, one for original articles and one for abstracts. Abstractors were appointed for each province, the authors of original articles were asked to furnish abstracts for publication and local Governments were asked to accord their support to these publications.

The first numbers appeared in the spring of 1931 and this meeting furnishes a good opportunity to take stock of the existing position. Taking the scientific journal first—the Indian Journal of Veterinary Science and Animal Husbandry.—The following table gives details of the type of material which has been so far published in each number, viz:—

	Volume I.				Volume II.				Volume III.			
	Pt. I.	Pt. II.	Pt. III.	Pt. IV.	Pt. I.	Pt. II.	Pt. III.	Pt. IV.	Pt. I.	Pt. II.	Pt. III.	Pt. IV.
Original Articles	25	80	46	50	70	70	86	82	128	67	59	47
Resumé of Reviews	10	7	..	13	..	..	..	..	..	2	2	..
Clinical Notes . . . . .	..	3	11	7	..	..	4	..	..	1	1	3
Abstracts	7	10	10	3	1	2	5	..	..	3	4	..
Selected Articles	20	14	14	30	30	32	4	..	..	13	22	30
Total	62	114	81	103	101	104	99	82	128	88	91	81

It will be observed that the primary object of this journal, to publish scientific and technical matter, has been kept in mind and that the proportion of such material has steadily increased certain numbers having consisted almost entirely of original articles.

This has been partly due to stringent orders to economise during the recent financial crisis, in consequence of which the journals had to be kept as small as possible and the number of illustrations reduced to the minimum. This affected Part III of Volume II to some extent and Part IV in particular, with the result that other matter was crowded out by original articles some of which had been awaiting publication for some time.

It is to be hoped that this phase is only a passing one and that it may soon be possible to expand this journal to meet the obvious demand which exists for a suitable medium for the publication of original matter.

Sufficient suitable material is available and promised to relieve the Editorial Committee of anxiety for the immediate future and with the combined support which has been accorded to it hitherto by research workers, in all branches of animal husbandry there seems every prospect that matter of the requisite standard of scientific accuracy and originality, will continue to be available and that this journal will furnish a valuable medium for the publication of such material. It is however, a matter for consideration whether, a further effort is not called for to endeavour better to attain the second object of publishing these journals, *viz.*, to disseminate knowledge of scientific work carried out in other countries, as a means of instruction for field workers in India.

In the case of 'Agriculture and Livestock' the general lack of original material and abstracts suitable articles of a non-technical nature, dealing with animal husbandry matters, has been severely felt, and is reflected in the composition of this journal.

What is most required in this case is that workers in a position to do so, for example college professors and research workers at institutions where well-filled libraries exist, should abstract from published literature articles of general practical interest which would assist field workers to keep in touch with current developments of Animal Husbandry in all its branches.

So far no abstracts from published literature of material of this kind have been received and only a very few for the scientific journal, and it has been necessary to deal with Animal Husbandry subjects mainly by the publication of articles selected from the current publications received in this office.

Since 'Agriculture and Livestock in India' is essentially a journal in which articles of popular interest to stock-owners should find a prominent place, and to which busy field workers should be able to turn for information regarding recent advances in animal husbandry work, more material from workers in close touch with such work and a more thorough abstraction of current literature is required.

The abstractors appointed for each province have in fact, with very few exceptions failed to function and though this failure has not so far been seriously felt in the case of the 'Indian Journal of Veterinary Science and Animal Husbandry,' a steady flow of abstracts for agriculture and livestock in India is badly needed. Suitable material is undoubtedly available but it is obviously impossible for any one person to deal with the mass of literature published now-a-days, on Animal Husbandry subject, and it seems that some arrangement will have to be made for selected workers to be responsible for the abstraction of a certain limited number of publications each.

This is particularly necessary where translations have to be made, as even if one translates as fast as a stenographer can take down, the time involved in abstracting and typing an article of any importance is far more than the restricted staff of this office can afford.

With the return to more prosperous times it seems certain that the present restriction of the 'Indian Journal of Veterinary Science and Animal Husbandry' to 100 pages in a quarterly issue will have to be modified, in order to facilitate prompt publication of original matter, and it is for consideration whether the best way to do this to increase the size of each number or to reduce the interval between numbers to a two-monthly one. In the interests of research workers the latter course is much to be preferred, though it would mean more work for the editorial and publication staff and would no doubt be somewhat more costly.

With a view to effecting much needed improvement in the appearance and durability of our journals the attention of the Publication Branch was drawn last autumn to the very unsatisfactory state in which copies reached this office and after the

matter had been discussed with the Manager, Government of India, Central Publication Branch, in Calcutta, changes were proposed by which some space would be saved and the journals would be much improved in appearance and durability without any material increase in cost.

ENCLOSURE II.

Extracts from the Proceedings of the meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry, held in February, 1933.

6. To review the present position of the two journals published by the Imperial Council of Agricultural Research in which animal husbandry subjects are dealt with and to suggest the best arrangements for the future to insure prompt publication of original work and for keeping field workers in touch with important advances in animal husbandry matters (Subject No. 4 of the Agenda.)

There was general agreement that the journals had maintained a high scientific quality but that their get-up was capable of improvement. The recommendations of the Sub-committee were adopted.

Extracts from the Report of the Sub-Committee on 'Veterinary Education'.

- Subject No. 4.*—To review the present position of the two journals published by the Imperial Council of Agricultural Research, in which animal husbandry subjects are dealt with, and to suggest the best arrangements for the future to ensure prompt publication of original work and for keeping field workers in touch with important advances in animal husbandry matters.

The Committee wish to record their opinion that the Indian Journal of Veterinary Science and Animal Husbandry is filling a long-felt want and is proving a most useful addition to the list of available Veterinary periodicals.

(1) In the present state of development of animal research work in India, it is considered preferable, in order to deal with any increase in the number of original articles, to enlarge the size of the present quarterly issues rather than to increase the number of issues, per annum.

(2) It is felt that this journal should not accept clinical articles for publication, but that its (3) abstracting section might be enlarged in order that it may form a convenient medium for disseminating the results of scientific work carried out in other tropical countries to field workers in India.

(4) In regard to 'Agriculture and Livestock in India', it is considered desirable that, both in the matter of original articles and abstracts, it should cater almost entirely for the non-scientific practical man, and in addition to articles of this type from professional men.

(5) Endeavours should be made to secure original contributions from practical farmers on topical subjects, such as would be discussed in the market place rather than in the Laboratory.

SUBJECT NO. 4.—'MISCELLANEOUS BULLETINS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH'.

Attention is invited to the enclosed copy of this Department Memorandum No. D./1506-33-Pub., dated the 19th September 1933, to the Editorial Committee. As mentioned therein a new series of publication entitled 'Miscellaneous Bulletins of'

the Imperial Council of Agricultural Research' has been started with a view to providing a suitable medium for the publication of any useful material received for publication that may not be suitable for the existing Journals or Monographs. The following four papers have so far been accepted for publication in this series :—

1. List of Publications on Indian Entomology, by the Imperial Entomologist, 1930.
2. List of Publications on Indian Entomology, by the Imperial Entomologist, 1931.
3. List of Publications on Indian Entomology, by the Imperial Entomologist, 1932.
4. Host Plant Index of Indo-Ceylonese Coccidæ by S. Ramachandran and T. V. Ramakrishna Ayyar.

2. The subject is submitted for the information of the Editorial Committee and for any remarks which members may wish to offer.

CHARAN DAS,
Secretary.

COPY OF A MEMORANDUM No. D./1506-33-PUB., DATED THE 19TH SEPTEMBER 1933, FROM THE OFFG. SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO ALL MEMBERS OF THE EDITORIAL COMMITTEE.

Members of the Editorial Committee are aware that the marginally noted publications are being issued under the auspices of the Imperial Council of Agricultural Research. The undersigned is directed to state that recently a paper entitled 'List of Publications in Indian Entomology for 1930 and 1931' compiled by the Imperial Entomologist, Pusa, was received for publication, and the Committee considered that its publication would be exceedingly useful to research workers in the country. It was, however, found that the paper could not conveniently be accommodated in any of the existing series of the Council's publications dealing with agricultural science, being too long for publication in the 'Indian Journal of Agricultural Science', and unsuitable for the series of Scientific Monographs. As similar lists of publications on other subjects are expected occasionally in future, it was considered expedient to start a new series entitled 'Miscellaneous Bulletins of the Imperial Council of Agricultural Research', in which can be published any useful material received for publication which is not suitable for the present Journals and monographs. The size of the Bulletins, which will be issued occasionally as material is available, will be crown quarto. The Controller of Printing has accorded sanction to the printing of the series. The matter is now for the information of the Editorial Committee.

1. Agriculture and Livestock in India.
2. Indian Journal of Agricultural Science.
3. Indian Journal of Veterinary Science and Animal Husbandry.
4. Scientific Monographs of the Imperial Council of Agricultural Research.

SUBJECT NO. 5.—REVISION OF THE LIST OF REFEREES.

Attention is invited to the enclosed copy (Enclosure I) of this Department Memorandum No. 780/4-Pub., dated the 18th April 1933, to the Editorial Committee, in which members were informed of certain additions and alterations made in the List of Referees for the examination of papers received for publication in the Council's journals. Since then the following changes have been carried out in it :—

1. Dr. W. Burns, one of the referees for 'Botany' (Genetics as well as General) expressed his inability to continue as a referee, in view of the pressure of his duties as Director of Agriculture, Bombay, and his name has therefore been removed from the list.
2. Lt.-Col. R. N. Chopra has been appointed as a referee for papers in 'Pharmacology and Poisonous plants'.
3. Mr. H. Cooper, one of the referees for 'Veterinary Pathology and Bacteriology' has died recently, and his name has therefore been removed from the list.

2. The following gentlemen have kindly assisted us with the refereeing of individual papers :—

1. Dr. C. W. B. Normand, Director General of Observatories, Poona. (Agricultural Meteorology).
 2. Dr. Mackenzie Taylor, Director, Irrigation Research Laboratory, Lahore. (Agricultural Meteorology).
 3. Mr. F. J. Plyman, Director of Agriculture, Central Provinces, (Agricultural Chemistry and Bacteriology).
 4. Mr. D. V. Bal, Agricultural Chemist, Central Provinces, (Agricultural Chemistry and Bacteriology).
 5. Mr. M. Carbery, Agricultural Chemist, Bengal. (Agricultural Chemistry.)
 6. Dr. Nazir Ahmad, Director, Cotton Technological Laboratory, Matunga. (Cotton Technology.)
 7. Mr. P. V. Isaac, Offg. Imperial Entomologist. (Agricultural Entomology.)
 8. Prof. P. C. Mahalanobis, Professor of Physics, Presidency College, Calcutta. (Statistical treatment of experimental data.)
 9. Rao Bahadur T. S. Venkatraman, Imperial Sugarcane Expert, Coimbatore. (Sugarcane breeding.)
3. The list as it stands at present (Enclosure II) is submitted to the Editorial Committee for any additions, alterations, etc., which members may wish to suggest.

CHARAN DAS,
Secretary.

ENCLOSURE I.

COPY OF MEMORANDUM No. 780/4-PUB., DATED THE 18TH APRIL 1933, TO THE EDITORIAL COMMITTEE OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Attention is invited to the enclosed extract from the Proceedings of the meeting of the Editorial Committee, held on the 29th January, 1932, in which the Committee revised the list of referees for the examination of papers received for publication in the Council's journals. Since the list was last revised by the Committee, the following changes and additions have been carried out in it on the suggestion of the Expert Advisers to the Council, and a copy of the revised list embodying the changes and additions is enclosed for the information of the other members of the Editorial Committee :—

1. Mr. D. Milne, one of the referees for 'Botany-General and Systematic' having recently proceeded on leave preparatory to retirement, the name of Dr. W. Burns has been substituted in his place.
2. The names of the following have been added to the list :—
 - (i) Messrs. J. C. McDougall and H. R. Stewart, under 'General Agriculture'.
 - (ii) Professor Birbal Sahni under 'Botany-General and Systematic'.
 - (iii) Dr. Hem Singh Pruthi, under 'Entomology'.
 - (iv) Mr. T. J. Hurley, under 'Veterinary Medicine'.
 - (v) Mr. P. V. Isaac under 'Veterinary Entomology'.
 - (vi) Dr. K. C. Sen under 'Animal Biochemistry'.

ENCLOSURE II.

LIST OF REFEREES.

General Agriculture.

D. R. Sethi, Esq., M.A., B.Sc., (Edin.) I.A.S., Director of Agriculture, Bihar and Orissa, Patna.

T. D. Stock, Esq., B.Sc., D.I.C., A.R.C.S., Deputy Director of Agriculture, Burma.

H. G. Allan, Esq., M.A., Director of Agriculture, United Provinces, Lucknow.
Wynne Sayer, Esq., B.A., I.A.S., Imperial Agriculturist, Imperial Institute of Agricultural Research, Pusa.

Professor N. N. Gangulee, B.Sc., Ph.D., Khaira Professor of Agriculture, Calcutta University, Calcutta.

J. C. McDougall, Esq., M.A., B.Sc., Principal, Agricultural College, Nagpur.

H. R. Stewart, Esq., F.R.C.Sc.I., D.I.C., N.D.A., Director of Agriculture, Punjab, Lahore.

Plant and Soil Bio-Chemistry.

Dr. V. Subrahmanvan, D.Sc., F.I.C., Professor of Bio-Chemistry at the Indian Institute of Science, Bangalore.

Rao Bahadur B. Viswanath, F.I.C., Agricultural Chemist, Coimbatore, P. O. Lawley Road, Madras.

Mrs. Dorothy Norris, M.Sc., Director, Lac Research Institute, Namkum, Ranchi.

Physical Chemistry.

Professor S. S. Bhatnagar, D.Sc., F.Inst.P., Professor of Chemistry, Punjab University, Lahore.

Professor J. C. Ghosh, D.Sc., Professor of Chemistry, Dacca University, Dacca.

J. Charlton, Esq., M.Sc., F.I.C., I.A.S., Agricultural Chemist to the Government of Burma, and Principal, Agricultural College, Mandalay, Burma.

Dr. H. E. Watson, D.Sc. (Lond.), F.I.C., Professor, Department of General Chemistry, Indian Institute of Science, Bangalore.

P. H. Carpenter, Esq., F.I.C., F.C.S., Chief Scientific Officer, Indian Tea Association, Tocklai, P. O. Cinnamara, Assam.

Agricultural Bacteriology.

N. V. Joshi, Esq., B.A., M.Sc., L.Ag., Assistant to the Imperial Agricultural Bacteriologist, Pusa.

Botany-Genetics.

Dr. F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S., I.A.S., Imperial Economic Botanist, Pusa.

Dr. G. P. Hector, M.A., D.Sc., I.A.S., Economic Botanist to Government of Bengal, Dacca.

D. N. Mahta, Esq., B.A. (Edin.), F.L.S., Economic Botanist to Government, Central Provinces, Nagpur.

D. Rhind, Esq., B.Sc., I.A.S., Economic Botanist to Government of Burma, Mandalay.

Botany (Genetics-Cytology.)

Dr. M. A. Sampathkumaran, M.A., Ph.D., Professor of Botany, Central College, Bangalore.

Botany—General and Systematic—and Horticulture.

Professor S. P. Agharkar, M.A., Ph.D., F.L.S., Ghose Professor of Botany, Calcutta University, Calcutta.

Professor Birbal Sahni, M.A., D.Sc., Sc.D., F.G.S., F.A.S.B., Professor of Botany, Lucknow University, Lucknow.

Plant Physiology.

Professor P. K. Parija, M.A., I.E.S., Professor of Botany, Ravenshaw College, Cuttack.

Professor T. Ekambaram, M.A., L.T., Ph.D., Professor of Botany, Presidency College, Madras.

Mycology.

Dr. W. McRae, M.A., D.Sc., I.A.S., Director, Imperial Institute of Agricultural Research and Imperial Mycologist, Pusa.

Dr. K. C. Mehta, M.Sc., Ph.D. (Cantab.), Professor of Botany, Agra College, Agra.

S. Sundararaman, Esq., M.A., I.A.S., Government Mycologist, Coimbatore, P. O. Lawley Road.

Entomology.

M. Afzal Hussain, Esq., M.Sc. (Punjab), M.A., (Cantab.), Locust Research Entomologist, Imperial Council of Agricultural Research, Agricultural College, Layallpur.

P. B. Richards, Esq., A.R.C.S., F.E.S., I.A.S., Entomologist to Government, United Provinces, Cawnpore.

Rao Sahib Y. Ramachandra Rao, M.A., F.E.S., Deputy Locust Entomologist of the Imperial Council of Agricultural Research, Baluchistan, Quetta.

Dr. B. N. Chopra, D.Sc., Assistant Superintendent, Zoological Survey of India, Calcutta.

Dr. Hem Singh Pruthi, M.Sc., Ph.D., Assistant Superintendent, Zoological Survey of India, Calcutta.

Agricultural Engineering.

T. A. Brownlie, Esq., C.E., M.I.W.E., M.I.M. and E.E., Agricultural Engineer to Government, Punjab, Lyallpur.

Agricultural Economics.

Dr. L. K. Hyder, B.A., Ph.D., C.I.E., Member, Public Service Commission, Simla/Delhi.

Veterinary Surgery.

A. D. McGregor, Esq., F.R.C.V.S., I.V.S., Principal, Bengal Veterinary College, Belgachia, Calcutta.

Ulric W. F. Walker, Esq., M.C., M.R.C.V.S., I.V.S., Professor of Surgery, Punjab Veterinary College, Lahore.

Veterinary Medicine.

P. J. Kerr, Esq., M.R.C.V.S., I.V.S., Director, Civil Veterinary Department, and Veterinary Adviser to Government, Bengal, Calcutta.

W. Taylor, Esq., M.R.C.V.S., D.V.H., I.V.S., Principal, Punjab Veterinary College, Lahore.

T. J. Hurley, Esq., M.R.C.V.S., D.V.S.M., Principal and Professor of Medicine, Madras Veterinary College, Madras.

Veterinary Pathology and Bacteriology.

V. Krishnamurti Iyer, Esq., G.M.V.C., Ag. Principal, Madras Veterinary College, Madras.

J. F. Shirlaw, Esq., M.R.C.V.S., Professor of Pathology and Bacteriology, Punjab Veterinary College, Lahore.

Proto-Zoology.

Col. R. Knowles, I.M.S., Professor of Protozoology, School of Tropical Medicine and Hygiene, Calcutta.

Š. K. Sen, Esq., B.A., M.Sc., F.E.S., Protozoologist, Muktesar.

Virus Diseases and Serum Preparation.

J. R. Haddow, Esq., B.Sc., M.R.C.V.S., D.V.S.M., I.V.S., Deputy Director, Imperial Veterinary Serum Institute, Izatnagar.

Helminthology.

F. Ware, Esq., F.R.C.V.S., I.V.S., Director, Imperial Institute of Veterinary Research, Muktesar.

Dr. Maplestone (School of Tropical Medicine and Hygiene, Calcutta.)

G. D. Bhalerao, Esq., M.Sc., Helminthologist, Imperial Institute of Veterinary Research, Muktesar.

Anantanarayana Rao, Esq., G.M.V.C., Lecturer in Parasitology, Madras Veterinary College, Madras.

Veterinary Entomology.

P. G. Malkani, Esq., B.A., B.Sc., M.R.C.V.S., Research Officer and Professor of Pathology and Bacteriology, Bihar and Orissa, Veterinary College, Patna.

S. K. Sen, Esq., B.A., M.Sc., F.F.S., Protozoologist, Imperial Institute of Veterinary Research, Muktesar.

P. V. Isaacs, Esq., B.A., D.I.C., M.Sc., F.E.S., Offg. Entomologist, Imperial Institute of Agricultural Research, Pusa

Mycotic Diseases.

Col. H. W. Acton, I.M.S., Director, School of Tropical Medicine and Hygiene, Calcutta.

Animal Bio-Chemistry.

F. J. Warth, Esq., M.Sc., I.A.S., Physiological Chemist, Imperial Department of Agriculture in India, Bangalore.

Dr. P. E. Lander, M.A., D.Sc., A.I.C., I.A.S., Agricultural Chemist to Government, Punjab, Lyallpur.

Dr. K. C. Sen, D.Sc., Biochemist, Imperial Institute of Veterinary Research, Muktesar, Kumaon, U. P.

Animal Breeding.

C. H. Parr, Esq., B.Sc., I.A.S., Deputy Director in charge of Cattle Breeding Operation, United Provinces, Muttra.

E. J. Bruen, Livestock Expert to Government, Bombay Presidency, Poona.

R. W. Littlewood, Esq., N.D.A., I.A.S., Deputy Director of Agriculture, Livestock, Madras, Hosur.

Dairying.

Z. R. Kothawala, Esq., B.Ag., B.Sc., N.D.D., Imperial Dairy Expert, Bangalore.

Capt. C. E. Macguckin, M.B., H.D.A., Assistant Controller, Military Dairy Farms, Northern Circle.

SUBJECT No. 6.—QUESTION OF IMPROVING THE ILLUSTRATIONS IN THE COUNCIL'S JOURNALS

Attention is invited to the enclosed extract from the letter of 31st January 1934 from Dr. M. A. Sampathkumaran, in which it is proposed that the question of the improving the illustrations in the Council's publications may be discussed by the Editorial Committee.

2. This question falls under two heads, viz. :—

(a) Original drawings and photos intended for reproduction in the Council's publications should be prepared and sent by authors in proper form.

(b) Proper reproduction of illustrations in Press.

3. As regards (a), attention is invited to paragraphs 14--19 of the "Instructions to authors of publications of the Imperial Council of Agricultural Research*", in which directions are given for preparing different kinds of illustrations in the proper form. Copies of the "Instructions" have been distributed to all Departments of Agriculture and Veterinary and Universities in India.

* Not printed.

4. In regard to (b), it may be mentioned that the process work connected with the Council's publications is being done through private firms in Calcutta, as the Government of India Press, Calcutta, where these publications are printed, does not possess the necessary equipment for such work. The work produced by these private firms has, however, been found in several cases to be not satisfactory, especially as regards colour reproduction, and the Manager of the Calcutta Press has been asked in such cases to get the blocks improved by the firms in question. He has also been instructed to secure as far as possible the best workmanship available in Calcutta for the reproduction of the illustrations in the Council's publications.

5. The question is now for the discussion of the Editorial Committee.

CHARAN DAS,
Secretary.

Extract from a D.-O. letter dated the 31st January 1934, from Dr. M. A. Sampathkumaran to Rai Sahib Malik Charan Das, Secretary, Imperial Council of Agricultural Research.

* *

As regards the Agenda I wish to suggest that there may be some discussion on the improvement of illustrations in the Journal.

* *

SUBJECT No. 7.—PROPOSAL TO PRINT THE 'INSTRUCTIONS TO AUTHORS OF PUBLICATIONS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH', IN THE COUNCIL'S JOURNALS, EITHER AT THE COMMENCEMENT OF EVERY YEAR OR ONCE IN TWO YEARS.

Attention is invited to the enclosed extract from a letter dated the 31st January 1934 from Dr. M. A. Sampathkumaran, in which he proposes that the 'Instructions to Authors of publications of the Imperial Council of Agricultural Research' may be printed in the journals either at the commencement of every year or once in two years.

2. A copy of the 'Instructions to Authors of Publications of the Imperial Council of Agricultural Research' is attached*. It may be mentioned that these Instructions were originally published in Part I, Vol. I of all the Council's journals, and that copies of the Instructions were distributed in 1931 to all Agricultural and Veterinary Departments, Universities and Institutes in India. Copies are also being supplied to all those who ask for them.

The proposal is submitted for the consideration of the Editorial Committee.

CHARAN DAS,
Secretary.

Extract from a D.-O. letter dated the 31st January 1934, from Dr. M. A. Sampathkumaran to Rai Sahib Malik Charan Das, Secretary, Imperial Council of Agricultural Research.

* *

Further that instructions may be printed in the Journal for the help of the authors about the way in which the papers (letter press, illustrations, citations) should be prepared. This may be printed in the beginning of every year or once in two years. This also may be included in the Agenda.

* *

* Not printed.

ANNEXURE II.

PROCEEDINGS OF THE MEETING OF THE EDITORIAL COMMITTEE OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH HELD ON SATURDAY, THE 17TH FEBRUARY 1934.

The following were present :

1. Dewan Bahadur Sir T. Vijayaraghavacharya, Chairman
 2. Mr. B. C. Burt.
 3. Col. A. Oliver.
 4. Dr. F. J. Warth,
 5. Dr. M. A. Sampathkumaran.
 6. Mr. W. Taylor.
- Rai Sahib Malik Charan Das, Secretary.

The meeting lasted from 11 A. M. till 2 P. M.

2. Proposal to print the 'Instructions to authors of the publications of the Imperial Council of Agricultural Research in the Council's Journals at the commencement of every year or once in two years. (Subject No. 7 of the Agenda.)

Dr. Sampathkumaran, who was invited by the Chairman to open the discussion on the subject, said that some of the papers received for publication in the Journals were not prepared in proper form by authors in regard to the system of referencing, illustrations, etc. He thought therefore that it would be an advantage if the 'Instructions' were printed periodically in the Journals, as is done in the case of Journals like the 'Indian Journal of Medical Research', etc. This proposal was accepted by the Committee, which recommended that the 'Instructions' should be published in the 1st number of each Journal every year, and that a notice should be inserted in a prominent place in all issues of the Journals drawing the attention of authors to the 'Instructions', mentioning the issue in which they were last published. For the year 1934, it was decided to include the 'Instructions' in the next numbers of the Journals. It was also agreed that a stock of spare copies of the 'Instructions' should be kept in the Council's Office for supply to authors whenever necessary, and that this fact should be mentioned when the 'Instructions' were published in the Journals.

The members of the Committee promised to go through the 'Instructions' at leisure and to forward suggestions for any additions, alterations, which they might consider necessary; any changes which may be decided upon would be published in the Journals in due course.

3. Question of improving the Illustrations in the Council's publications (Subject No. 6 of the Agenda).

Dr. Sampathkumaran was of the opinion that many of the half tone illustrations appearing in the Council's Journals did not compare favourably with those appearing in the Journals published in England, America and Germany. He suggested that an attempt might be made to get some of the illustrations reproduced in England as is done by some Journals in India. He was also of the view that there was scope for improvement in the get up of the journals and that better paper might be employed for the printing than that now in use in which the print shows through. As regards the illustrations, Mr. Burt explained that the Council was probably getting the best workmanship available in Calcutta for the purpose, and pointed out that the cost of the Journals would become prohibitive if illustrations were reproduced in England as suggested by Dr. Sampathkumaran. He added that if it could be shown that better work was being done anywhere in India, then the Department would urge the Government Press to bring up the illustrations of the Council's Journals to that level. The Chairman also pointed out difficulties, both financial and otherwise, in the way of adopting Dr. Sampathkumaran's suggestion. Dr. Warth was of the view that the illustrations as they were, were fairly satisfactory and usually demonstrated the authors' points adequately. The consensus of opinion was that the illustrations were generally adequate as they were, though in certain cases the block makers could have done better. Dr. Sampathkumaran said that as our Journals were sent in large numbers to outside countries, it would not be creditable to this country if illustrations in the Journals of the Government of India did not compare favourably with those of other countries. He also said that very good illustration work was being done at the Mysore Government Press, Bangalore. Dr. Sampathkumaran was asked to let the Council's Office have some samples of reproductions by the Bangalore Press and if those

reproductions were really better, action would be taken by the Council's Secretariat in the direction of getting the standard of their work improved to that standard.

4. As regards the paper used for the Journals, it was pointed out that the paper was not good enough with the result that the text of one page showed itself on the reverse side. It was explained that representations had been made to the Controller regarding the use of better paper for the covers and the removal of one or two other defects in the get-up of the Journals. It was thought that the paper now used was not much inferior to that used in some foreign journals but it was decided to continue efforts for improvement. It was particularly recommended that such paper should be used that the text would not show through on the reverse.

5. *Revision of the list of referees.* (Subject No. 5 of the Agenda).

The Chairman went through the list under each section and invited suggestions from members in each group: as a result the following changes were agreed to:

(a) The heading "General Agriculture" was altered into "General Agriculture and Horticulture". In this section, it was decided to omit the name of Dr. N. N. Gangulee, who is out of India and to add in his place the name of a suitable referee from Madras possibly the Professor of Agriculture, Coimbatore or Mr. D. G. Munroe, Deputy Director of Agriculture, Coimbatore:

(b) The heading "Physical Chemistry" was changed to "Physical Chemistry and Physics". In this section, Dr. H. E. Watson's name was omitted and the following were added:]

Dr. Mackenzie Taylor, Director, Irrigation Research Laboratory, Lahore.

Dr. Nazir Ahmad, Director, Cotton Technological Research Laboratory, Matunga, Bombay.

Dr. K. R. Krishnaswami Iyer, Indian Institute of Science, Bangalore.

(c) Under "Agricultural Bacteriology", the name of "Mr. D. V. Bal, Offg. Agricultural Chemist, Central Provinces, Nagpur", was added.

(d) The heading "Botany-Genetics" was altered into "Botany-Plant Breeding and Genetics and Cytology" and the names of Mr. J. B. Hutchinson, Geneticist, Institute of Plant Industry, Indore and Professor Sampathkumaran added.

(e) The heading "Botany-Genetics-Cytology" was omitted and the next heading "Botany-General and Systematic and horticulture" was changed to Botany-Morphology and Systematic; the name of Dr. M. A. Sampathkumaran, Professor of Botany, Central College, Bangalore, was added under the latter.

(f) Under "Mycology", the name of Mr. M. J. Narasimham, Mycologist, Mysore Agricultural Department, was added.

(g) Under "Agricultural Engineering", the following were added:

Mr. N. G. Charlie, Agricultural Research Engineer, Madras.

Mr. H. W. Stewart, Agricultural Engineer, Bihar and Orissa.

(h) Under "Agricultural Economics", the name of Professor P. J. Thomas, University Professor, Madras, was added.

(i) Under "Virus Diseases and Serum Preparation", the name of Mr. J. F. Shirlaw, Professor of Pathology and Bacteriology, Punjab Veterinary College, Lahore, was included.

(j) Under "Veterinary Entomology", the name of Mr. H. L. Bhatia, Assistant, Entomological Section, Pusa, was added.

(k) Under "Animal Breeding", the name of Captain C. E. Macguckin, Assistant Controller, Military Dairy Farms, Northern Circle, was added.

The List of referees as revised by the Committee is attached (Appendix I).

6. *Miscellaneous Bulletins of the Imperial Council of Agricultural Research.* (Subject No. 4 of the Agenda).

Mr. Burt explained that the Miscellaneous Bulletins had been started with a view to providing a suitable medium for the publication of useful scientific material that might not be suitable for the existing Journals and the Monographs. The kind of matter proposed to be published in the series would be what might be termed professional rather than scientific. All the members were agreed that the starting of this new series was very desirable.

7. To consider the recommendations made by the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held in February, 1933 in regard to the Journals dealing with Livestock matters. (Subject No. 3 of the Agenda).

The five recommendations noted below made by the Animal Husbandry Wing were taken up for consideration one by one :—

(i) *"That in the case of the Indian Journal of Veterinary Science and Animal Husbandry, it would be preferable to enlarge the size of the present quarterly issues rather than to increase the number of issues per annum".*

This was agreed to unanimously.

(ii) *"That the 'Indian Journal of Veterinary Science and Animal Husbandry' should not accept clinical articles."*

Colonel Olver explained that the clinical papers being mainly of more general professional interest were considered by the Sectional Committee which dealt with the subject at the Animal Husbandry Wing Meeting to be out of place in a scientific journal. Mr. Taylor agreed with that view but thought that a certain number of clinical papers that were coming from Veterinary Colleges in India were of great general interest to all field workers. He suggested that such material should be made available in some form. Dr. Sampathkumaran enquired whether such notes could not be published in the Miscellaneous Bulletins series. The point was then considered whether it would be worthwhile to republish the clinical papers which were being published in provincial publications with a view to making them available to all workers in India. Colonel Olver and Mr. Taylor thought that such clinical papers were of considerable professional interest. In the result, the Committee recommended that the Council might collect together suitable clinical papers, whether they had appeared in provincial publications or not, and publish them periodically, as a Miscellaneous Bulletin and entitled "Selected Clinical Articles".

(iii) *"That the abstracting section of the 'Indian Journal of Veterinary Science and Animal Husbandry' should be enlarged as a medium for disseminating the results of scientific work carried out in other tropical countries."*

Col. Olver was of the opinion that some arrangement would have to be made for abstracting from literature appearing in foreign journals, articles of general practical interest which would assist field workers to keep in touch with current developments in animal husbandry in all its branches, and that the employment of a full-time abstractor with a knowledge of foreign languages would eventually be necessary as abstracts would have to be translated in many cases. Mr. Taylor agreed that an enormous amount of material was appearing in foreign languages which should be made available to workers in India. So far as the agricultural side was concerned, Mr. Burt was of the view that the abstracts and special articles published by the Imperial Agricultural Bureaux covered a wide field and kept research workers in India in touch with current literature. But Col. Olver thought that on the Animal Husbandry side such abstracts, though available to research workers, were not seen by field-workers, who wanted more detailed abstracts of particular articles than were given in abstracting journals, to keep them in touch with current work. The question of appointing a whole-time abstractor was however dropped as there appeared to be no one immediately available capable of doing the work. It was therefore recommended that the members of the Animal Husbandry Section of the Editorial Committee might mark suitable articles for being abstracted by any abstractors who had expert knowledge of the subject as well as of the language and who might be remunerated according to the amount of work produced. As regards the rate of remuneration, it was recognised that no hard and fast rule could be laid down as it would have to vary according to the length of the abstract as well as any special difficulties in each case. As a general principle it was considered that the remuneration might be about Rs. 15 for an abstract of 200 words. The Committee also recommended that this scheme might be tried for a year.

(iv) *"That Agriculture and Livestock in India should cater almost entirely for the non-scientific practical man."*

Col. Olver explained that what had been suggested was that the popular journal should contain articles which were written by scientific men in a popular manner and which would be intelligible to the non-scientific practical man. As a model, he cited the journal 'Farming in South Africa'. He thought that articles containing a certain amount of research work should not, for the mere reason that they did not come up to the standard required for the scientific journals, be published in the 'Agriculture

and Livestock in India'. Mr. Burt, while agreeing with the latter view, was not in favour of making a radical change in the present scope of the Journal, as it would be if the Journal were made to cater only for the non-scientific practical man. A large number of agricultural graduates were, he said, being turned out by the Agricultural Colleges in India every year, many of whom were engaged in practical agriculture of one kind or another and the articles of the type now being published which embodied some experimental work, would appeal to them. After some discussion it was agreed that the kind of material now being published should not be excluded, but in addition, special popular contributions might be called for from suitable writers. It was recognised however that to obtain really good contributions, it would be necessary to pay for them. The Committee recommended as a trial for a year that a sum of Rupees one hundred might be set apart for each issue of the Journal for payments to such contributors. The annual cost would be Rs. 600.

(v) *That an endeavour should be made to secure for Agriculture and Livestock in India original contributions from practical farmers on topical subjects.*

This was unanimously agreed to.

8. To consider whether papers in pure botany should be published in the Indian Journal of Agricultural Science. (Subject No. 2 of the Agenda).

Mr. Burt explained how the question arose. A paper entitled 'Studies in the Development of the Female Gametophyte in some leguminous crop plants in India' was received for publication and the referee to whom the paper was referred considered that the paper was a good one for a purely botanical journal but was not suitable for an agricultural journal. The paper was eventually published in the 'Indian Journal of Agricultural Science' as the Agricultural Section of the Editorial Committee was in favour of publishing the article in question. As regards the question of the general policy to be followed in future, Mr. Burt was not in favour of excluding such papers as it would be an advantage to Indian agricultural workers to find such papers in the Agricultural journals. Dr. Sampathkumaran was in agreement with Mr. Burt and said that contributions from Indian Universities, which the Council welcomed, would naturally border on the pure sciences and that such contributions would be useful both to the agricultural Departments and Universities in India. The Committee was agreed that such articles should not be excluded.

9. To review the present position of the Council's publications. [Subject No. I (a) of the Agenda.]

The Committee went through the various statements that were submitted to it showing particulars regarding the working of the Council's publications during the years 1931-33. The members were generally satisfied with the working of the publications and were agreed that they had maintained a high standard throughout. The Chairman observed that the number of books received for review in the journals had not been as high as one would have desired, and suggested that free copies of the journals might be sent to some of the important publishers of agricultural and veterinary books in India and abroad. There was general agreement that the Council's journals had gone to all the important scientific centres in the world, but it was thought it might be profitable to make them better known among publishers than was the case at present. The Chairman's suggestion was adopted by the Committee.

10. Proposal to increase the subscription circulation of the Council's Journals. [Subject No. I (b) of the Agenda.]

The proposal was explained by Col. Oliver. With a view to introducing the Council's journals to as large a number as possible of those interested in such subjects in other countries, it was suggested that Messrs. Thacker Spink & Co., Calcutta, might be authorised to issue a notice to interested publishers, librarians, etc., giving particulars of the publications together with suitable specimen articles from each journal. He added that a circular letter like the one proposed was issued in the case of the publications of the Indian Research Fund Association and that it resulted in a considerable increase in the circulation of those publications. The heaviest item in the cost of this proposal would be the printing of a sufficient number of copies of specimen articles from each journal, and this would vary with the length of the specimen article proposed and the number of illustrations it contained; the cost would be from Rs. 400-500 per journal. The Committee was generally in favour of the proposal.

CHARAN DAS,

Secretary.

The 18th February 1934.

APPENDIX

LIST OF REFEREES.

General Agriculture and Horticulture.

Mr. D. R. Sethi, M.A., B.Sc., (Edin.), I.A.S., Director of Agriculture Bihar and Orissa, Patna.

Mr. T. D. Stock, B.Sc., D.I.C., A.R.C.S., Deputy Director of Agriculture, Burma

Mr. R. G. Allan, M.A., Director of Agriculture, United Provinces, Lucknow.

Mr. Wynne Sayer, B.A., I.A.S., Imperial Agriculturist, Imperial Institute of Agricultural Research, Pusa.

Mr. J. C. McDougall, M.A., B.Sc., Principal, Agricultural College, Nagpur.

Mr. H. R. Stewart, F.R.C.S.I., D.I.C., N.D.A., Director of Agriculture, Punjab, Lahore.

A suitable referee from Madras possibly the Professor of Agriculture, Coimbatore or Mr. D. G. Munroe, Deputy Director of Agriculture, Coimbatore.

Plant and Soil Bio-Chemistry.

Dr. V. Subrahmanyan, D.Sc., F.I.C., Professor of Bio-Chemistry at the Indian Institute of Science, Bangalore.

Rao Bahadur B. Viswanath, F.I.C., Agricultural Chemist, Coimbatore, P. O. Jawley Road, Madras.

Mrs. Dorothy Norris, M.Sc., Director, Lac Research Institute, Namkum, Ranchi.

Physical Chemistry and Physics.

Professor S. S. Bhatnagar, D.Sc., F.Inst.P., Professor of Chemistry, Punjab University, Lahore.

Professor J. C. Ghosh, D.Sc., Professor of Chemistry, Dacca University, Dacca.

Mr. J. Charlton, M.Sc., F.I.C., I.A.S., Agricultural Chemist to the Government of Burma, and Principal, Agricultural College, Mandalay, Burma.

Mr. P. H. Carpenter, F.I.C., F.C.S., Chief Scientific Officer, Indian Tea Association, Tocklai, P. O. Cinamara, Assam.

Dr. Mackenzie Taylor, Director, Irrigation Research Laboratory, Lahore.

Dr. Nazir Ahmad, Director, Cotton Technological Research Laboratory, Matunga, Bombay.

Dr. K. R. Krishnaswami Aiyer, Indian Institute of Science, Bangalore

Agricultural Bacteriology.

Mr. N. V. Joshi, Esqr., B.A., M.Sc., L.Ag., Assistant to the Imperial Agricultural Bacteriologist, Pusa.

Mr. D. V. Bal, Offg. Agricultural Chemist, Central Provinces, Nagpur.

Botany—Plant breeding, Genetics and Cytology.

Dr. F. J. F. Shaw, A.R.C.S., F.L.S., I.A.S., Imperial Economic Botanist, Pusa.

Dr. G. P. Hector, M.A., D.Sc., I.A.S., Economic Botanist to Government of Bengal, Dacca (on leave).

Mr. D. M. Mahta, B.A., (Edin.), F.L.S., Economic Botanist to Government, Central Provinces, Nagpur.

Mr. D. Rhind, B.Sc., I.A.S., Economic Botanist to Government, Burma, Mandalay.

Mr. J. B. Hutchinson, Geneticist, Institute of Plant Industry, Indore.

Dr. M. A. Sampathkumaran, Professor of Botany, Central College, Bangalore.

Botany—Morphology and Systematic.

Professor S. P. Agharkar, M.A., Ph.D., F.L.S., Ghose Professor of Botany, Calcutta University, Calcutta.

Professor Birbal Sahni, M.A., D.Sc., Sc.D., F.G.S., F.A.S.B., Professor of Botany, Lucknow University, Lucknow.

Dr. M. A. Sampathkumaran, Professor of Botany, Central College, Bangalore.

Plant Physiology.

Professor P. K. Parija, M.A., I.E.S., Professor of Botany, Ravenshaw College, Cuttack.

Professor T. Ekambaram, M.A., L.T., Ph.D., Professor of Botany, Presidency College, Madras.

Mycology.

Dr. W. McRae, M.A., D.Sc., I.A.S., Director, Imperial Institute of Agricultural Research and Imperial Mycologist, Pusa.

Dr. K. C. Mehta, M.Sc., Ph.D., (Cantab.), Professor of Botany, Agra College, Agra.

Mr. S. Sundararaman, M.A., I.A.S., Government Mycologist, Coimbatore, P. O. Lawley Road.

Mr. M. J. Narasimham, Mycologist, Mysore Agricultural Department.

Entomology.

Mr. M. Afzal Hussain, M.Sc., (Punjab), M.A., (Cantab.), Entomologist to the Government of Punjab, Lyallpur.

Mr. P. B. Richards, A.R.C.S., F.E.S., I.A.S., Entomologist to Government, United Provinces, Cawnpore.

Rao Sahib Y. Ramachandra Rao, M.A., F.E.S., Locust Research Entomologist of the Imperial Council of Agricultural Research, Karachi.

Dr. B. N. Chopra, D.Sc., Assistant Superintendent, Zoological Survey of India, Calcutta.

Dr. Hem Singh Pruthi, M.Sc., Ph.D., Assistant Superintendent, Zoological Survey of India, Calcutta.

Agricultural Engineering.

Mr. T. A. Brownlie, C.E., M.I.W.E., M.I.M., and E.E., Agricultural Engineer to Government, Punjab, Lyallpur.

Mr. N. G. Charlie, Agricultural Research Engineer, Madras.

Mr. H. W. Stewart, Agricultural Engineer, Bihar and Orissa.

Agricultural Economics.

Dr. L. K. Hyder, B.A., Ph.D., C.I.E. Member, Public Service Commission, Simla/Delhi.

Prof. P. J. Thomas, University Professor of Economics, Madras.

Veterinary Surgery.

Mr. A. D. McGregor, F.R.C.V.S., I.V.S., Principal, Bengal Veterinary College, Belgachia, Calcutta.

Mr. Ulric W. F. Walker, M.C., M.R.C.V.S., I.V.S., Professor of Surgery, Punjab Veterinary College, Lahore.

Veterinary Medicine.

Mr. P. J. Kerr, M.R.C.V.S., I.V.S., Director, Civil Veterinary Department and Veterinary Adviser to Government, Bengal, Calcutta.

Mr. W. Taylor, M.R.C.V.S., D.V.H., I.V.S., Principal, Punjab Veterinary College, Lahore.

Mr. T. J. Hurley, Esq., M.R.C.V.S., D.V.S.M., Principal and Professor of Medicine, Madras Veterinary College, Madras.

Veterinary Pathology and Bacteriology.

Mr. V. Krishnamurti Iyer, G.M.V.C., Ag. Principal, Madras Veterinary College, Madras.

Mr. J. F. Shirlaw, M.R.C.V.S., Professor of Pathology and Bacteriology, Punjab Veterinary College, Lahore.

Proto-Zoology.

Col. R. Knowles, I.M.S., Professor of Protozoology, School of Tropical Medicine and Hygiene, Calcutta.

Mr. S. K. Sen, B.A., M.Sc., F.E.S., Protozoologist, Muktesar.

Virus diseases and serum preparation.

Mr. J. R. Haddow, B.Sc., M.R.C.V.S., D.V.S.M., I.V.S., Deputy Director, Imperial Veterinary Serum Institute, Izatnagar.

Mr. J. F. Shirlaw, Professor of Pathology, and Bacteriology, Punjab Veterinary College, Lahore.

Helminthology.

Mr. F. Ware, F.R.C.V.S., I.V.S., Director, Imperial Institute of Veterinary Research, Muktesar.

Dr. Maplestone (School of Tropical Medicine and Hygiene, Calcutta).

Mr. G. D. Bhalerao, M.Sc., Helminthologist, Imperial Institute of Veterinary Research, Muktesar.

Mr. M. Anantanarayana Rao, G.M.V.C., Lecturer in Parasitology, Madras Veterinary College, Madras.

Veterinary Entomology.

Mr. P. G. Malkani, B.A., B.Sc., M.R.C.V.S., Research Officer and Professor of Pathology and Bacteriology, Bihar and Orissa Veterinary College, Patna.

Mr. S. K. Sen, B.A., M.Sc., F.E.S., Protozoologist, Imperial Institute of Veterinary Research, Muktesar.

Mr. P. V. Isaac, B.A., D.I.C., M.Sc., F.E.S., Offg. Imperial Entomologist, Imperial Institute of Agricultural Research, Pusa.

Mr. H. L. Bhatia, Assistant, Entomological Section, Pusa.

Mycotic Diseases.

Col H. W. Acton, I.M.S., Director, School of Tropical Medicine and Hygiene, Calcutta.

Animal Bio-Chemistry.

Mr. F. J. Warth, M.Sc., I.A.S., Physiological Chemist, Imperial Department of Agriculture in India, Bangalore.

Dr. P. E. Lander, M.A., D.Sc., A.I.C., I.A.S., Agricultural Chemist to Government, Punjab, Lyallpur.

Dr. K. C. Sen, D.Sc., Biochemist, Imperial Institute of Veterinary Research, Muktesar-Kumaon, U. P.

Animal Breeding.

C. H. Parr, B.Sc., I.A.S., Deputy Director in Charge of Cattle Breeding Operations, United Provinces, Muttra.

Mr. E. J. Bruen, Livestock Expert to Government, Bombay Presidency, Poona.

Mr. R. W. Littlewood, N.D.A., I.A.S., Deputy Director of Agriculture, Livestock, Madras, Hosur.

Capt. C. E. Macguckin, Assistant Controller, Military Dairy Farms, Northern Circle.

Dairying.

Mr. Z. R. Kothawala, B.Ag., B.Sc., N.D.D., Imperial Dairy Expert, Bangalore.

Capt. C. E. Macguckin, M.B., H.D.A., Assistant Controller, Military Dairy Farms, Northern Circle.

Pharmacology and Poisonous Plants.

Lt.-Col. R. N. Chopra, M.B., I.M.S., Professor of Pharmacology, School of Tropical Medicine and Hygiene, Calcutta.

APPENDIX XXXVII.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, ADVISORY BOARD, NINTH MEETING,
FEBRUARY 1934.

SUBJECT No. 27.

Report of the first meeting of the Standing Soil Science Committee.

Present.

Diwan Bahadur Sir T. Vijayaraghavacharya (Chairman).
Dr. J. K. Basu.
Mr. B. C. Burt.
Dr. J. C. Ghosh.
Dr. Krishnan.
Dr. J. N. Mukherjee.
Rao Bahadur B. Viswanath.

Letters expressing inability to attend had been received from Dr. Mackenzie Taylor, the Agricultural Chemist, Central Provinces and Mr. Cliff, Deputy Director of Agriculture, North Bihar Range.

Subject 27 (i).—Application from the Government of Bengal for a continuation grant of Rs. 18,800 spread over three years for research into the properties of colloid soil constituents by Professor J. N. Mukherjee, Calcutta University. (Appendix XXXVII-A.)

Professor Mukherjee outlined the history of the scheme and said that in the original proposal two Research Assistants had been proposed. The essential feature of the scheme was the comparative study of the colloidal acid complex in clays and of colloidal aluminium hydroxide and colloidal silicic acid; also a study of the differences between the properties and behaviour of colloidal acid clays and the above pure substances and mixtures of them.

2. The Committee are satisfied of the need for an experienced Research Assistant who can be retained for the full period of the scheme. They are convinced of the value and importance of this fundamental work on the colloid constituents of soils and recommend the extension of the scheme for sanction. They consider that a suitable salary for the Senior Research Assistant should be Rs. 250—275—300 per mensem, a recommendation which Professor Mukherjee accepts. The Committee consider that, even allowing for the fact that the full resources of the University physico-chemical laboratory have been placed at the disposal of the scheme, the annual provision for equipment is too small and that a small sum may also be required for travelling allowance for the assistants. It is therefore proposed that the saving of about Rs. 900 effected by the change in the salary of the Senior Research Assistant should be devoted to this purpose. With this modification the Committee recommend the scheme for sanction.

Subject 27 (ii).—Application from the Government of the Punjab for a grant for a scheme to investigate the changes in the microflora of kalar and alkaline soils during reclamation. (Appendix XXXVII-B.)

The Committee consider that the programme of work proposed by the Provincial Research Committee is suitable on the understanding that, in addition to the number (or density) of the micro-organisms, their type, relative activity and habitat should also be studied. For this purpose a well-qualified Micro-Biologist is required, and for an officer with the necessary qualifications the standard of pay proposed is suitable. The scheme is recommended for sanction. The Committee understand that the work of the Micro-Biologist will be supervised by either Dr. Lander or Dr. Mackenzie Taylor.

Subject 27 (iii).—Report on the investigations carried out by Dr. A. N. Puri on the standardisation of physico-chemical 'Single value' measurements most suitable for Indian soils. (Appendix XXXVII-C.)

The Committee noted that some provinces are already trying out this method and others have agreed to do so when an opportunity occurs. The Committee also consider that the Indian Society of Soil Science (the Indian National Branch of International Society of Soil Science) will probably afford facilities for the co-operative testing of new methods of soil analysis in future.

Third International Congress of Soil Science.

The Committee strongly endorse the proposal made in Secretary's note (not printed) that the Imperial Council of Agricultural Research should meet the expenses of one member, who would be the leader, of the Indian delegation to the Third International Congress of Soil Science, 1935, including the cost of his passage from India to England and back. This representative, if possible, should be the President of the Indian National Section of the International Society of Soil Science which is now being formed. If the President is unable to go to England, a national representative should be elected by the Indian National Section of the International Society of Soil Science.

The Committee approved of the steps which the Imperial Council of Agricultural Research Secretariat had already taken to bring the Congress to the notice of provincial Agricultural Departments and Universities through their respective local governments. The Committee consider it extremely important that there should be a strong Indian delegation at this Congress.

Indian National Branch of the International Society of Soil Science (not printed).

The Committee noted that, as recommended at the last meeting of the Advisory Board of the Council, this subject was brought up at the last meeting of the Indian Science Congress, that a provisional organising committee had been formed and that Professor J. N. Mukherjee had very kindly consented to act as Convenor and Secretary for the current year. The Committee endorse the view that the Indian Society of Soil Science should be essentially an unofficial organisation. The draft scheme and bye-laws seem to them to be generally appropriate and they commend them to the careful consideration of all soil workers in India.

CHARAN DAS,
Secretary.

New Delhi, the 20th February 1934.

APPENDIX XXXVII-A.

NOTE DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 27(i) APPLICATION FROM THE GOVERNMENT OF BENGAL FOR A CONTINUATION GRANT OF RS. 18,800 SPREAD OVER THREE YEARS FOR RESEARCH INTO PROPERTIES OF COLLOID SOIL CONSTITUENTS BY PROFESSOR J. N. MUKHERJEE, OF THE CALCUTTA UNIVERSITY.

At its meeting held in June 1930 the Advisory Board recommended a scheme (pages 32-33 and 149-150 of the printed Proceedings) for research into properties of colloid soil constituents by Professor J. N. Mukherji of the University of Calcutta at a cost of Rs. 12,000 spread over a period of five years, *vide* details below:—

Non-Recurring.

	Rs.
Super Centrifuge	2,000

Recurring.

	Rs.
One Assistant at Rs. 150	1,800 per annum.
Other equipment	200 per annum.

The Scheme was started with effect from the 1st October 1930. The cost of the super-centrifuge was actually Rs. 4,109-12-0 and accordingly an extra grant of Rs. 2,109-12-0 was also sanctioned.

2 The progress reports on the Scheme for the years 1930-31 and 1931-32 were considered by the Advisory Board at its meeting held in July 1932 (*vide* pages 472-474 of the printed proceedings) and that for the year 1932-33 at the last meeting of the Board held in August 1933.

3. In his annual report for the year 1932-33 Professor Mukherji made a proposal that it would be of immense help if he could obtain one more assistant who could follow up the methods developed already and devote himself to the accumulation of data on specific subjects. The technical Sub-Committee of the Advisory Board which examined the Report in question reported that "in the absence of more detailed information in regard to the work for which an additional assistant is required, the Committee was not able to recommend to the Board that the extra grant for the assistant be given". The report of the Committee was adopted by the Board and the Governing Body and Professor Mukherji was informed accordingly.

4. Attention is now invited to an extract from the Bengal Government's letter (Annexure I), No. 142, dated the 10th January 1934, forwarding *inter alia* a fresh scheme (Annexure II) for work on soil colloids by Professor J. N. Mukherji. This scheme has also been recommended by the Provincial Agricultural Research Committee *vide* extracts from the Minutes of the Seventh Meeting of the Committee held on the 7th December 1933 (Annexure III).

5. The scheme involves a total expenditure of Rs. 18,800 (non-recurring Rs. 2,000 and recurring Rs. 16,800) spread over a period of three years as detailed below:—

	Rs.
One Research Assistant at Rs. 300	3,600
One Research Assistant at Rs. 150	1,800
Equipment	200
	<hr/>
Per year	5,600
	<hr/>
For three years	16,800
Add Non-Recurring	2,000
	<hr/>
Total	18,800

6. The Agricultural Expert to the Imperial Council of Agricultural Research notes that the proposal involves a three years' run of the enlarged scheme, if sanctioned. This appears to be a reasonable proposal and merits consideration in view of the fact that no other work is in progress in India on soil colloids from this aspect.

7. The Vice-Chairman to the Council considers that it will be an advantage to have the scheme examined in the first instance by the Soil Science Committee of the Council which consists of the following gentlemen:—

- (1) The Vice-Chairman, Imperial Council of Agricultural Research—Chairman, *ex-officio*.
 - (2) The Agricultural Expert, Imperial Council of Agricultural Research.
 - (3) Mr. A. P. Cliff, Deputy Director of Agriculture, North Bihar Range, Muzaffarpur, Bihar and Orissa.
 - (4) Dr. J. K. Basu, Soil Physicist, Sugarcane Research Scheme, Padegaon, Bombay-Deccan.
 - (5) Rao Bahadur B. Viswanath, F.I.C., Agricultural Chemist to the Government of Madras, Coimbatore.
 - (6) Dr. Krishnan, Agricultural Chemist to the Government of Hyderabad.
 - (7) Dr. E. Mackenzie Taylor, M.B.E., Ph.D., D.Sc., F.I.C., Director, Irrigation Research, Punjab.
 - (8) The Agricultural Chemist to the Government of the Central Provinces.
 - (9) Dr. J. C. Ghosh, D.Sc., Head of the Department of Chemistry, Dacca University, Dacca.
- The Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

In addition Dr. Mukherjee is also being invited to attend the meetings of the above Committee of the Advisory Board as a visitor.

8. The Committee will meet at 2.45 p.m. on Monday, the 19th February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

9. Two of the papers referred to in the Scheme have been published in the Indian Journal of Agricultural Science, Volume I, Part II, and Volume II, Part VI: a copy of the third paper is attached (Annexure IV).

ANNEXURE I.

Extract from letter from the Secretary to the Government of Bengal, Agriculture and Industries Department, Agriculture Branch, Calcutta, to the Secretary, Imperial Council of Agricultural Research, New Delhi, No. 142, dated the 10th January 1934.

Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

In continuation of this Department letter No. 1, dated the 2nd January 1934 (not printed) on the subject mentioned above, I am directed by the Government of Bengal (Ministry of Agriculture) to forward herewith, for inclusion in the agenda of the meeting of the next Advisory Board, two under-noted schemes, which were also approved by the Provincial Agricultural Research Committee, together with relevant extracts (Annexure III) from the minutes of the meeting of the Committee. As suggested by the Committee, * * * * the scheme for work on Soil Colloids has been redrafted by Professor J. N. Mukherji. I am to say that the local Government recommended the schemes subject to the condition that no financial liability devolves on them.

(1) * * * * *

(2) Scheme for work on Soil Colloids by Professor J. N. Mukherji of the Calcutta University (Annexure II).

2. One hundred and fifty spare copies each of the schemes will be forwarded to you direct by the Director of Agriculture, Bengal.

ANNEXURE II.

A SCHEME OF WORK ON SOIL COLLOIDS.

Introduction.

When I first approached the Imperial Council of Agricultural Research for a grant for financing Researches on Soil Colloids, I pointed out that the services of two Research Assistants—one on Rs. 300 per month and the other on Rs. 150 per month—would be necessary for the purpose. The person appointed at the higher salary would be able to take charge of the work which covers an extensive field of enquiry. The Council found it possible to sanction the appointment of only one Research Assistant at Rs. 150 per month. In view of the results obtained in connection with the work already done under the present scheme and the recent work of Mattoon and others, extensive measurements requiring the whole-time devotion of two men are necessary; so that the preliminary results can be followed up and definite conclusions may be arrived at within a reasonable period. I regret that through an oversight a request was made for a second Research Assistant without particulars of the scheme and the Advisory Board did not find it possible to recommend the appointment in the absence of necessary particulars (*vide* letter No. F.34/33/Agri., dated the 13th October 1933.)

The work under the existing grant has, as will be evident from the accompanying scheme, sufficiently advanced to warrant the services of a really experienced and qualified man who will be able to relieve me to a considerable extent in the matter of guidance. On second thought I have found it desirable to ask for the appointment of an assistant on Rs. 300 as stated in the first scheme as against Rs. 150 as stated in the scheme recently considered by the Advisory Board (*vide* letter No. F.34/33/Agri., dated the 13th October 1933).

Scheme.

In connection with the work undertaken with the support of the Imperial Council of Agricultural Research, our first objective has been to ascertain the points of difference, if any, between the properties of the acid constituents of soil in a state of colloidal solution and those of acids in true solution. Two papers have been published in the Indian Journal of Agricultural Science and a third paper has been communicated for publication. The results show that a treatment of colloidal solutions of acidic substances from the point of view of classical electro-chemistry is not justifiable. The application of the usual electro-chemical theories is limited by reactions involving interfaces in which the total quantities of the acid taking part in the reaction, are not defined by the amount of the acid substances present in the system. The forms on the titration curves show that the presence of an interface renders it necessary to consider such factors as determine the amount of the acidic constituents present in the interface which enters into reaction under any set of conditions. The equilibrium condition is thus determined by the ratio of the active interface to the volume of the solution, by the time of interaction and by the absorption of ions. The interaction with an alkali is perhaps not simply a neutralisation of existing hydrogen ions—either, in a free, or, in a "bound" condition—but the absorption of the hydroxyl ions by the surface with a consequent change in the acid neutralising capacity of the system, has to be considered. Dissociation constants and definitions of strength of acids on the basis of which the equilibrium conditions can be formulated have not the same significance as in usual electro-chemical systems. The experimental investigations have dealt with titration curves of some insoluble acidic substance and of colloidal solutions of silica and of aluminium oxide. The manner of variation of the hydrogen ion activity of silicic acid sols on dilution has also been studied. It has been found, contrary to the conclusions of previous authors, that silicic acid sols show apparently the characteristics both of a strong and a weak acid. There is also evidence indicating that it is difficult to reconcile the observed activities of the ions with their specific conductivities. It will be seen that the factors which distinguish the properties of colloidal acid solutions from those of acids in true solution are of a complicated nature. So far it has been possible to deal with only a fringe of the problem and the enquiry may be profitably extended. In soil, however, we have to consider still more complicated reactions. The manner of association of the sesquioxides with the acidic constituents, the extent to and the manner in which the sesquioxides serve as acid reservoirs and retain other ions in a state of absorption, are some of the questions on which definite information seems to be lacking. Moreover in order to obtain a clear conception of the properties of the colloidal complex, it is necessary to investigate the properties of those systems other than those dealing with their interaction with alkali.

The main lines of work which may be profitably undertaken are—

- (1) The extension of the enquiry on the acidic properties of the individual soil constituents.
- (2) The manner in which the individual properties of these substances are affected by their mutual admixture by the presence of sesquioxides and by electrolytes.
- (3) Other characteristic colloidal properties of the colloidal complex and other constituents of soil.

In order to carry out the above programme it is necessary that a number of persons devote themselves to this work for a period extending over several years. I would have hesitated to undertake the work and still more to approach the Imperial Council for further grants were it not for the fact that the experience gathered by us in this laboratory enables me to hope that we shall be able to carry out a substantial portion of the programme. I would like to mention also that it will be possible for me to avail to some extent of the services of research students provided they can be associated with some experienced persons whose continuity of service can be relied upon. The investigation of systems which are not constituents of soil but are allied in nature, is expected to yield useful information. I intend to allot such problems as also those which have reached a stage when they can be undertaken without too much of guidance, to ordinary research students.

I would therefore request the Imperial Council of Agricultural Research for the appointment of a second Research Assistant and for a non-recurring grant as detailed in the statement of cost given below. If a second Research Assistant be sanctioned, I propose to distribute the work as follows :—

A. The existing Research Assistant would continue the work he is doing at present. The problems he would take up are indicated below :—

- (1) Conductometric and Potentiometric titrations, measurements of activities of ions of the following sols prepared under different conditions, allowing different times of interaction and in general in continuation of the present work :—

Silicic acid, humic acid, colloidal acid clay isolated from different soils of known history wherever possible; ferric oxide, aluminium oxide, and mixed suspensions of the sesquioxides and the acidic constituents.

- (2) Work with the above systems in presence of such electrolytes as are often present in soil.

I hope that information thus obtained will also be of help in understanding the manner in which ions of aluminium, iron, chlorine, sulphate, HCO_3 , etc., are associated with the soil and the extent to which aluminium, iron, silica, humic acid, etc., enter into reactions under different conditions.

B. The work to be undertaken by the other Research Assistant will be as follows :—

- (1) The study of soil colloids in a gel state, the effect of the degree of dispersion, of SiO_2 to R_2O_3 ratio in relation to properties of colloidal clay.
- (2) The acid properties of soil colloids and their mixtures in a gel condition, such as total acidity, ionic exchanges, electro osmosis.
- (3) Properties of acid colloidal clay and its salts.

Settling velocities, degree of dispersion and dilution, evidences of primary particles and their aggregation, cataphoretic speeds, coagulation, thixotropy, an ion association, evidence of the extent of reaction of the alumina, silicon oxide and ferric constituents in such systems.

It is perhaps not necessary to deal in detail with the relationship of such investigations to practical problems of agriculture. The above enquiry is expected to yield useful information on the nature of the colloidal complex and its properties which are of fundamental interest to the physico-chemical interactions in soil responsible for soil acidity, base exchange, interaction with lime, leaching, percolation and other properties of the colloidal clay complex.

On account of the extensive literature and of the nature of the enquiry it would be helpful if the Second Assistant were qualified to take up the study himself with a minimum amount of guidance. I would appreciate it very much if the Council could see its way to sanction a remuneration likely to secure the services of a person with qualifications equivalent to a Doctor of Science and who has in addition experience of the subject. A monthly salary of Rs. 300 may secure the services of such a qualified person.

I would request the sanction of the scheme for a period of three years.

*Financial effect of the Scheme.**

	Rs.
<i>Recurring</i> .—A Second Research Assistant at Rs. 300 per month.	
Rs. 300 + 12 + 3	10,800
<i>Non-recurring</i> .—Grant of Rs. 2,000 for purchase of suitable Potentiometer, Galvanometer and Accessories	2,000
Total	12,800

*This is in addition to the present grant which has been sanctioned up to the 30th September 1935.

ANNEXURE III.

Extract from the Minutes of the Seventh Meeting of the Bengal Provincial Agricultural Research Committee, held in the office room of the Hon'ble Minister for Agriculture and Industries, Writers' Buildings, Calcutta, on Thursday, the 7th December 1933.

Present.

- (1) The Hon'ble Nawab K. G. M. Farouqi, Khan Bahadur, Minister for Agriculture and Industries, Bengal, *President*.
- (2) Professor S. P. Agharkar, M.A., Ph.D., F.L.S.
- (3) Mr. M. Carbery, M.Sc., I.A.S., Assistant Director of Agriculture, Bengal.
- (4) Mr. L. R. Fawcus, I.C.S., Secretary to the Government of Bengal, Department of Agriculture and Industries.
- (5) Professor J. C. Ghosh, D.Sc. (Dacca University).
- (6) Professor J. N. Mukherjee, D.Sc. (Calcutta University).
- (7) Mr. K. McLean, B.Sc., I.A.S., Director of Agriculture, Bengal, *Secretary*.

* * * * *

12. Scheme for Work on Soil Colloids, by Professor J. N. Mukherjee, Calcutta University. It was agreed that the scheme should be approved, but that it should be redrafted by Dr. Mukherjee and submitted again to the Secretary.

* * * * *

KENNETH McLEAN,

*Offg. Director of Agriculture, Bengal,
and*

Secretary, Bengal Provincial Agrl. Research Committee.

DATED CAMP CALCUTTA,

The 8th December, 1933.

ADVANCE COPY OF PAPER NOT YET PUBLISHED.

ANNEXURE IV.

ON THE NATURE OF REACTIONS RESPONSIBLE FOR SOIL ACIDITY, PART III

BY

PROFESSOR JNANENDRANATH MUKHERJEE, D.Sc., SATYAPRASAD ROYCHOUDHURY, D.Sc.,
SUDHAMOY MUKHERJEE, M.Sc., AND BIMALRANJAN MAJUMDAR, M.Sc.

Special Features of Colloidal Acids.

In part II (Mukherjee, Roychoudhury, Dasgupta and Chatterjee, 1932) evidence has been given to show that colloidal solutions of silicic acid behave in many respects as a strong acid, and in some other respects it has the character of a weak acid. Colloidal electrolytic systems have properties which require that they should be treated theoretically on a basis different from that of usual electrolytes (Mukherjee, 1933). It is desirable at this stage to discuss the differences between these systems with reference to colloidal solutions of insoluble acid substances, as they elucidate the nature of the chemical reactions involving the colloidal acid complex in soil.

Z. Rabinowitsch and Laskin (1928), and Pauli and Valko (1929), have observed that silicic acid sols possess the properties of a strong acid. Pauli and Valko (loc. cit. Table 183) prepared the sols by the hydrolysis of silico-hexane and purified them by electrodialysis. The total acidity was measured by conductometric titration and the free acidity was calculated from the e.m.f. of the hydrogen electrode as also from the specific conductivity. Rabinowitsch and Laskin (loc. cit.) working with electrolysed silicic acid sol. found that concordant pH values of the sol were obtained by both hydrogen and quinhydrone electrodes. They also estimated the total acidity of the sol by

potentiometric and conductometric titrations. The dissociation constants of the various silicic acid sols, calculated from their potentiometric titration curves, were found to be of the order of 10^{-4} as compared to 10^{-9} , the approximate value of the first dissociation constant of silicic acid in true solution. The percentage dissociation of the acid increases with the dilution unusually rapidly and at a dilution of 128 times of the sol it becomes 330. The degree of dissociation was calculated from the measured pH of different dilutions and the total acidity of the undiluted sol. This difference, between the truly dissolved acid and the colloidal acidoid electrolyte, is explained on the assumption that the colloidal particles contain the acid anhydride molecules, which are progressively hydrated as the dilution proceeds, and the dissociation of the hydrated molecules supplies fresh hydrogen ions. Another peculiarity observed by them was that on dilution of the silicic acid sol the specific conductivity increases and the pH decreases with time. After some hours a constant value of both the quantities are obtained. The pH dilution curve of an arsenious sulphide sol was found (Rabinowitch and Kargin, 1931) to be S-shaped in form and is explained as follows. At first a dissociation of an adsorbed H_2S on the surface of the A_2S_3 particles takes place up to 100 per cent. Then the new part of the curve begins which indicates no fresh formation of H^+ ions. At higher dilutions, the H^+ ion concentration changes very little with dilution on account of progressive hydrolysis of A_2S_3 particles. Colloidal solutions of tungstic acid also gave peculiar conductivity and hydrogen ion activity curves on dilution, which were assumed to indicate a change in the degree of dispersion with dilution.

3. Pallmann's (1930) observations (which have been referred to by Mukherjee, Roychoudhury, Dasgupta and Chatterjee, 1932) also give the impression that the pH of the suspensions studied by him varies with the dilution, in a manner which is different from the behaviour of true acids.

4. Salter and Morgan (1923) in their study of the effect of soil water ratio on the pH value of acid soils found that the results can be expressed in the form of the usual absorption isotherm. Bradfield (1924) found however that the hydrogen ion concentration of colloidal acid clay increases with the concentration of the colloid in a way characteristic of a weak acid. He therefore joins issue with the point of view of Salter and Morgan and emphasises that the clay acid behave like an acid in true solution. Salter and Morgan support the usual physical point of view which regards the exchange acid produced by neutral salts as a result of the splitting up of the salt by the absorption of the alkali (so-called hydrolytic absorption). An objection on the 'true acid theory' of soil acidity consists of the fact, that equivalent amounts of different strong bases (sodium hydroxide and calcium hydroxide) are not required in electrometric titrations of acid soils. Bradfield points out that such results are usually obtained when a relatively large ratio of soil to reacting base is used and he suggests that "such conditions favour complex side reactions in which the solubilities of the resulting salts play a role". Such a large ratio of soil to reacting base is present in the usual procedure in electrometric titrations of weak acids, when the acid is taken in the titration vessel and the alkali is added from outside. On account of the hydrolysis of the resulting solution, it is difficult to find out the end point. Using the reverse procedure equivalent quantities of both bases are required to neutralise the same amount of the clay acid and he considers that this stoichiometric equality shows that the reaction cannot be an absorption process. The suggestion, that the non-equivalence of the two bases (when the acid is titrated by the base) is brought about by complex side reactions, is not completely free from objection, as such differences between the quantities of two strong bases required for the neutralisation of a colloidal acid, actually exist (*vide* Pennyquick, 1930). It is difficult to account for such differences from theoretical considerations based on solubility differences. The further observation of Pennyquick that hydroxyl ions disappear by chemical reaction with 'anhydride' acid molecules through the formation of fresh anions on the surface shows that the interaction with hydroxyl ions cannot always be attributed to the neutralisation of hydrogen ions.

5. The conception of an equilibrium between the hydrogen ions, the anions and the undissociated acid which obtains in the case of an acid in true solution is inapplicable to these colloidal systems, because the total neutralisable acid is not determined by the total amount of the acid substance present but by the amounts of the acid in a state of true solution and on the surface of the particles. The preceding observations show that the latter quantity does not change proportionally to this dilution. That total quantity of acid, which enters into the equilibrium, depends on the degree of dispersion, and may also depend on the concentration of the alkali and the time of reaction. The effect of the amount of the solid phase and of the time of interaction have been already studied with reference to simple system (Mukherjee and Sen, 1931). The titration curves of cinnamic and isophthalic acid (Mukherjee and Sen, *loc. cit.*) show that

the apparent strength, or dissociation constant, of the acid depends on these factors. In the case of colloidal solutions of insoluble acid substances like silicic acid or colloidal acid clay, the conditions of the equilibrium are still more complex; for, neither the colloidal acid nor its salts are in true solution as is the case with cinnamic acid. The apparent dissociation constant has no real significance. A discrepancy probably also exists (Mukherjee, 1932) between the conductivities of solutions of colloidal substances, calculated from the activities of ions, and those directly observed. The theoretical considerations advanced by Mukherjee (1921, 1922) offers a basis for the correlation of the observations. Colloidal particles of acidic substances owe their negative charge to the primarily absorbed anions on the surface. The conception of the primary absorption is distinct from the usual conception of the absorption of ions. Absorption has been and is often attributed to changes in interfacial energy without any indication as to the location of the absorbed ions within the interface. A distinction between the fixation of an ion on the surface of the solid and its presence in the liquid side of the interface is however necessary. The stability of the primarily absorbed ions results from the 'building in' so to say, of these ions in the lattice structure of the solid colloidal particle or of its solid surface layers only and is associated with the magnitude of the potential energy. Subsequent absorption of oppositely charged ions on the solid surface is the result of electrostatic forces or of chemical affinity. Even when the chemical affinity is weak the electrostatic absorption is alone sufficient under suitable conditions for the fixation of ions of opposite sign on the charged surface. The secondary absorption resulting from electrostatic forces has been termed 'electrical absorption' and consists in the union of primarily absorbed ions with the electrically absorbed one. If the latter are polyvalent the possibility arises of forming complexes which carry a charge opposite in sign to that of the primarily absorbed ions. In systems where the chemical affinity referred to above is negligible such a reversal of the charge of the surface can be attributed purely to electrical absorption. If we take the case of a colloidal acid solution of silicic acid, the distribution of the ions in the mobile sheet of the charged colloidal particles will remain unaffected by the number of such colloidal particles in unit volume so long as collisions between these particles are small and, in consequence, do not affect the distribution of the ions between the mobile and the primarily absorbed layers. Such a particle may contain hydrogen ions both in the primarily absorbed layer and moving freely in the mobile sheet, and behave as a strong acid for very low dilutions though the total acidity will be greater than the free acidity. It may thus have the character of an undissociated acid as also of a strong completely dissociated acid. The possibility of the absorption of hydroxyl ions by chemical affinity is an important factor in determining the total neutralising capacity of the acidic substances. The alkali may disappear through the fixation by absorption of the hydroxyl ions on the surface, e.g., through combination with SiO_2 molecules, and not only by a neutralisation of the hydrogen ions on the surface.

7. The preceding discussion shows that colloidal acids do not behave as acids in true solution and their special features consist in the following: The total acid is not determined by the total quantity of the acidic substance in the system. The time of interaction, the degree of dispersion, the total amount of the substance present in the system, and the absorption of hydroxyl ions (as distinct from the neutralisation of hydroxyl ions by the hydrogen ions associated with the colloid) or of other anions in a smaller extent, are possible factors which determine the total quantity of the acid entering into the reaction. An acid, e.g., silicic acid, known to be very weak in a state of true solution—on the basis of the usual principles of electro-chemistry behaves in some respects as an exceptionally strong acid when present as a colloidal solution. The corresponding *solid* acids or *solid* salts have no unequivocal existence and discussions of dissociation constants or equilibrium conditions in terms of such solubilities lack in reality (Mukherjee, 1929). According to classical electro-chemistry the basicity of a colloidal acid (assuming the particles to be of the same size and shape) should be given by the total number of neutralisable hydrogen ions associated with it. It has been stated above that this number does not give a true indication of the total neutralisable acid in the system nor its variation with the dilution of the sol. The number of the primarily absorbable or actually absorbed anions with which the hydrogen ions are associated in a free or absorbed state, depend on the extent of the interface and possibly also on the pH (e.g., on the alkaline side). This indefiniteness of the total neutralisable acid need not necessarily be the common characteristic of all such systems and indeed even of the same substance. Thus the particles of a *very finely dispersed* acidic substance may react very quickly and the total acid estimated experimentally may be identical with the total amount of the substance. Also systems may be met with in which the surface of the particles is fully saturated by the primarily absorbed anions and the degree of dispersion does not change with the dilution. There however remains an essential difference. The basicity as defined above probably has not the same significance as in the case of polybasic acids in true solution. In the

light of the theoretical picture discussed in the preceding paragraph the nature and basicity of the primarily absorbed anions should be the relevant factors in determining the equilibrium conditions. It appears to be erroneous to consider the stages of dissociation of the total number of hydrogen ions without reference to the character of the primarily absorbed ions. So far the acidic substance has been considered to be in a state of uniformly dispersed colloidal solution. But the state of aggregation or the structure of the gel possibly enters as additional factors in determining the behaviour of the acid constituents of soil. Besides the association of the sesquioxides, either in a free state, or, in combination with soil acids raises other interesting considerations. Possibly only a small amount of the aluminium or ferric ions, associated with the soil occurs in a state of free solution and the manners in which these ions in soil enter into reactions involving hydroxyl or hydrogen ions, is of considerable interest. The strong electrical absorption of these trivalent cations by primarily absorbed anions, which often leads to a reversal of the charge, is well known (Mukherjee and Coworkers, 1926; Ghosh, 1926). Surface complexes of various types may result profoundly affecting the interaction of the system with acids and alkalis. It would thus appear that colloidal acid systems would show a manifold variation in their behaviour. A comprehensive theoretical treatment on quantitative lines awaits fuller experimental material dealing with various systems, of which the acid constituents of soil form a very interesting group.

Titration Curves of Silicic Acid Sols and Aluminium Oxide Sols

An illustration of such variations is afforded by the existing data relating to silicic acid sols. While Pauli and Valko (loc. cit.) find that their sols are completely dissociated, Rabinowitsch and Laekin (loc. cit.) find that these sols are partially dissociated. It has been shown in part II that the total acid is greater than the free acid and this is approximately in agreement with Rabinowitsch and Laekin. But the variation of the hydrogen ion activity, with the concentration of the sol, is more in conformity with the conclusions of Pauli and Valko. The difficulties of the relevant measurements and the great influence exerted by traces of electrolytic impurities have been referred to in previous papers. In some of the potentiometric titration curves more than one break was observed simulating the curves of a polybasic acid with dissociation constants which vary considerably with the stage of dissociation. Similar breaks have been recorded in the literature on the soil acids. It appears that the breaks in the curves observed by us are possibly to be attributed to the peculiarities of the kinetics of the interaction between the colloid and the added alkali. (It is necessary to carry the titrations to much higher pH values than we have done so far for further information.) The titration curves observed by us differ in some respects from those of Rabinowitsch and Laekin (loc. cit.) as also of Pauli and Valko (loc. cit.). It was thought desirable to continue the work on the silicic acid sols and also to ascertain the changes brought about by 'ageing', which results in the formation of visible floculi. The sol used in this investigation contained a considerable amount of sodium chloride. This has the advantage that the hydrogen ions associated with the colloid may be exchanged and of showing any effect such an exchange may have on the titration curves. The silicic acid sols used in this and the previous paper differ in this respect from the sols used by the authors referred to above.

2. The results of titration of aluminium oxide sols containing traces of hydrochloric acid, with alkali have been given in part II. The extent of combination of aluminium oxide in a colloidal state with hydrochloric acid to form absorbed aluminium ions has been investigated. For this purpose it is necessary that the sol is as free as possible from hydrochloric acid (free or combined) and the pH is near the neutral point. Under such conditions the concentration of the aluminium ions in a state of true solution should be very low. Such investigations would give an idea of the extent to which the range of pH values in which the absorbed aluminium ions serve as reservoirs of potential acidity. It is hoped to deal more fully with several aspects of such reactions in later papers.

3. In part II, a method for simultaneous potentiometric and conductometric titrations has been described. The present paper records: (a) results of such simultaneous titrations with a sample of silicic acid sol at different dilutions, and (b) results of potentiometric titrations with two samples of aluminium hydroxide sols of very low specific conductivities. As suggested in previous parts, traces of CO_2 or O_2 cause considerable error, and for the purposes of a quantitative interpretation of the results these sources of error should be avoided. In the present series of measurements great care was taken to exclude CO_2 . Nevertheless some of the titration curves were not very regular. Perhaps traces of CO_2 could not be entirely avoided. It was also felt in the course of the investigation that the passage of a stream of hydrogen gas may not ensure an efficient mixture of alkali and acid. Further improvements eliminating these troubles have been made with the collaboration of Mr. S. C. Ganguly, M.Sc. The

Results given below were obtained with the arrangements described in part II, and the results obtained by the recent improvements will be communicated in a later paper.

EXPERIMENTAL.

Preparation of Silicic Acid Sol.—The silicic acid sol was prepared by adding 525 cc. of sodium silicate solution of sp. gr. 1.16 to 910 cc. HCl solution containing 210 cc. of conc. HCl. The mixture was dialysed against repeated changes of cold distilled water until a weakly opalescent sol was obtained. It was stocked in an atmosphere of H_2 (Cp. part II).

Preparation of Aluminium Hydroxide Sols (K and M).—Aluminium hydroxide precipitated by adding a litre of 0.1 N ammonium hydroxide to a litre of 0.1 N aluminium chloride solution was washed repeatedly with conductivity water by the help of a centrifuge until a partial peptisation took place. A portion of the residual precipitate, when suspended in water, gave a fairly stable suspension.

- (i) To one part of the suspension two litres of conductivity water were added and a sol was obtained (K).
- (ii) On adding 2 litres of conductivity water containing 1 cc. of .005 N HCl to another portion, sol M was formed.

The sols were stocked in an atmosphere of H_2 (Cp. part II).

Measurement of Hydrogen Ion Concentration.—The H^+ ion concentrations of the sols were measured at $50 \pm 1^\circ C$ by means of the glass electrode or by the quinhydrone electrode against normal calomel electrodes. A K— type Leeds Northrup potentiometer was used. The e. m. f. remained remarkably constant during all the measurements given in the following tables:—

Preparation of Hydrogen.—Pure electrolytic hydrogen was prepared by the method already described in part II.

Simultaneous Potentiometric and Conductometric Titrations of the Sols.—The apparatus described for this purpose in part II was used. The conductivity measurements were taken at $350 \pm 1^\circ C$ by means of a Leeds Northrup conductivity bridge and curtis coil resistances.

Determination of Cl^- Ion Concentration.—The Cl^- ion concentrations were measured by Hg-HgCl electrodes. The accuracy of the electrodes was tested before use.

The Estimation of SiO_2 in Silicic Acid Sol.—A measured volume of the sol was evaporated to dryness in a platinum basin on a water bath three times with conc. HCl, digested with acid and water, filtered, and the filtrate collected. The residue with the filter paper was dried and ignited in a platinum crucible and the SiO_2 weighed.

RESULTS AND DISCUSSIONS.

(I) Simultaneous Potentiometric and Conductometric Titrations of Silicic Acid Sol (A) and its dilution*. Between two successive readings there was a constant time interval of 30 minutes**. 50 cc. of sol were taken in each titration.

TABLE I.—(Figs. I to V, Curves I to X).

Silicic Acid Sol (A).

Conc. of Silica—4276 gm. mole per litre.

The following calculated data were corrected of change of volume.

A.			A./2.			A./6.			A./11.			A./21.		
cc. Baryta added.	pH (Curve I.)	Sp. cond. $\times 10^6$ (Curve II.)	cc. Baryta added.	pH (Curve III.)	Sp. cond. $\times 10^6$ (Curve IV.)	cc. Baryta added.	pH (Curve V.)	Sp. cond. $\times 10^6$ (Curve VI.)	cc. Baryta added.	pH (Curve VII.)	Sp. cond. $\times 10^6$ (Curve VIII.)	cc. Baryta added.	pH (Curve IX.)	Sp. cond. $\times 10^6$ (Curve X.)
0	1.47	486	0	1.44	280	0	2.47	603	0	2.08	382	0	2.42	295
1	1.59	394(?)	1	1.58	253	.5	2.72	592	.2	2.42	330	.1	2.60	281(?)
2	1.73	460	2	1.73	230	1.0	3.22	481	.4	3.00	312	.2	2.77	298
3	1.88	443	3	1.73	207	1.5	6.80	471	.6	4.02	290	.3	3.0	285
4	1.92	426	4	2.04	191	2.0	7.63	459	.8	6.32	290	.4	3.00(?)	292(?)
5	2.19	468(?)	5	2.48	173	2.5	7.69	457	1.0	7.27	283	.5	3.47	271
6	2.33	296	6	4.81	169	3.0	7.98	488	1.2	7.50	296	.6	5.70	245
7	2.70	442	7	..	..	3.5	8.04	522	1.4	7.63	316	.7	7.01	259
8	3.21	532	8	..	..	4.0	8.09	550	1.6	7.68	332	.8	7.22	283
9	3.33	542	9	5.30	166	4.5	8.22	575	1.8	7.86	338	.9	7.63	305
10	3.99	575	10	5.74	169(?)	5.0	8.29	581	2.0	7.91	343	1.0	7.67	309(?)
11	5.30	612	11	5.98	161	..	..	..	..	..	..	1.1	7.85	366
12	5.51	622	12	6.07	163	..	..	..	..	..	..	..	..	..
13	5.72	649	..	..	..	..	..	..	..	..	..	..	..	..

* At the time of these titrations partial coagulation of the sol took place.

**The strength of the baryta solution (.059N) remained satisfactorily constant during the titrations.

(II) The total neutralisable acid as obtained from the conductometric and e. m. f. titration curves have given in gm. ions of hydrogen per litre in Table II.

TABLE II.

Dilution.	Free Acidity before coagulation (Curve XI*, Fig. VI).	Free Acidity when signs of coagulation were observed.	Sp. cond. $\times 10_3$ before coagulation.	Sp. cond. $\times 10_3$ after signs of coagulation were observed.	Total Acidity in gm. hydrogen per litre from	
					Conductometric titration.	Potentiometric titration.
A . . .	.0132	.034	684	486	.00708	.0124
A/2 . . .	.0059	.036	376	280	**	.00649
A/6 . . .	.0019	.0034	130	60.3	.00283	.00153
A/11 . . .	.00084	.0083	75	38.2	.00109	.00087
A/21 . . .	..	.0038	..	29.5	.00071	.00070

*The free acidity values were obtained by H_2 electrode (*vide* Table III).

**No definite minimum point in the conductometric titration curve was obtained.

1. Table III below represents the agreement between the pH values of the silicic acid sol (A) obtained by both the hydrogen and the quinhydrone electrodes.

TABLE III.

Dilution.

A . . .	1.879 (H_2 electrode).
	1.96 (Quinhydrone electrode).
A/2 . . .	2.23 (H_2 electrode).
	2.33 (Quinhydrone electrode).
A/6 . . .	2.71 (H_2 electrode).
	2.42 (Quinhydrone electrode).
A/11 . . .	3.076 (H_2 electrode).
	3.051 (Quinhydrone electrode).

Curve XI in Figure VI gives the variations in log ΔH_0 of the sol A with concentrations. Curve XI' in the same figure shows the variation in log ΔH_0 of four corresponding HCl solutions, the least concentrated of which is such that it has the same ΔH_0 as sol A/11. A corresponding series of curves have been given in Figure VII, which have been obtained from the data on silicic acid sol given in part II. Curves XII and XII' have been obtained by the same manner of calculations as used in and correspond to curves XI and XI'.

2. The sol contains free electrolytes, hydrochloric acid and sodium chloride. The concentration of these electrolytes increases proportionately with that of the sol. Moreover, it is well-known that the presence of neutral salts like NaCl solution in contact with silica causes increased acidity (Mukherjee and Co-workers, 1926). The ionic strength of these solutions is greater than that for hydrochloric acid solutions having the same pH. The activity coefficients should therefore be smaller and also decrease more rapidly with the concentration. In part II the possibility has been discussed that the e. m. f. of the hydrogen electrode may be in error. The agreement between the quinhydrone and hydrogen electrodes is definitely against it. Rabinowitsch and Laskin (1928) have also found that both these electrodes give results in mutual agreement.

3. A rather good agreement is noticed between the total acidity after partial flocculation and the free acidity measured before flocculation (Table II). But the free acidity appears to increase considerably in each case on ageing and shows irregular variations whereas the specific conductivity of the sol decreases. The potentiometric titration curves, given later, have a normal form and this constitutes a difficulty in attributing the surprisingly large increase, on ageing, of the free hydrogen ion activities to the unreliability of the hydrogen electrode. The decrease in the conductivity is

also in contrast to the agreement between the free and total acidities mentioned above. The changes brought about by flocculation therefore requires further investigation. The manner of variation of the hydrogen ion in concentration with the dilution of the sol is typical of a completely dissociated acid and in agreement with previous results (part II). In consideration of the greater ionic strength and the polyvalent character of the silicic acid particles the AHO curves indicate that the sol is a stronger acid, in this respect, than hydrochloric acid.

(III) *Electrometric Titration Curves of Silicic Acid Sols* (vide Table I, Figures 1 to V, Curves I to X).—Greater precautions have been taken in the present work for excluding traces of air from the titrating vessel. The run of the titration curves are more regular than they were previously (vide part II). Although the difficulties previously mentioned have been eradicated to a large extent it seems that a more efficient stirring of the sol than that secured by bubbling hydrogen gas should be ensured. Attempts were made to measure simultaneously the gradual variations of Cl^- ion concentrations in the sol by Ag-AgCl electrodes. It was found at the end of the titrations that these electrodes were unreliable. The causes of the poisoning are under investigation. The AgCl data have therefore been omitted from the Table I.

2. Table II shows that except in the case of the pure sol the value of total acidity calculated from the conductometric titration curve is greater than that from the potentiometric titration curve. We find that the total acidity values given by the conductometric titration curve, as all dilution except with the pure sol, are greater than the free acidity values, measured before coagulation, while only with sol A/21 the total acidity values given by potentiometric and conductometric titrations agree. The extremely low value of total acidity of the pure sol by conductometric titrations is indeed difficult to explain. The results evidently show that disagreements are more prominent with concentrated than with diluted sols. There is one factor which might have caused some disturbance in conductometric titrations, specially with concentrated sols. The distance between the two electrodes in the titration vessels was rather small and with comparatively concentrated sols it was likely that some of the silicic acid might have set into flocculi in the space between them. The sol as a whole was fluid and the form of the conductivity curves indicate that this disturbance may be excluded. In contrast to the findings of Rabinowitch and Laskin (loc. cit.), the shapes of the conductometric titration curves do not resemble those of strong acids. On the contrary, these curves represent more the conductometric titration curves of moderately strong or weak acids. Curve IV forms an exception. Barium silicate is known to be sparingly soluble. Considering the form of the AHO curve and the agreement between the free and total acidities mentioned previously the conductivity curves should have only steep branches. The curves therefore have an unexpected form and indicate that the neutralisation of hydrogen ions by the alkali and the formation of insoluble barium silicate or the electrical absorption of barium ions are not the only reactions taking place in the system. Both branches of the curves indicate a reaction between the interface and the hydroxyle ions, whose kinetics are of a complicated nature. The descending portions show that processes resembling hydrolysis of salts are taking place. Possibly barium ions liberate hydrogen ions from the interface. These hydrogen ions do not appear to have been in an undissociated state in view of the agreement between the free and total acidities. A difference in the conductivity coefficients of the hydrogen ions in the double layer may be imagined but such explanations would be highly speculative in the absence of more complete data.

3. The potentiometric titration curves, when closely examined, also show a departure from the normal form for a strong acid. The curve for sol A does not show the usual steep rise following a flatter portion. The form of the curve of course depends to some extent on the scale used for plotting it but the values of the tangent $\delta E'_x$, where $\delta_x E$ represents the change in the e.m.f. produced by δ_x gram equivalents of the alkali, which should be used, justify this statement and give an idea of the extent to which the curves differ from that of a strong acid. It is remarkable that as the dilution proceeds the curves for both sets of titrations, conductometric and potentiometric, approach the forms characteristic of strong acids. It is also to be noted that the total acidity given by both titrations agree for sol A/21. The potentiometric titration curve which undergoes a sharp change near the neutral point is not likely from its nature, to show as marked a departure in form as the conductivity curves. It thus appears that the departure from the normal form and the resemblance with the form of weak acids is real and some sort of interaction involving the interface takes place.

4. Regarding the possible sources of error a chance of the access of ammonia or carbon dioxide into the titration vessel is to be excluded in view of the special arrangement used and of the observed steady e.m.f. and conductivities. The irregular distribution of the points in some of the titration curves referred to before might result from the absence of a more vigorous stirring. The presence of a reaction involving an interface would aggravate the difficulties in the way of ensuring a rapid attainment of the equilibrium. The addition of the baryta solution was not uniform in one respect for the different dilutions in the sol. It was added in amounts of 1 cc. to the sols A and A/2, of 0.5 cc. to A/6, of 0.2 cc. to A/11 and of 0.1 cc. to A/21. The difference arose out of the diminution of the total acid on dilution. Although the interval between successive additions was constant in all cases the rate of reaction might vary with the pH. Finally unequal quantities of the silica might have been transferred with equal volumes of the sol on account of the non homogeneous dispersion after partial flocculation. The agreement between the free and total acidities show that the error from this cause cannot be considerable.

5. The results taken as a whole agree with the conclusion stated at the beginning of this paper that silicic acid sols prepared in the manner given here seems to have the character of a strong acid in some respects of a weak acid in others. Partial flocculation does not appear to change the total acidity calculated from the potentiometric titration curves. The sols used by Pauli and Valko were electrolysed and their sols as also those of Rabinowitsch and Laskin were free from added electrolytes. The pH of the sol A and its dilutions are considerably lower and they also contain a larger amount of silicic acid and of free sodium chloride.

(IV) Potentiometric Titrations of Aluminium Hydroxide Sols.

TABLE IV.—(Fig. VIII, Curves XIII, XIV, XV).

Aluminium Hydroxide Sol (K).

Interval between consecutive additions of acid=30 minutes.

Conc. of HCl=.001 N; 50 cc. of sol was taken.

cc. of acid added.	E. M. F. (in volts).		I III	pH (Curve XIII)	pH II (Curve XIV).	III (Curve XV).
	I	II				
0.0	.6655	.6627	.6624	6.31	6.25	8.24
0.2	.6636	.6647	.6539	6.27	6.28	6.09
0.4	.6642	.6612	.6673	6.29	6.23	6.32
0.6	.6543	.6617	.6685	6.12	6.23	6.34
0.8	.6225	..	.6579	5.60	..	6.15 (?)
0.9	..	.6320	..	..	5.74	..
1.0	.5954	..	.6697	5.16	..	6.35
1.1	..	.6105	..	..	5.40	..
1.2	..	..	.6432	..	..	5.89
1.3	..	.5915	..	..	5.08	..
1.5	..	.5813	..	..	4.92	..
1.7	..	.5770	..	..	4.84	..

TABLE V.—(Fig. VIII, Curve XVI).

Aluminium Hydroxide Sol (M).

Interval between consecutive additions of acid=30 min.

Conc. of HCl .001 N; 50 cc. of sol was taken.

cc. of acid added.	E. M. F. in Volts.	pH (Curve XVI)
0	.66475	6.27
0.2	.6648	6.27
0.4	.6617	6.22
0.7	.64005	5.86
0.9	.6214	5.56
1.1	.6010	5.23
1.3	.5957	5.14
1.55	.5643	4.63
1.70	.5585	4.53
1.90	.5229	3.95

The reproducibility of the titration curves of aluminium hydroxide sol is not so satisfactory being in contrast with the reproducibility observed previously (Part II). Perhaps a greater time for reaching an equilibrium of the reactions and more efficient stirring would be helpful. The main reason for this want of agreement is possibly the low specific conductivity and electrolyte content of these sols. Sol K has a specific conductivity of $\cdot 18 \times 10^4$ and sol M. $\cdot 0546 \times 10^5$. In fact, considering the difficulties met with at such dilutions of acids, accurate reproducibility is difficult of attainment.

Three of the curves practically coincide with each other in their initial portions. The first additions of the acid have practically no effect on the pH which diminishes thereafter at a comparatively rapid rate. Free aluminium ions are unstable at such high pH values (Britton, 1932). Curve XVII represents the calculated decrease of the pH of pure water on the gradual addition of hydrochloric acid in identical amounts. The sol reacts with hydrogen ions and absorbs them at first completely and then in progressively smaller proportions. The absorbed aluminium ions on the surface appear to be quite stable at pH 6.4. Comparing curve XVII with the others and from the date on the hydrolysis of aluminium ions it is possible to form a rough estimate of the amount of these ions on the surface. It is however necessary to ascertain the limits of reproducibility of the titration curves and also to ascertain the significance in terms of the concentration of hydrogen ions, of the observed e.m.f. of the hydrogen electrode. There appears to be some doubts as to the applicability *in toto* of the usual conceptions to these systems (Mukherjee, 1933).

Summary.

1. The titration curves of silicic acid sols show features which are of a complicated and unexpected nature when compared to those of acids in true solution. In agreement with previous observations they show that the sol appears to have simultaneously the character of a strong and of a weak acid.

2. Absorbed aluminium ions present on the surface of colloidal particles of aluminium hydroxide sole are stable at pH 6.4.

Our thanks are due to the Imperial Council of Agricultural Research for enabling one of us (S. P. R. C.) to undertake this work as a Research Assistant and also for other facilities.

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APPENDIX XXXVII-B.

NOTE, DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 27 (ii).—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF RS. 13,120 SPREAD OVER THREE YEARS FOR A SCHEME TO INVESTIGATE THE CHANGES IN THE MICROFLORA OF KALLAR AND ALKALINE SOILS DURING RECLAMATION, BY DR. S. JAGJIWAN SINGH, M.Sc., Ph.D.

At its meeting held in August 1933, the Advisory Board considered the application mentioned above (Annexure I) and recommended that the scheme should first be examined by a technical Committee in time for the next meeting of the Board. Relevant extracts from the proceedings of the Board are enclosed (Annexure II).

2. The Standing Committee on Soil Science recommended by the Advisory Board has since been constituted as under :—

- (i) The Vice-Chairman, Imperial Council of Agricultural Research (Chairman).
- (ii) The Agricultural Expert, Imperial Council of Agricultural Research.
- (iii) Rao Bahadur B. Viswanath, Government Agricultural Chemist, Madras.
- (iv) Dr. J. K. Basu, Soil Physicist, Sugarcane Research Scheme, Bombay, Deccan.
- (v) Dr. E. MacKenzie Taylor, Director, Irrigation Branch, Punjab.
- (vi) Mr. A. P. Cliff, Deputy Director of Agriculture, North Bihar Range, Muzaffarpur.
- (vii) The Agricultural Chemist to Government, Central Provinces.
- (viii) Dr. Krishnan, Agricultural Chemist, Hyderabad.
- (ix) Dr. J. C. Ghosh, Dacca University.

Secretary, Imperial Council of Agricultural Research—Secretary (*ex-officio*).

This Committee will now examine the scheme at its meeting which will be held on Monday, the 19th February 1934, at 2.45 P.M. in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board, in due course.

ANNEXURE I.

Appendix VII.

NOTE, DATED THE 28TH JUNE 1933 BY THE SECRETARY ON SUBJECT No. 10.—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF RS. 13,120 SPREAD OVER A PERIOD OF THREE YEARS FOR A SCHEME TO INVESTIGATE THE CHANGES IN THE MICROFLORA OF KALLAR AND ALKALINE SOILS DURING RECLAMATION SUBMITTED BY DR. JAGJIWAN SINGH, M.Sc. (PUNJAB), Ph.D. (LONDON).

Attention is invited to the attached copy of a letter from the Government of the Punjab, No. 1572-D., dated the 26th June 1933 (Annexure) forwarding a report of the sub-committee appointed by the Punjab Council of Agricultural Research (Enclosure I to Annexure) to consider a scheme of Soil Microbiological research (Enclosure II to Appendix) submitted by Dr. Jagjiwan Singh, M.Sc. (Punjab), Ph.D. (London). The scheme as revised by the sub-committee involves an expenditure of Rs. 13,120 spread over a period of three years.

The scheme is now for the consideration of the Advisory Board.

ANNEXURE.

LETTER FROM THE GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 1572-D., DATED THE 26TH JUNE 1933.

I am directed by the Punjab Government (Ministry of Agriculture) to forward a report of the sub-committee appointed by the Punjab Council of Research to consider a scheme of Soil Micro-biological research submitted by Dr. Jagjiwan Singh, M.Sc. (Punjab), Ph.D. (London).

2. Some time ago, Dr. Jagjiwan Singh, a resident of the Gujranwala district, submitted an application (Encl. II) for a grant to enable him to carry out work on the biology of alkaline soils. His application was considered by the Punjab Council of Research at a meeting held in November 1932. The Council considered that the application was a discourse on possibilities rather than a scheme for investigation and that as such, it was not in a suitable form for submission to the Imperial Council of Agricultural Research. A Sub-committee of the Provincial Council of Research was appointed to examine the proposals and to report on them. This sub-committee re-drafted the scheme.

3. The Provincial Council of Research considered the revised scheme (Encl. I) at its meeting on the 29th April 1933. The Council felt that the work proposed therein is likely to yield useful results and unanimously decided that the scheme, as now revised, should be forwarded and recommended to the Imperial Council of Agricultural Research for acceptance and provision of a sum of Rs. 15,120 spread over a period of three years. It will be observed that the scheme is to be carried out in conjunction with the reclamation operations conducted at the Chakanwala farm by the Irrigation Branch, whilst the laboratory work is to be done at the Punjab Agricultural College and Research Institute, Lyallpur.

4. I am accordingly to request that the scheme may be considered by the Council at its next meeting, and financed by it to the extent indicated above. Laboratory accommodation will be provided by the Director of Agriculture, Punjab.

5. One hundred printed copies of the scheme are being forwarded to you under separate cover.

ENCLOSURE.

REPORT OF THE SUB-COMMITTEE APPOINTED BY THE PUNJAB COUNCIL OF RESEARCH TO CONSIDER THE SCHEME OF SOIL MICRO-BIOLOGICAL RESEARCH SUBMITTED BY DR. JAGJIWAN SINGH.

The scheme* for the Biological Examination of alkali soils by S. Jagjiwan Singh was considered.

The Committee were of opinion that investigation of the micro-flora of kallar and alkaline soils under reclamation might afford valuable information as to the stage reached at any time during the process of reclamation. At present the only indication of the condition of the soil is crop growth. It may be possible by the study of the micro-flora to obtain an earlier indication of soil conditions than is possible with the crop. Modifications in the scheme for reclamation may then be indicated at an earlier stage. Accordingly it was decided that the title of the investigation should be as follows:—

“The changes in the micro-flora of kallar and Alkaline soils during reclamation.”

No definite scheme of research had been put forward by S. Jagjiwan Singh. The steps in the reclamation of alkaline and kallar soils as now practised at the Irrigation Research Institute were described and the following scheme of research was drawn up:—

- (1) In the Punjab, in the reclamation of kallar soils the first operation is leaching to remove excess of salts. On the alkaline soils thus produced a rapid growth of algæ takes place following leaching, and it is probable that other micro-flora may also develop. It is suggested, therefore, that the applicant should study the development of the micro-flora, following this initial process of leaching.
- (2) In the case of alkaline soils again the first operation is leaching. This continues till the conductivity of the water standing on the plot is approximately 400. At this stage gypsum is broadcasted in the standing water and leaching continued. A change takes place in the soil which enables a rice crop to be grown. It is suggested that the applicant should study, firstly, the changes in the micro-flora accompanying leaching until the time of application of gypsum and, secondly, the changes associated with the alterations produced by the gypsum.
- (3) The yield of the rice crop is taken as an indication of the state of reclamation. It may be possible to substitute for this an examination of the deve-

* Attached.

lopment of the micro-flora. If this is the case it will save a considerable amount of time. The stages of reclamation which are recognised at the Chakanwali Reclamation Farm are as follows :—

- (a) If the yield of rice crop is 12 maunds or below the land is only partially reclaimed and requires both further leaching and rice crops.
- (b) If the yield of the rice crop is between 12 and 20 maunds per acre, then it is possible to grow a Rabi crop consisting of lentil, barley or gram. Rice is again necessary in the following Kharif. This indicates an advance of reclamation over (a).
- (c) If the rice crop is 20 maunds per acre or over then land is considered to be fully reclaimed.

The Sub-Committee suggest that the micro-flora characteristic of these three conditions should be examined with a view to obtaining a comparison which would indicate the stage of reclamation reached.

The Committee discussed fully the question of suitable places where the research could be carried out. It was agreed that the most suitable place is the Irrigation Research Institute, as the applicant would be in contact with both the Farm where reclamation was proceeding and the Chemist and Physicist responsible for investigations of the kallar and alkaline soils. Accommodation, however, is not available at the Irrigation Research Institute. It was decided that the work should be carried out at Lyallpur Agricultural College where accommodation is available and also the necessary equipment. The Sub-Committee felt that Dr. Chaudhri might give his advice in connection with the botanical side of the investigations. To this Dr. Chaudhri agreed. Dr. Lander and Dr. McKenzie Taylor both agreed to place the facilities of the laboratories at the disposal of the applicant, and also any information which he requires, if available, at their laboratories would be given to him.

It was agreed that following would be the probable cost of the scheme :—

First Year: Salary.

	Rs.
Micro-biologist at Rs. 250 per mensem	3,000
Laboratory Assistant at Rs. 18 per mensem	216

Second Year: Salary.

Micro-biologist at Rs. 275 per mensem	3,300
Laboratory Assistant at Rs. 20 per mensem	240

Third Year: Salary.

Micro-biologist at Rs. 300 per mensem	3,600
Laboratory Assistant at Rs. 22 per mensem	264

Total for three years 10,620

Apparatus and Chemicals for three years	1,000
Travelling Allowance for three years	1,000
Contingencies	500

Total 13,120

The Sub-Committee recommend to the Punjab Council of Research for favourable consideration the scheme as amended, and suggest that steps should be taken to obtain the early consent of the Imperial Council of Agricultural Research for the necessary funds.

ENCLOSURE II.

SCHEME TO INVESTIGATE THE CHANGES IN THE MICRO-FLORA OF KALLAR AND ALKALINE SOILS DURING RECLAMATION.

Alkali soils cover an immense amount of area in more than one Province in India, and the existence of these infertile lands involve a serious loss of land revenue. For instance, in the Punjab if the alkali area, which is over four thousand square miles, were to grow wheat alone and that once a year, the total production of this stuff would

be about twenty-nine lakhs of tons. Thus we find that, whereas there is an apparent loss to the revenue of the Province which amounts to several lakhs of rupees, over and above an extremely large quantities of the food stuff are withheld from the people on account of the very presence of the alkali lands.

The importance of the alkali problem in India has been recognised for many years, and much time and money have been devoted to its solution. A scientific study of any soil problem involves physical, chemical and biological aspects. Work in connection with the alkali soils has been mostly studied from physical and chemical standpoint, and the biological aspect has not received the attention it deserves. In passing it may be mentioned here that a very strong evidence both in this country and America has been accumulating of late which definitely suggest that Micro-organisms are mainly responsible for the formation and maintenance of alkali lands.

The effect of Soil Alkali in reducing growth of crops or in changing completely the physical features of the soil is easily recognised. There are, however, equally important changes produced in the biological structure of the soil, these changes cannot be detected and valued without a special study and are not so well understood. Micro-organisms, it may be stated, play an important role in the soil processes, their chief activities being, rock disintegration and soil formation, decomposition of organic matter in soil, liberation of nitrogen in an available form as Ammonia, formation of nitrates, fixation of nitrogen, disappearance of available nitrogen from soil, synthesis of microbial cell substance, oxidation and reduction of soil constituents, transformations in composted stable manure, production of artificial manures, liberation of mineral elements such as phosphorous from relatively insoluble substances, transformation of sulphur, the improvement of plant growth following soil inoculation, changes following partial sterilisation and other treatments, etc. It will thus be seen that the activities of Micro-organisms in the soil are fundamental in nature and form an integral part of soil study since the very growth of plants is largely determined by their action. Consequently there is little likelihood of over-estimating the need of their study in any questions which involve a scientific understanding of a serious soil problem. Alkali problem in India is vital in nature and touches the very foundations of the prosperity of the Provinces it is prevailing. This is particularly true since the evil has a tendency to increase. Indeed complete knowledge and understanding of such a problem point by point and step by step is imperative. It is in this way that the problem would be put upon fundamental basis, and to put the problem upon fundamental basis is to deal effectively with it both with regard to the origin and reclamation of alkali lands. It is needless therefore to point out that it will be in the immediate and distant interest of the whole study of the alkali soils if the unexplored but essential biological aspect is worked out, and this would help materially in the understanding and solution of the alkali problem. In the following pages effort has been made to show the importance of the biological study of the alkali soils, and also the proposed line of work in this connection is attached herewith.

Proposed line of work.

There are two main questions about the alkali problem. First is the question dealing with the origin of alkali soils and, secondly, problems connected with their reclamation. These two aspects are dealt with separately.

1. *Origin of Alkali Soils.*—There are various theories with regard to the origin and formation of alkali lands. These may be enumerated thus:—

- (1) Movement of sub-soil water currents from high water levels to lower ones and the accumulation of salt on account of the evaporation of water from the land to which it has drained.
- (2) Steepage from canals, the result of which is waterlogging and as a result of free evaporation and accumulation of salt on the surface.
- (3) The construction of canals. Sometimes the surface drainage of the country is disturbed owing to this cause, the result being an accumulation of salt in the soil.
- (4) Bad aeration and drainage or the biological cause. Alkali lands, it can be stated fairly accurately, have followed in the wake of the spread of canal system in this Province and elsewhere. Wherever the air supply is cut off by constant surface irrigation of stiff soils with a tendency to impermeability by the accumulation of stagnant sub-soil water or by interference with the surface drainage alkali salts sooner or later have appeared. Under such peculiar conditions some of the anaerobic organisms become active and bring about a phase of oxygen hunger (reduction) in the soil

with the production of such substances like sulphuretted hydrogen and the metallic sulphides. Upon cultivation or with improvement in general conditions when these soils come in contact with air and water, the above reduction products are oxidised into harmful alkalis like sulphates, chlorides, and carbonates which salts rise to the surface. The above hypothesis of the origin of alkali lands is supported by direct and indirect observations by Howard, in India, and Cameron and others in America :—

- (1) All badly drained areas under natural conditions if examined are frequently found to contain bluish green markings which are associated with the activities of those soil organisms which are able to live in badly drained soils without a supply of free oxygen.
- (2) In alkali zones of north Bihar wells dug for human use had to be left open to the air otherwise the water is contaminated by sulphuretted hydrogen thereby indicating a well marked reductive phase in deeper soil layers.
- (3) In a sub-soil drainage experiment in Nira valley, Mann and Tambane found that the salt water which ran out of these drains soon smelt strongly of sulphuretted hydrogen, and the white deposit of sulphur was formed at the mouth of each drain proving how strong were the reducing activities in the soil. The reduction phase here was actually demonstrated.

The above preliminary observations point the supreme importance of further investigations of the origin of alkali lands in India and the discovery of the conditions which are necessary for their formation. Once this is definitely established the question of the prevention and cure of the alkali problem might enter on a new phase; a great step forward will have to be made and another principle will have been added to agricultural science on alluvial soils. It will then be possible to undertake a scientific examination of the basis of perennial irrigation as practised at the present day in the plains and to prevent any misuse of the method. It is proposed to work out in detail the biological changes accompanying the origin of the alkali lands.

Biological work in connection with Reclamation.—Side by side with the study of the biological factors accompanying the formation of alkali soils, the microbiology of the reclaimed lands shall also be worked out in which the micro-biological analysis will give out useful results and indications in connection with the potential value of the reclaimed soils and the degree of the success achieved with regard to their permanent reclamation. It is proposed to work out for the above purpose on the following lines :—

- (a) Requirements of the plant and the soil organisms are practically the same, and in recent years a definite correlation has been established between soil fertility, crop growth, and the number of micro-organisms. So instead of making experiments with crops on the reclaimed soils the number and conditions of micro-organisms shall indicate the potential value of these soils and the inherent possibilities contained in them for bearing crop in the future. Tests like these have been worked out in England, America and other countries and found to be extremely useful. Thus Sir John Russell puts the use of such tests as follows :—

“Soils in which plants grow well are also soils of high micro-organic activity. Instead therefore of making pot cultures with plants to ascertain soil deficiencies it should suffice to make culture experiment with bacteria which can be done much more rapidly and requires much less space.”

Further latest general fertility tests as devised out by Winogradsky and J. Ziemiecka where Azatobacter can be used for indicating general fertility of the soil shall be applied.

From these micro-biological tests it is proposed to sort out the reclaimed soils into different groups or classes. Thus for instance, class I would be those areas which would satisfy all the micro-biological conditions with regard to the density of population and the types of organisms. Class II would be those tracts which are deficient either in the density of the micro-biological population or are lacking in different types of organisms and so on. By this process we will know the general level of fertility of the reclaimed soils and can be served as a useful way of assessing the value of the land.

(b) Another useful line of investigation would be to work out micro-biological tests which might indicate whether or not a particular type of land would go alkaline sooner or later. For this, examination shall be made of the alkaline, semi-alkaline and normal soils, and it is expected that particular type of organisms present in the alkaline and semi-alkaline regions would by their very presence in the reclaimed and normal soils suggest the coming of the trouble. Preventive measures could then be taken and the development of the harmful types could be checked and controlled.

The micro-biological data shall be examined satisfactorily and the results would be put upon a quantitative basis so that they may have a definite value. Finally it may be said that a host of problems would arise during the course of the work, and their anticipation, as in all scientific research, is not possible at this stage unless the work is actually in progress.

The scheme shall take at least three years in order to come to any conclusions and shall require the following expenses :—

	Rs.	Total Rs.
Total expenses for the first year—		
One qualified soil micro-biologist	350—50—750	4,200
Assistant Chemist	150—10—250	1,800
Laboratory Assistant	20—2—40	240
Second year—		
Micro-biologist	400	4,800
Chemist	160	1,920
Laboratory Assistant	22	264
Third year—		
Micro-biologist	450	5,400
Chemist	170	2,040
Laboratory Assistant	24	288
Total travelling and recurring expenses for three years . . . . .	..	1,000
Total . . . . .	..	<u>21,752</u>

It is of course presumed that Lyallpur Agricultural College will give facilities of the necessary apparatus and the work will go on with their closest co-operation.

ANNEXURE II.

EXTRACTS FROM THE PROCEEDINGS OF THE ADVISORY BOARD, AUGUST 1933

Application from the Government of the Punjab for a grant of Rs. 13,120 spread over a period of three years for a scheme to investigate the changes in the Microflora of Kallar and alkaline soils during reclamation, submitted by Dr. Jagjivan Singh, M.Sc. (Punjab), Ph.D. (London). (Subject No. 10 of the Agenda.)

The scheme was introduced by Mr. Stewart who explained that the actual programme of work had been drawn up by a sub-committee of the provincial agricultural research council. Professor Parija, and Rao Bahadur Viswanath supported the scheme. Professor Ghosh supported the scheme but suggested that if the scheme was approved it should be subject to the modification that the Punjab Government would appoint a suitable Micro-Biologist in the usual manner. The Chairman explained that the grant, if sanctioned, would be given to the Punjab Government on the usual conditions and not to Dr. Singh. Mr. Stewart also said that it had already been explained

to Dr. Jagjiwan Singh that no guarantee could be given to him that he would be appointed if the scheme were sanctioned. At the suggestion of Dr. Burns, it was decided by 14 against 4 votes that the scheme should first be examined by a technical committee in time for the next meeting of the Advisory Board. As regards the character of the Committee, it was unanimously agreed that there should be a permanent and standing committee for the examination of all schemes on soil problems submitted to the Board, which should include an Agriculturist, a Soil Chemist, a Soil Bacteriologist, Economic Botanist and Soil Physicist. In regard to the personnel of the Committee, it was as usual left for the consideration of the Chairman with a recommendation that he will bear in mind the following names suggested by various members of the Board :—Dr. Lander and Dr. MacKenzie Taylor from the Punjab, Dr. Basu (Bombay Sugarcane Research Station), Rao Bahadur Viswanath (Madras), Dr. Shaw (Pusa), Prof. J. C. Ghosh (Dacca), Mr. Carpenter (Assam), Mr. Tamhane (Sind), and Dr. S. K. Mukerji (Lucknow University).

APPENDIX XXXVII-C.

NOTE DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 27 (iii), REPORT ON THE INVESTIGATIONS CARRIED OUT BY DR. A. N. PURI, M.Sc., Ph.D., A.I.C., ON THE STANDARDISATION OF PHYSICO-CHEMICAL "SINGLE VALUE" MEASUREMENTS MOST SUITABLE FOR INDIAN SOILS.

At its meeting held in July 1932, the Advisory Board considered the Report on the investigations carried out by Dr. A. N. Puri, on the standardisation of physico-chemical single value measurements most suitable for Indian soils, with the aid of a grant from the Council. A copy of Dr. Puri's report and of the report of the Sub-Committee of the Advisory Board which examined it will be found in Appendix XLV (pages 471-472 and 512-517) of the printed proceedings of the meetings of the Board held in July the Advisory Board which examined it, will be found in Appendix XLV (pages 471-472) and all Local Governments including the constituent States of the Council were addressed accordingly (Annexure I).

2. Copies of the replies received from the Governments of Burma, Central Provinces and the Punjab to the Council's circular letter (Annexure I) is enclosed (Annexure II). It would appear that the intention of the Council's letter has been somewhat misunderstood by the Local Governments concerned, and it appears desirable for the subject to be considered again by the Advisory Board.

3. The Vice-Chairman considers that it will be an advantage to have these considered in the first instance by the Soil Science Committee of the Council which consists of the following gentlemen :—

- (i) The Vice-Chairman, Imperial Council of Agricultural Research. (Chairman).
- (ii) The Agricultural Expert, Imperial Council of Agricultural Research.
- (iii) Rao Bahadur B. Viswanath, Agricultural Chemist to Government, Madras.
- (iv) Dr. J. K. Basu, Soil Physicist, Sugarcane Research Scheme, Bombay-Deccan.
- (v) Dr. E. MacKenzie Taylor, Director, Irrigation Research, Punjab.
- (vi) Mr. A. P. Cliff, Deputy Director of Agriculture, North Bihar Range, Muzaffarpur.
- (vii) The Agricultural Chemist to Government, Central Provinces.
- (viii) Dr. Krishnan, Agricultural Chemist, Hyderabad.
- (ix) Dr. J. C. Ghosh, Dacca University.

The Secretary, Imperial Council of Agricultural Research. Secretary *ex-officio*.

This Committee will meet on Monday, the 19th February 1934 at 2-45 P.M. in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi, and its report will be placed before the Advisory Board in due course.

ANNEXURE I.

COPY OF LETTER No. 29/AGRI., DATED THE 6TH JANUARY 1933, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO ALL LOCAL GOVERNMENTS (INCLUDING THE N.-W. F. P., MYSORE, HYDERABAD AND BARODA).

Report of the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian Soils.

I am directed to forward herewith a copy of a report of the investigations carried out by Dr. A. N. Puri on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian soils for the study of which the Imperial Council of Agricultural Research made a grant of Rs. 5,250. The report was considered by a Sub-Committee of the Advisory Board of the Council in July 1932 and an extract from the proceedings of the Sub-Committee is also enclosed. It will be seen therefrom that it was suggested at the Committee that the method evolved by Dr. Puri should be brought to the notice of chemists in the provincial departments so that it might be tried out. I am accordingly to request that if the ^{Local Government} Government of Mysore, etc. have no objection, the papers forwarded with this letter may kindly be brought to the notice of the [provincial] Agricultural Chemist ^(in Mysore) etc. so that Dr. Puri's method may be tried out by them. The results of the trials may also kindly be communicated to this Department in due course.

2. I am to add in this connection that the papers referred to in the concluding paragraph of Dr. Puri's report are being published in "Soil Science" beginning with the issue for April 1932. A summary of each of these papers as received from Dr. Puri is also being published by the Imperial Council of Agricultural Research in the abstract Section of the Indian Journal of Agricultural Science, beginning with the December 1932 issue of the Journal.

ANNEXURE II.

[Copies of the replies received from the Governments of Bengal, Burma, Central Provinces and the Punjab to the Council's Circular letter (Annexure I).]

Copy of letter from the Secretary to the Government of Burma, Forest Department, to the Secretary, Imperial Council of Agricultural Research, No. 24-O., dated the 8th February 1933.

Report of the investigations carried out by Dr. A. N. Puri, M. Sc., Ph. D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian soils.

With reference to your letter No. 29/Agri., dated the 6th January 1933, I am directed to forward a copy of letter No. 102/1-A-12, dated the 10th February 1933, from the Agricultural Chemist, Burma, and to say that the Government of Burma (Ministry of Forests) agree in the opinion of the Director of Agriculture, Burma, that no useful purpose would be served by trying out Dr. Puri's method in this Province.

(Enclosure to above).

LETTER No. 102/1-A-12, DATED THE 10TH FEBRUARY 1933, FROM J. CHARLTON, Esq., M.Sc., F.I.C., I.A.S., AGRICULTURAL CHEMIST, BURMA, MANDALAY.

SUBJECT :—*Trial to Dr. A. N. Puri's method on the standardisation of Physico-Chemical "Single-Value" measurements.*

I have the honour to address you with regard to your endorsement No. 701/1-A-10 Pt. IX, dated the 31st January 1933 forwarding Forest Department Endorsement No. 24-O., dated the 19th January 1933, to your address, together with documents from the Imperial Council of Agricultural Research.

[] to local Governments only.
() to the States.

If you will be good enough to refer to my sanctioned programme of work for 1932-33, you will find that the following details are still uncompleted :—

1. Selection of groundnuts for high oil content.
2. Analysis of produce of Permanent Manurial series on the Mandalay College Farm.
3. Pot Experiments with Hmawbi in fertile soils.
4. Investigation of Upper and Lower Burma paddy soils on a profitable basis.
5. Investigation of soils for the Deputy Director of Agriculture, Northern Circle.
6. Investigation of forest soils in conjunction with the Deputy Conservator of Forests, Arakan Division.

The remaining work has been completed but I am likely to be occupied a good deal with working up data in connection with Yemane forest soils and also although the Forest Chemist is under notice to leave within a month, the examination of data obtained over the last six years is really only just beginning and is occupying a good deal of my time. Even now I am busy with checking of mathematical analysis of data supplied by Mr. Castens and this has kept me busy in my spare time for a fortnight.

I may add that certain of this work has an important practical bearing on the work of the department as a whole. For many years the Agricultural Chemist, Burma, has worked not as a unit but as a cog in the machine which is the department as a whole. To take him off the work at present pursued will result in disturbing the work of Deputy Directors of Agriculture as well.

The full details of Dr. Puri's work have not as yet been made available; all that I know is the information given by Dr. Puri's resume given with the attached correspondence. From this it appears that Dr. Puri has been working with measurements as follows :—

1. Mechanical analysis of soils—Hydrometer and Manometric methods.
2. Moisture absorption of soils.

From this Dr. Puri claims that he can calculate the per cent. clay in a given soil from its moisture absorption under specified conditions.

3. pH measurements and state of Saturation of Soils.

As regards the first item, I may say that during the past 12 years no occasion has arisen in this laboratory when ordinary mechanical analysis would not suffice. The adoption of Robinson's pipette method was carried out in these laboratories immediately it was published. The hydrometer and manometric methods have their good points but for practical use in a provincial laboratory no method even approaches the pipette method of mechanical analysis.

As regards the deduction of Single Value soil properties of soils, I have already shown that this is a chimera—*vide* Indian Journal of Agricultural Science, Volume II, Pt. I, in which I showed that the loss on ignition, sticky point moisture and moisture contained by soils at 50 per cent. relative humidity are not constants at all but variable because of the replaceable bases present. Dr. Puri should know of this work and I fail to see how he can conclude that it is possible to calculate the per cent. clay present unless the replaceable bases have been treated so as to obtain only one and this of course means that the soil will not be as in the field. Further, the presence of organic matter will have to be considered. This was clearly shown by Keen and Coutts in the original paper on the subject in the Journal of Agricultural Science XVIII (1928) Part 4, 740—765. The conclusion is inevitable that it is simpler to find the per cent. clay directly and certainly one will have to find the replaceable bases per cent. in order to fully describe the soil.

As regards the last point it must be admitted that much remains to be done on pH measurements and the state of saturation of soils and I can say little until I have the full details of Dr. Puri's work.

I must say at this point that when the question of giving a grant to Dr. Puri arose and my opinion was asked I was favourable to giving him a grant for the work.

It seems clear however that if the Imperial Council of Agricultural Research intends to have all provincial agricultural chemists check chemical work for which a grant has been given, it is likely that provincial agricultural chemists will be able to do little else. I would point out that such work is emphatically work that should be done in a central research institute such as Pusa and not in provincial laboratories which

are occupied with more practical questions. The question arises "What then?" Suppose the methods are found to be sound what will be the position? Not only have we got Dr. Puri investigating these problems but we have also the International Society of Soil Science and also the Bureau of Soil Science at Rothampsted fully alive to all these questions and putting out regularly large quantities of literature on the same subject. Perusal of this literature will clearly show that finality can never be achieved as research can never be standardised (or it would not be research). My contention is that if a method is good and sound it will be adopted. As an example I would quote the pipette method of mechanical analysis of G. W. Robinson. It may safely be left to provincial agricultural chemists to test out any method evolved by Dr. Puri or any other chemist when occasion or necessity arises and if satisfied, the provincial chemist will certainly use the method.

I would therefore make the following suggestions in lieu of the demand that each provincial agricultural chemist shall check all Dr. Puri's results :—

1. A selection of provincial soils shall be collected and sent to the Imperial Agricultural Chemist, Pusa, for test and his results shall be regarded as adequate.
2. The provincial agricultural chemist should be allowed to check Dr. Puri's work as they find time to do so but should not be ordered to give it any priority.

Of the above I prefer No. 1.

COPY OF A LETTER FROM THE REVENUE SECRETARY TO GOVERNMENT, CENTRAL PROVINCES, NAGPUR, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI, No. 240/234/XIV, DATED THE 28TH MARCH 1933.

Report of the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian Soils.

With reference to your letter No. 29/Agri., dated the 6th January 1933, on the above subject, I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward for the information of the Council, a copy of a memorandum No. 1248, dated the 15th March 1933 from the Director of Agriculture, Central Provinces, and to say that unless the practical difficulties indicated by the Director are solved there would appear to be very limited scope for trying out Dr. Puri's method.

(Enclosure to the above).

COPY OF MEMORANDUM NO. 1248, DATED NAGPUR, THE 15TH MARCH 1933, FROM THE DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES, TO THE REVENUE SECRETARY TO GOVERNMENT, CENTRAL PROVINCES, NAGPUR.

Report of the investigations carried out by Dr. A. N. Puri, M.Sc., Ph. D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian Soils.

Reference Agriculture Department's endorsement No. 39/36-XIV, dated the 11th January 1933 forwarding copy of letter No. 29/Agri., dated the 6th January 1933, from the Secretary, Imperial Council of Agricultural Research, on the abovementioned subject. Dr. Puri's report is herewith returned.

2. The subject matter of Dr. Puri's report is not new to the officers of this Department as articles describing Dr. Puri's method have already appeared in publications dealing with "Soil Science". The papers now returned have been read carefully by the Agricultural Chemist and I have discussed the subject with him. Unfortunately

nothing is said regarding the purpose of the single value physical measurements and the practical use to which they can be put. The methods at present adopted by this department for the mechanical analysis of soils is the revised British Official method evolved after a good deal of work by leading Soil Scientists and which is practically similar to the International method. This department will however be quite willing to try Dr. Puri's method when opportunity offers and when the necessary apparatus is obtained but I would point out that the apparatus required is somewhat bulky and not so easy to manipulate as some of the simpler methods, *vide* the criticisms made by some of the members of the Advisory Board of the Imperial Council of Agricultural Research. The subject is one which deals with the application of physics to soil science and might well be taken up in the Physical laboratories of the Science College, Nagpur, should the staff of that College be interested in the subject. This is a point which will be kept in view and will be placed before the Research Sub-Committee of the Central Provinces Board of Agriculture.

3. My general conclusion in the matter is that the method does not at present indicate any practical application and although we are always prepared to give new methods a trial it is rather unusual for scientific workers to be induced to apply methods unless the application of such methods promises to yield valuable results. I suggest that the Secretary, Imperial Council of Agricultural Research, be asked to obtain from Dr. Puri a note showing how his methods can be made of practical value to the problems of local Agriculture Departments.

COPY OF LETTER FROM THE DEPUTY SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 1025-D., DATED THE 11TH APRIL 1933.

Report of the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian Soils.

In reply to your letter No. 29/Agri., dated the 6th January 1933, I am directed by the Punjab Government (Ministry of Agriculture) to observe that Dr. Puri carried out his work in the laboratories of the Research Institute, Lyallpur, where the Chemical section had an opportunity of following his methods. There is no doubt as to the usefulness of the work on which Dr. Puri was engaged, but it is always difficult to elaborate a "standard" method suitable for all soils and under all conditions. For heavy clay soils Dr. Puri's method has some advantages over the old Sedimentation method, but on the whole, the Agricultural Chemist to Government, Punjab, who has been consulted, still prefers to use the latter, which he considers to be more suitable for general laboratory routine.

2. I am to add that the Agricultural Chemist is of opinion that, whilst Dr. Puri's work on "Soil reaction and state of saturation" is an extremely interesting piece of technical research, it requires to be followed up, and is not yet, in his opinion, sufficiently final to be brought under "Standard" methods. He would like to see Dr. Puri's methods discussed on some occasion at a meeting of Soil Chemists.

COPY OF LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 32-T.A.I., DATED THE 22ND APRIL 1933.

Report of the investigations carried out by Dr. A. N. Puri, M.Sc., Ph.D., A.I.C., on the standardisation of Physico-Chemical "Single Value" measurements most suitable for Indian Soils.

I am directed to refer to your letter No. 29/Agri., dated the 6th January 1933, on the subject mentioned above, and to forward herewith an extract from a letter No. 6701, dated the 10th March 1933, from the Agricultural Chemist, Bengal, furnishing a report on the method evolved by Dr. Puri.

(Enclosure to the above).

EXTRACT FROM A LETTER No. 6701, DATED THE 10TH MARCH, 1933, FROM THE AGRICULTURAL CHEMIST, BENGAL.

• • • • •

The first two experiments seem rather difficult in technique and it is doubtful whether they could replace the international pipette method. As regards their applicability to Bengal soils which are widely diverse in their characteristics nothing can be said until some trials have been made. The moisture absorption method is of interest and will be tried out as soon as the work at present in hand permits.

As regards the last experiment there is no known method of estimating lime requirements which will give results even approximating to field experience. The colorimetric method for pH determinations has been found in this laboratory as the quickest and simplest for comparative work. The correlation by Dr. Puri of the State of saturation with the pH value is however interesting.

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APPENDIX XXXVIII.

NOTE DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 28 (s).—REPORT FOR THE YEAR 1932-33 ON THE SCHEME FOR BREEDING EXPERIMENTS IN CONNECTION WITH THE IMPROVEMENT OF GOATS CONDUCTED BY MR. A. E. SLATER.

The second annual report on the scheme for breeding experiments in connection with the improvement of goats conducted by Mr. A. E. Slater at the Mission Poultry Farm, Etah, for the period 1st April 1932 to 31st March 1933 is submitted to the Advisory Board for consideration (Annexure).

2. The report will be examined by the Standing Cattle Breeding Committee consisting of the following members which will meet on the 19th February 1934 and the Committee's report will be circulated to the members of the Advisory Board in due course.

1. Diwan Bahadur Sir T. Vijayaraghavacharya, Chairman.
2. Colonel A. Olver, Animal Husbandry Expert, Imperial Council of Agricultural Research.
3. Mr. T. F. Quirke, Director of Veterinary Services, Punjab.
4. Captain C. E. MacGuckin, Assistant Director, Military Dairy Farms, Lahore Cantonment.
5. Mr. E. J. Bruen, Livestock Expert to the Government of Bombay.
6. Sardar Dost Mohammad Khan, Proprietor, Jehangirabad Cattle Farm.
Rai Sahib Malik Charan Das, Secretary.

3. The first annual report for the period 6th June 1931 to 31st March 1932 was considered by the Advisory Board at its meeting held in February 1933 and it has been printed as Annexure II to Appendix XVIII (pages 129-137) of the proceedings of the meeting of the Board.

ANNEXURE.

SECOND YEAR'S PROGRESS REPORT ON THE SCHEME FOR BREEDING EXPERIMENTS IN CONNECTION WITH THE IMPROVEMENT OF GOATS IN THE UNITED PROVINCES.

A note on the work done for the year 1932-33 with Balance Sheet and tables of Live Stock statements (adult and kids), by A. E. Slater, B.S.A.; and Sardar Singh Bhatia, I.D.D.

INTRODUCTION.

Rupees 4,837 was received from the Imperial Council of Agricultural Research on 10th May 1932. A non-recurring grant of Rs. 800 was received on February 10th, 1933; this contribution being by the Government United Provinces, for making the floor of the main goat shed pucca (i.e., of concrete), and constructing a verandah and courtyard in front of the building.

We would express our thanks to the local Government for this and believe that the main building will be much improved by this.

LINES OF RESEARCH

These were outlined in the report for 1931-32 and have been carried on throughout 1932-33.

The following records give details regarding milk recording and determination of butter fat on 57 goats; consisting of 30 Jumna Paris, 18 Bar-Bari, one Toggenburg and 8 Desi.

The Live Stock statement for adult stock shows 79 female goats. Detailed records for 20 goats have not been given in these records, owing to the fact that all the factors were not available; some goats being dry and others not having completed their lactation.

Records.

Table No. 1.

Serial No.	No. of Goats.	Breed.	Milk yield during lactation (lbs.)	Average percentage of butter fat.	Maximum yield a day. lbs.	Average milk yield per day during lactation lbs.	No. of days.		Remarks.
							In milk.	Dry.	
1	4	Jumna Pari.	236.10	4.6	1.8	1.2	194	104	
2	7	"	390.0	4.5	2.4	1.5	255	98	
3	9	"	462.9	6.6	2.12	1.3	349	..	
4	10	"	349.0	3.4	2.4	1.2	287	82	
5	11	"	376.6	6.3	3.0	1.5	238	..	
6	12	"	576.12	5.5	4.12	2.4	242	..	Had been sick for one month during lactation.
7	16	"	197.8	5.0	2.12	1.1	182	..	
8	17	"	488.13	5.4	2.2	1.3	369	101	
9	20	"	397.7	6.6	2.10	1.5	275	85	
10	21	"	581.10	5.3	3.10	2.3	247	147	
11	22	"	543.4	5.0	3.12	1.8	303	39	
12	23	"	450.10	3.8	3.4	1.4	17	172	
13	24	"	308.9	7.8	2.4	1.4	214	133	
14	25	"	312.5	4.2	2.4	1.3	242	96	
15	26	"	302.15	6.3	2.4	1.4	223	116	
16	29	"	707.8	6.8	2.12	1.2	577	..	
17	33	"	546.10	5.2	4.12	2.2	248	136	
18	34	"	410.6	5.1	3.4	1.7	239	116	
19	35	"	272.7	6.3	2.0	1.3	209	..	
20	36	"	516.5	5.4	3.0	2.0	253	89	
21	37	"	424.0	4.1	2.4	1.4	307	83	
22	38	"	611.6	5.4	4.2	2.6	245	99	
23	39	"	219.9	..	1.4	1.3	178	56	

Serial No.	No. of Goats.	Breed.	Milk yield during lactation. (lbs.)	Average per-centage of butter fat.	Maximum yield a day. lbs.	Average milk yield per day during lactation. lbs.	No. of days.		Remarks.
							In milk.	Dry.	
24	40	Jumna Pari.	310.14	4.4	2.4	1.2	254	98	
25	41	"	450.15	4.5	2.8	1.3	348	68	
26	42	"	526.3	6.3	3.8	2.0	265	98	
27	43	"	595.1	5.0	3.2	1.7	392	..	
28	44	"	687.12	6.0	2.2	1.2	575	..	
29	45	"	1237.4	5.4	8.4	3.3	383	51	
30	46	"	479.1	5.2	5.8	2.3	206	..	
31	51	Bar-Bari.	231.0	4.1	3.8	1.5	172	79	
32	52	"	329.4	3.0	8.0	2.9	128	54	
33	53	"	272.11	6.5	3.6	1.0	255	48	
34	54	"	254.12	2.3	2.8	1.5	183	24	
35	61	"	250.10	4.8	8.10	1.2	203	50	
36	62	"	488.0	3.3	2.0	1.0	492	..	
37	64	"	253.6	3.5	3.8	1.5	178	244	
38	65	"	302.11	6.5	2.8	1.3	241	..	
39	66	"	442.14	4.0	4.4	1.9	235	71	
40	67	"	420.4	2.6	3.12	1.6	281	36	
41	70	"	504.11	2.5	3.0	1.2	418	..	
42	71	"	460.0	5.5	2.4	1.0	476	..	
43	72	"	264.0	4.5	2.0	1.2	207	70	
44	74	"	447.6	3.5	4.6	2.0	226	283	
45	77	"	327.0	4.0	3.0	1.7	188	..	
46	79	"	243.0	2.5	2.8	1.7	172	194	
47	82	"	244.14	5.0	1.10	0.9	299	229	
48	85	"	219.9	2.4	2.4	1.2	194	16	Kidded ten days before due kidding date.

Serial No.	No of Goats.	Breed.	Milk yield during lactation. (lbs)	Average percentage of butter fat.	Maximum yield a day. lbs.	Average milk yield per day during lactation. lbs.	No. of days.		Remarks.
							In milk.	Dry.	
49	94	Toggenburg.	869.4	4.0	12	3.3	262	14	Suffered from goatpox for 1½ months during lactation.
50	107	Desi.	598.7	4.2	3.12	2.6	228	72	
51	108	„	436.3	2.2	4.4	1.6	274	98	
52	116	„	528.7	5.0	3.8	2.0	256	70	
53	118	„	347.14	5.5	5.0	2.0	156	69	
54	119	„	349.1	5.5	2.8	1.2	291	104	
55	120	„	510.3	3.5	2.12	1.5	336	73	
56	123	„	430.10	6.0	4.0	2.0	205	75	
57	126	„	368.4	5.5	2.8	2.0	185	218	

ANALYSIS OF RECORDS.

Certain interesting facts are at once apparent.

Determination of Butter fat.—Though the determination of butter fat did not form one of the lines of research as laid down in the report for 1931-32, yet it was deemed to be advisable by the Animal Husbandry Expert to the Imperial Council of Agricultural Research, who made the following note in his inspection report dated 9th May 1932:—

“The system of recording milk yield is satisfactory but the percentage of butter fat should be tested and recorded to enable the amount of extra feed required to produce the increased milk and butter fat yields obtained by better management, to be accurately tested.”

We have been glad to follow out this suggestion, especially as this is a “virginfield,” and the writers are not aware of any research work dealing with this matter having been done before anywhere in India.

The records show the average percentage of butter fat as follows:—

1. Jumna Pari	5.3	2. Bar-Bari	3.8
3. Desi	4.6	4. Toggenburg.	4.0

The highest butter fat percentage in Jumna Pari being 7.8, Bar-Bari 6.5 and Desi 6.0.

The highest milk yield during lactation in Jumna Pari being 1,237.4 lbs., Bar-Bari 504.11 lbs., and Desi 598.7 lbs.

Result of Cross-Bred Goats.—Of the eight cross-bred females (Toggenburg x Desi) No. 101, kidded on 5th April, 1932. Her lactation record up to March 31st, 1933, is 1,148.14 lbs., her maximum yield of milk in one day being 6.8 lbs., testing on an average 4.2 per cent. of butter fat. This goat, which shows much promise, is still in milk, and her complete lactation record will appear in report for 1933-34.

The average in each breed for milk yield during lactation, percentage of butter fat, maximum milk yield a day, average milk yield per day during lactation, number of days in milk and number of days dry is as follows :—

Table No. 11.

	Milk yield during lactation.	Per-centage of butter fat.	Maximum milk yield a day. lbs.	Average milk yield per day during lactation. lbs.	No. of days.	
					In milk.	Dry.
Average of 30 Jumna Paris.	465.6	5.3	3.0	1.5	287	104
Average of 18 Bar-Baria.	331.0	3.8	3.2	1.3	252	107
Average of 9 Desia .	446.1	4.6	3.5	1.8	241	98
Average of 56 goats .	414.2	4.3	3.2	1.5	260	103

FEEDING.

The same method of feeding has been followed as in year 1931-32, *vide* that report.

Fodder.—It is apparent that of the four fodders we are growing, *i.e.*, Napier grass, Guinea grass, Passamuli and Lucerne, the goats seem most fond of Guinea grass. About eighteen cuttings per year have been secured under irrigation. Napier grass when young is also found to be palatable. Kids have shown the greatest preference for Lucerne.

Silage.—This has also been given a trial. A kacha pit 16'×10'×8' was filled with about 250 mds. of chaffed green juar well pressed and covered with about 3' of earth. The pit was opened after five months. The goats at first did not like it, but within a fortnight they ate it, though they prefer the green fodder. Bucks of all breeds liked it and ate it with relish.

This experiment was conducted because of the scarcity of fodder for grazing during May and June.

The experiment will be continued during 1933-34, but using Napier grass instead of juar, the yield of which is slight in May and June, but heavy during the monsoon.

The grain ration is the same as 1931-32, but has been supplemented by the addition of 3 per cent. of "Chun Brand" mineral mixture which has taken the place of crushed salt.

Rock salt is available at all times, in the paddocks, the goats showing a great liking and desire for this.

MORTALITY.

For this *vide* statement of Adult Stock for 1932-33. Comparing mortality for 1932-33 with that of 1931-32, it is gratifying to note that this has been much less. For 1931-32, the mortality in adults was 19 per cent. whereas this year the figure is only 8.5 per cent. There were no cases of "Bisi" this year; last year most of the deaths were due to that. Deaths this year have been due mostly to Pneumonia.

It is interesting to note that there has been no mortality in cur crossbred goats.

POST-MORTEM EXAMINATION.

Whenever a death occurred, a careful post-mortem was carried out by the local Veterinary Doctor and S. S. Bhatia. Material for examination such as worm parasites, lungs, livers, gall bladders, and hearts have been sent to the Director, Civil Veterinary Department, United Provinces.

We have received the following statements from the Director on this matter :—

Letter dated February 8, 1932.

"I am to inform you that liver presented two small Echinococcus Cysts; portal vein presented obstruction due to which liver was enlarged and friable. The whole trouble is caused by the internal parasites and cysts."

Letter dated February 18, 1932.

"With reference to your letter dated 9th instant, I am to say that the specimens sent by you were found nearly the same as in other cases, liver presented an Echinococcus Cyst."

SEGREGATION.

Though, as has been stated, mortality is less this year than last we would point out the necessity for a segregation ward. The Animal Husbandry Expert to the Imperial Council of Agricultural Research remarked in his inspection report dated May 9th, 1932 :—

"The Bar-Baris are evidently more highly susceptible to the Pneumonia which is such a scourge among goats in many parts of the country and as this disease is contagious I think more provision should be made for the segregation of animals so affected."

"In regard to the control of disease it is important that isolation facilities should be increased, that careful post-mortem examinations by a professional man should be carried out whenever possible and material for examination, such as worm parasites, submitted to the Imperial Institute of Veterinary Research, Muktesar, or a local laboratory for accurate identification as opportunity offers."

Further the committee of the Advisory Board of the Imperial Council of Agricultural Research which considered the progress report for the year 1931-32 adopted the report with the suggestion that we be asked to investigate the causes of heavy mortality among goats mentioned in the report.

Further the importance of isolation of sick animals was emphasised.

We find ourselves in entire agreement with the committee on both these points and would point out that without a segregation ward this work on mortality cannot be satisfactorily carried out.

We would therefore ask either the Local Government, or the Imperial Council of Agricultural Research, to make a small non-recurring grant for such a segregation ward.

We estimate that a small ward consisting of two rooms 12' x 12' with a verandah and two paddocks would cost about Rs. 600.

BRUCELLA INFECTION.

We would state that acting on the advice of the Animal Husbandry Expert to the Imperial Council of Agricultural Research, arrangements for Brucella infections have been made. In Colonel Olver's inspection report he stated : "In an experimental herd of this kind the goats and all fresh purchases should also be tested for Brucella infections so as to obviate danger of passing on this infection to human beings and of contagious abortion in the herd". This matter will be dealt with in report for 1933-34.

ACKNOWLEDGMENTS.

We would thank Colonel A. Olver, C.B., Animal Husbandry Adviser to the Imperial Council for his valued advice, personal interest and assistance, also Captain S. G. M. Hickey, I.V.S., Director, Civil Veterinary Department, United Provinces, for his help, advice and ready assistance on matters concerning diseases.

Respectfully submitted.

A. E. SLATER.

SARDAR SINGH BHATIA.

BALANCE SHEET FOR 1932-33

Receipts.			Expenditure.		
	Rs.	A. P.		Rs.	A. P.
1. Balance in hand on 1st April, 1932	119	5 4	1. Salary for assistant	1,064	12 0
2. Annual recurring grant by the Imperial Council of Agricultural Research	4,837	0 0	2. Menials salary	1,089	6 0
3. Sale of milk	605	6 6	3. Ration (grain)	1,318	7 6
4. Sale of adult stock	144	4 0	4. Fodder (purchased)	361	9 6
5. Sale of male kids	68	5 0	5. Cultivation	631	12 3
6. Sale of manure	10	0 0	6. Dairy	166	2 9
7. Services of Buck on village goats	3	12 0	7. Office	113	3 3
8. Cash paid by Mr. Slater	38	4 2	8. Medicine	61	2 9
			9. Veterinary Doctors' allowance.	150	0 0
			10. T. A.	12	0 0
			11. Equipment	428	7 3
			12. Miscellaneous	429	6 0
Total	5,826	5 3	Total	5,826	5 3

Statement of "ADULT STOCK" for 1932-33.

Breed.	In hand on 1st April, 1932.	Deaths.	Sold.	From young stock.	Total in hand on 31st March 1933.
Toggen Burg—					
I { Male	2	..	..	..	2
Female	5	3	..	..	2
Jumna Pari—					
II { Male	4	..	2	..	2
Female	42	2	2	..	38
Bar-Bari—					
III { Male	3	..	..	..	3
Female	21	1	..	2	22
Desi—					
IV { Male . . . . .	..	..	..	..	..
Female	19	3	7	..	9
Cross-Bred—					
V { Male	1	..	1	..	..
Female	8	..	..	..	8
Total	105	9	12	2	86

Statement of "YOUNG STOCK" for 1932-33

Breed.	In hand on 1st April, 1932.	Births.	Deaths.	Sold.	Added to the adult stock.	Total.
Toggen-Burg—						
I { Male	1	3	2	..	..	2
{ Female	2	2	..	..	..	4
Jumna Pari—						
II { Male	5	21	7	11	..	8
{ Female	12	27	1	3	..	35
Bar-Bari—						
III { Male	6	17	..	21	..	2
{ Female	11	16	3	..	2	22
Desi—						
IV { Male . . . . .	..	..	..	..	..	..
{ Female	1	..	..	..	..	1
Cross-Bred—						
V { Male	5	18	3	12	..	8
{ Female	8	13	1	..	..	20
Total	51	117	17	47	2	102

APPENDIX XXXVIII-A.

SUPPLEMENTARY NOTE, DATED THE 2ND FEBRUARY 1934, BY SECRETARY ON SUBJECT No. 28 (i).—REPORT FOR THE YEAR 1932-33 ON THE SCHEME FOR BREEDING EXPERIMENTS IN CONNECTION WITH THE IMPROVEMENT OF GOATS CONDUCTED BY MR. A. E. SLATER,

As stated in the note dated the 24th January 1934, on the subject mentioned above, already circulated to the members of the Advisory Board, Mr. Slater's report was examined by the Standing Cattle Breeding Committee of the Council at its meeting held on the 19th February 1934. An extract of paragraph 11 of the proceedings of that meeting relating to this report is reproduced below.

"On consideration of Mr. Slater's report on the scheme for breeding experiments in connection with the improvement of goats the Committee considered that the work is being carried on on satisfactory lines and is already leading to valuable results. They wish to emphasise the importance of controlling Brucella infection and for this and other reasons consider that an adequate isolation ward is essential."

"It appeared from the figures produced in the report that some of the goats had been kept in milk for unduly long periods and the Committee suggest that an effort should be made to determine the optimum length of a lactation period in each of the breeds dealt with and to milk their goats accordingly."

2. The subject is now for the consideration of the Advisory Board.

APPENDIX XXXIX.

NOTE DATED THE 29TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 28 (ii).—REPORT OF MR. K. P. R. KARTHA ON MILK PRODUCTION STATISTICS.

As recommended by the Advisory Board at its meeting held in January 1932, and subsequently sanctioned by the Governing Body, Mr. K. P. R. Kartha was appointed in the first instance for a period of six months to—

- (i) work out the comparative over-all cost of milk and butterfat production from Indian cows, half-bred cows and buffaloes, respectively, under the different conditions of feeding and management which have existed in the military dairies from time to time;
- (ii) complete the statistical study of the results which have been obtained in the Ferozepore herd in grading up Sahiwal cattle for higher milk yield; and
- (iii) work on the comparative incidence of contagious abortion among Indian and half-bred cows in the Southern Circle.

Mr. Kartha joined his appointment on the 11th April, 1932, and his term of employment has since been extended from time to time with the sanction of the Governing Body and the present term of sanction expires in April, 1934. He submitted a note to the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in February, 1933, on the comparative economic efficiency of the Indian cow, the half-bred cow and the buffalo as producers of milk and butterfat. A copy of this note with the findings of the Animal Husbandry Wing was circulated to the members of the Advisory Board with memorandum No. F-34/V/33, dated the 25th April 1933. Mr. Kartha has since prepared two technical and three popular articles for publication and has now submitted a resume (Annexure) of his work while at Lahore Cantonment. This report will be examined by the Standing Dairying Committee which meets in March, 1934, and its report will be submitted to the Summer 1934 Meeting of the Advisory Board. Meanwhile Mr. Kartha's report is submitted for the information of the Board.

ANNEXURE.

LETTER FROM MR. K. P. R. KARTHA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, THROUGH THE ASSISTANT DIRECTOR OF DAIRY FARMS, NORTHERN CIRCLE, LAHORE CANTONMENT, No. 95, DATED THE 6TH JANUARY 1934.

I have the honour to give below a report of my work up to date at Lahore. I have been submitting my reports periodically to the Animal Husbandry Expert in the shape of results obtained from time to time, and the main object of this report is to link these up into a connected whole presenting in one view the investigations carried out by me during my appointment at Lahore Cantonment and the conclusions that have emerged therefrom.

I was appointed about the middle of April 1932. The first problem that was tackled was an investigation into the comparative economic efficiency of the Indian Cow, the Half Bred Cow, and the Buffalo as producers of milk and butter fat. The study was based on a population of 821 living milch animals in addition to a number of dead animals, bulls and calves examined for information regarding longevity, rate of mortality, etc., etc. These 821 animals comprised a total of 4,370 lactations. The principle of the study was to draw up a balance sheet, as it were, for each animal, i.e., to find out how much money has actually been expended on it during its life time, and how much has been returned by it. On the debit side would enter the expenses involved in various directions in calling an animal into existence, and maintaining it till death or disposal. On the credit side would appear the calves it leaves behind, the milk and butter fat yielded by it and the realisation from sale, if sold. A balance is struck keeping the milk and butter fat on one side and the money on the other, from which the cost of a unit of production is derived. This cost is taken as a measure of efficiency. The principle has been explained in detail and the conclusions that emerged from the study are contained in a "Note on the comparative economic efficiency of the Indian Cow, the Half Bred Cow and the Buffalo as producers of Milk and Butter Fat" submitted to the meeting of the Animal Husbandry

wing of the Board of Agriculture and Animal Husbandry in India, held at De'hi in February, 1933. The conclusions are briefly the following:—

1. For quick and cheap production of milk the Half-Bred Cow is the best.
2. The Indian Cow, as evidenced from the Pedigree herd at Ferozepore, shows latent milking qualities, and if specially bred can come up to the level of the Half Bred in milk production and beat her in butter production.
3. If fodder is cheap the buffalo can compete with any breed in butter fat production and the Ordinary Indian Cow in both milk and butter. If fodder is of moderate price only the specially bred Indian Cow can beat her in butter production, but if fodder is dear even the ordinary Indian Cow can beat her.
4. Under existing conditions the buffalo is more economic for the villager than the cow as the free grazing she gets or the road side enables her to beat the cow in the production of milk and butter.

The bye-products of the investigation are appended in the form of detailed tables showing the average lactation yield, lactation length, dry period, service period, age at first calving, interval between calvings, average daily yield during life time and the sex ratio of calvings, of the various classes of animals in the different administrative units considered. A table is also appended to the paper showing the best average mature production per year of Indian breeds and their various crosses (19 varieties, having varying proportion of foreign blood) with European bulls. This read with another table showing the comparative incidence of contagious abortion in the various proportions of foreign blood (which is a study of 14,326 pregnancies) gives an indication, however inconclusive it may be, that incidence of abortion, and therefore, by inference, susceptibility to diseases generally, increases with an increase in the level of production. These tables will be valuable for future reference, as they summarise the main characteristics of the herds.

This investigation (and also a part of the following) took me till the beginning of 1933. The work that was next done may comprehensively be described as an analysis of milk records of the various types of cattle. This analysis besides enabling an estimate to be made of the comparative economic efficiency from a different stand point brings out a volume of information which is of very great use in the course of dairy industry and business.

Milk yield, on the quantity of which depends the economic efficiency, is not a single entity. It is the resultant of a complex of forces, and it is conceivable to suppose that the yield is affected through its components. It is therefore necessary to analyse the yield into its components, study them individually and measure the effect of various factors of heredity and environment on them.

Data of milk yields of 812 lactations of the various types of cattle were analysed into the two factors: the maximum to which they rise and the rate at which they decline. The rate of decline was taken for special study. This was a stupendous task and involved a good deal of waste of labour. In order to study the weekly rate of decline it was necessary to copy the records actually into specially prepared forms that cut off the data automatically into blocks of seven days. No less than 600,000 figures had to be copied for a study of 1,000 lactations calculating at the rate of only two milkings a day and 300 days per lactation. These had to be added up by sevens and all further processes had to be gone through without the aid of a calculating machine. And when all is done it would so happen sometimes that either the whole lactation is not done in one farm, or the animal may have passed through so many farms that it becomes impossible to get full particulars about them. In this connection it has to be borne in mind that History Sheets travel with the animals while the milk records remain behind, and the transfers are very frequent. Thus a good deal of labour is wasted and time spent in hunting up records. A new form of recording is now under consideration, and if and when it is adopted it will overcome this as well as some other difficulties which investigators experience owing to the information regarding one animal not being available in one record.

The results of analyses are embodied in two papers entitled "The Lactation Curve and the Prediction of Milk Yields" and "The Persistency of Lactation" which were submitted to the Animal Husbandry Expert. These papers contain full details regarding data and the statistical methods employed in their analysis. As these papers appeared to be very technical and long, I was asked to prepare shorter papers, out of the material, of a popular nature. These have been prepared and are now in the hands of the Animal Husbandry Expert awaiting publication.

The idea was to present these at the Indian Science Congress and an abstract of all the papers was prepared for the purpose. But as there was no sufficient time for including these in the agenda of the Science Congress the idea was given up; copies of the abstract have, however, been forwarded and it is hoped this will appear in the proceedings of the Congress.

To summarise the conclusions :—

1. The maximum is found to be reached between the third and the sixth week of lactation. Certain individuals show a tendency to maintain the level attained at maximum, others start their decline immediately.
2. The rate of decline is the lowest or in other words persistency is highest in the Specially Bred Indian Cow and is lowest in the Ordinary Indian Cow. The Buffalo and the Cross Bred Cow are more or less on the same level.
3. The ratio of any month's yield to that of preceding month is a constant quantity. This fact enables a dairy man to test if conditions are normal in his herd.

Tables are given showing the maximum and the rate of decline and also showing *inter alia*.

1. How a complete lactation may be predicted from an incomplete one.
2. How an estimate may be made of the economic worth of an animal from a knowledge of yield during any stage of the lactation. This is particularly useful in the official testing of herds. Incidentally it has been shown practically (and confirmed mathematically) that the fourth month of lactation is the ideal time for conducting a short time test.
3. How lactations of different lengths may be reduced to a standard length. This is very necessary in the comparison of herds.

Then as regards the effect of factors like level of production, age and pregnancy on persistency, the following results were obtained :—

1. Level of production definitely affects persistency—the higher the production the less persistent the animal is. Table is given showing values of persistency at different levels of production.

2. Persistency decreases definitely from first to second lactation, less markedly from second to third and thereafter the curve flattens out. It is significant that variations due to age follow the same trend as that due to level of production, showing that it is the latter and not the former that affects persistency.

3. *Pregnancy*.—No definite conclusions were obtained regarding influence of pregnancy. This subject requires further investigation.

In addition to the above many 'auxiliary' small investigations were conducted which are either not big enough to be treated in a separate paper or if big enough no definite conclusions have been obtained. The most notable among these is the one concerning the optimum calving interval. This is a question that vitally affects the economy of milk production and is intimately bound up with the health of the animal. But it is regretted that though over 1,000 animals were studied no definite results were obtained. The Military Dairies in their standing orders have put down definite orders regarding the time at which animals should be put to bull, and the investigation only shows that these orders have been obeyed. In order to obtain satisfactory results it appears definite experiments should be conducted on large scale.

The effect of dry period is being examined.

A preliminary study of over 800 animals was made to find out whether the production of a heifer is an accurate index of her true worth as a mature animal. Heifers production is found to be correlated with the best subsequent production, but the data require further analysis in order to construct a satisfactory prediction equation for estimating the worth of an animal when it is still a heifer, and also to find out what the minimum production of a heifer should be in order to justify her retention in the herd.

Other data regarding mortality, longevity, etc., etc., have been boiled down to definite results and recorded. And for purpose of any information that may be required in future extracts have been taken from over a 1,000 History Sheets and have been recorded in my files.

In conclusion I must express my deep indebtedness to Captain C. E. Macguckin, M.B.E., Assistant Director of Dairy Farms, Northern Circle, for the valuable guidance and advice I have obtained from him and the uniform kindness and courtesy he has always extended to me. I am also thankful to his office, generally, for the hospitality I have enjoyed in a generous measure throughout the period of my stay there, and particularly to the Livestock Section for their kind co-operation and their constant willingness to render me all possible help.

Forwarded.

2. The statistical data collected by Mr. Kartha during his various investigations have been of great practical value to me and I am sure the more popular articles he has written on the results of these investigations will help Dairymen in India in solving some of their many problems.

C. E. MACGUCKIN, *Captain,*
Assistant Director, Dairy Farms,
Northern Circle.

APPENDIX XL.

REPORT OF THE RICE RESEARCH SCHEME COMMITTEE HELD
ON 20TH FEBRUARY 1934.

PRESENT :

Diwan Bahadur Sir T. Vijayaraghavacharya (Chairman).
 Professor S. P. Agharkar.
 Mr. R. G. Allan.
 Rao Bahadur D. Ananda Rao.
 Dr. W. Burns.
 Mr. B. C. Burt.
 Professor J. C. Ghosh.
 Mr. K. McLean.
 Professor P. K. Parija.
 Mr. J. H. Ritchie.
 Lieut.-Col. A. J. H. Russell (part time).
 Dr. M. A. Sampathkumaran.
 Mr. M. Vaidyanathan.
 Rao Bahadur B. Viswanath (part time).

Subject 30.—Annual reports for 1932-33 on the Bengal and Burma rice research schemes. (Appendix XL-A.)

(1) Bengal.

(a) Bankura experiment station—

In the opinion of the Committee the sub-plots used in the green-manuring experiment, especially in certain others, are too small and it was considered that the layout was not satisfactory. It appears, however, that at this farm there are special difficulties owing to the fact that rice is grown on comparatively small terraces. After consideration, the Committee recommend that item (3) of the programme of work (at page 3) "To find out ways and means of increasing the productivity of the soil of this tract"—which was doubtless, included as a result of the Council's recommendation should be omitted from the programme of work at this station. This part of the rice problem is being undertaken by the agricultural Chemist, Bengal, on adjoining land and, in view of the limited area and special difficulties at Bankura, should be omitted from the programme of work of the Council's scheme. In regard to the other experiments special agricultural technique is required owing to the difficulty that the experimental blocks are necessarily small. A good statistical layout alone is insufficient and this question should be discussed on the spot by the Statistician and the officer responsible for the planning of the experiment.

The programme of 1933-34 has been largely carried out already but for future years the Committee recommend that items (III) and (IV) (pages 14-15) should be omitted. The retention of items I, II, V, VI, VII (1), VII (2) is approved it being understood that the phrase 'water requirements' refers to the testing of varieties on different terraces where the depth of water is different. As regards item VII (3) an enquiry might be made as to what exactly is proposed under this item.

(b) Lhinsura—

The Committee have no criticisms to make on the report itself. After a discussion of details, they suggest however, that for all schemes of this nature, (and not only rice schemes) it is desirable that a full technical programme of work should be drawn up and submitted to the Council as soon as possible after financial sanction has been given to the scheme. This programme should be brought before a suitable sub-

committee wherever possible and in any case should be examined by the staff of the Council. It is often inevitable that before an annual progress report can be discussed, the next year's work is well under-way, and it is considered that, if a technical programme could be discussed in detail whilst the preliminary work on a scheme is in progress, a considerable amount of time would be saved.

In regard to both the Chinsura and Bankura report, the Committee would draw attention to the need of adopting a more definite method of reporting the results of field experiments. All such experiments should end with a statement of the conclusions, *viz.*, that a particular variety or treatment was, or was not, significantly better, or worse, than the standard treatment or variety—or than the treatment or the variety with which it was being compared. As a certain measure of uniformity is desirable in this respect, it is suggested that the Statistician to the Council should prepare a draft form of report and circulate it.

(2) *Burma research scheme.*

The comments which have been made regarding the method of stating results in the Bengal scheme apply to this scheme also. It is also desirable that in the tables, the area of the plots from which the results have been obtained, should be stated. The Committee have no other criticisms to make on this report which states very clearly the work in progress and the results so far attained.

Subject 33.—Application from the Government of the Central Provinces for a grant of Rs. 10,088 for research work on the "Gangai" pest of rice. (Appendix XI-D.)

The Director of Agriculture, Central Provinces, explained to the Committee that this pest which bores the stem of the paddy plant and frequently destroys it, appears to have been serious for the first time in 1932. Professor Parija considered that it was probably identical with an insect which had occurred in the Angul district of Orissa. It was decided that an enquiry should be made as to whether other provinces have suffered from this pest. Meanwhile the Director of Agriculture, Central Provinces, will furnish some further information which is being collected regarding the amount of damage done by it in the Central Provinces.

Subject 33.—Application from the Government of Bengal for a grant of Rs. 20,812 for a scheme of research on the physiology of the rice plant. (Appendix XL-C.)

Professor Agharkar explained the scheme to the Committee in detail. It was the opinion of the Committee that some of the work proposed has already been carried out either in India or in other countries whilst some of the other problems mentioned are now being studied in India. On the other hand there are a number of points connected with the physiology of the rice plant which require further study, *e.g.*, the reason why the application of soluble manures at certain stages of growth leads to marked increases of yield and the reasons underlying the necessity for un-watering rice fields at a certain stage in the growth of the crop and the replacement of the standing water by fresh water—a practice which is common in Bihar and Orissa and some other irrigated rice areas. It was agreed that the scheme should be withdrawn for reconsideration.

CHARAN DAS,

Secretary.

NEW DELHI;

The 21st February 1934.

APPENDIX XL-A.

NOTE DATED THE 20TH JANUARY 1934, BY SECRETARY, ON SUBJECT No. 30.—ANNUAL REPORTS ON THE WORKING OF THE RICE RESEARCH SCHEMES IN BENGAL AND BURMA FOR THE YEAR 1932-33.

A co-ordinated scheme of rice research in the provinces of Madras, Bengal, United Provinces, Burma, Bihar and Orissa, Central Provinces and Assam, was sanctioned by the Council in May 1931. Details of the various provincial schemes will be found in Appendices XV (pages 103—133) and V (pages 77—81) of the printed proceedings of the meetings of the Advisory Board held in June 1930, and January 1931, respectively. The first progress reports on the working of the Madras, United Provinces and Bihar and Orissa schemes were placed before the Advisory Board at its meeting held in August 1933.

2. The first progress reports for 1932-33, in respect of the Bengal and Burma rice research schemes have now been received (Annexures I and II) and are for the consideration of the Advisory Board. Work on both these schemes was started with effect from the 1st June 1932. As in the case of the progress reports submitted to the Board in August 1933, these reports will also be examined first by a sub-committee consisting of :—

- (1) The Vice-Chairman, Imperial Council of Agricultural Research (Chairman).
- (2) The Agricultural Expert, Imperial Council of Agricultural Research.
- (3) Mr. R. G. Allan, Director of Agriculture, United Provinces.
- (4) Dr. W. Burns, Director of Agriculture, Bombay.
- (5) Prof. J. C. Ghosh.
- (6) Rao Bahadur D. Ananda Rao, Officiating Director of Agriculture, Madras.
- (7) Mr. D. R. Sethi, Director of Agriculture, Bihar and Orissa.
- (8) A representative of the Department of Agriculture, Bengal.
- (9) Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.
- (10) Rao Bahadur B. Viswanath, Agricultural Chemist, Madras.
- (11) Prof. P. K. Parija, Ravenshaw College, Cuttack.
- (12) Mr. M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.

This sub-committee will meet in the Conference Room, First Floor South Block, Imperial Secretariat Buildings, New Delhi, at 2.45 P.M. on Tuesday, the 20th February 1934, and its report will be placed before the Board.

ANNEXURE I.

ANNUAL REPORT OF THE RICE RESEARCH STATION, BENGAL, 1932-33.

(i) Bankura Station.

Introduction.—A considerable portion of the Western Bengal area under rice is characterised by highly undulated land of heterogeneous constitution and as such the cultivation of rice is practised in steep terraces of varying situation. This presents a peculiarity, not met with commonly in any other part of the Plains of Bengal. The problem of the improvement of rice for this tract is therefore complex, as several varieties have to be produced suitable for the various situations met with, and generally the varieties found best for the Bengal plains do not suit the soil and other environmental conditions of these places.

Another interesting feature of the rice production of this tract is that after meeting the local demand there is always, in good years a big surplus for export, which finds its way through Calcutta to other parts of the world.

But on the other hand, the method of cultivation in vogue in this tract is not up-to-date. So from many standpoints, especially the commercial, there is great necessity as well as scope for the improvement of rice of this tract.

For want of adequate staff and funds the Bengal Government could not undertake elaborate researches for this tract, but as the tract offered great possibilities, the

Imperial Council of Agricultural Research and the Empire Marketing Board, London, offered financial help to take up the work on the desired lines.

The Scheme was started with effect from 1st June 1932, and in the first instance has been sanctioned for a period of 5 years.

Establishment.—I held charge of this work from its inception throughout the period under report.

The following staff was appointed from the grant of Imperial Council of Agricultural Research, India :—

- | | | | |
|--------------------------|---|---|----------------------------------|
| 1. Rice Research Officer | . | Babu Khitish Chandra Banerji, B.A., L.Ag. | with effect from 1st June 1932. |
| 2. Senior Assistant | . | Babu J. R. Pal, B.Ag., | with effect from 1st June 1932. |
| 3. Field Assistant | . | Moulvi Abdul Latif | with effect from 10th July 1932. |
| 4. Fieldman | . | Babu Premendra Mohan Mitra | with effect from 1st June 1932. |

Besides these officers the Bengal Government maintain one Fieldman.

Aims and Objects.—The main objects are :—

- (1) to find out high-yielding paddy-varieties suitable to such different situations of terraced paddy lands as are found in the Western districts of Bengal.
- (2) to study the rice market of this tract and find out such varieties of paddy as would enable many rice mills working in this tract to export the surplus rice outside Bengal.
- (3) to find out ways and means of increasing the productivity of the soil of this tract.
- (4) to find out the range of adaptability of paddy.

Scope of work.—As the officers engaged in the work were appointed late in the season, attention was confined only to the already existing scheme of field experiments that was being followed for the last few years by the Bengal Agricultural Department. All available data collected were verified. Special attention was paid this year to the study of the situation of the area and the special problems of paddy cultivation of the tract, the knowledge of which was essential to formulating a fitting scheme for future work. Although the whole staff is stationed at Bankura, work is undertaken at Suri Farm in Birbhum district also, as situations met with at Suri and Bankura collectively represent the areas for which the scheme is undertaken.

Tours.—The Rice Research Officer was on tour for 80 days. The Senior Assistant and the Field Assistant were on tour for 96 days. These tours were undertaken to arrange and conduct the experiment at Suri Farm, to study the requirements of the tract and conditions of cultivation of paddy, to collect new samples of paddy and to study the rice market.

Problems of Paddy Cultivation in the Tract.—The tract for which the present work is undertaken consists of the whole of Birbhum and Bankura districts, Asansole sub-division of Burdwan district and the Western portion of Midnapore district. The western portion of this tract is a continuation of the Chhotanagpur plateau and the paddy areas thereof are steeply terraced and the soil is full of kankar, which is often ferruginous, and coarse sand. In many places, the surface soil is only a few inches deep, the underlying subsoil being distinctly stony, and the fall in level between the highest situation and the lowest situation in any one field is often great, as much as 25 to 30 ft. Four classes of lands according to situation are generally recognised, the most common names being "Danga", "Bad", "Kanali" and "Shole". Of these by far the most important is "Bad" land which constitutes about 50 per cent. of the total paddy area. The next in importance is "Kanali", which is about 20 per cent. Manuring is practised but the quantity of cattle manure available is far too short for the requirement, and tank silt is extensively used as manure. "Danga" and "Bad" suffer very much for want of water and every year about 10 per cent. land on an average goes uncultivated. The question of water supply is the acutest of all problems in this area. Irrigation is resorted to, in many places, from bundhs and tanks, but owing to carelessness and want of repairs the bundhs and tanks are in most cases becoming unsuitable for irrigation and the problem is becoming acuter every year. Under the existing conditions, drought-resistant, at

the same time, high-yielding varieties of paddies for the "Danga" and "Bad" lands are much in demand, and our main work will be to find out such varieties. Adaptability of the variety is another factor to be desired, and this must be kept in view in all investigations. Response to better culture and manuring should also be sought for, in the recommended varieties for this tract. In the eastern portion of the tract, the land is less undulating and the level from the highest to the lowest situation does not vary much. The soil is loamy in character and is more fertile than the western portion. Two situations are generally recognised, but the problems are almost the same as in the western portion. Scarcity of water and paucity of manure exist equally intensively, and drought-resistant varieties of paddy with wide adaptability are required.

Broadcast *Aus* is unknown. All paddies are transplanted and the earliest harvest is in October. Paddy is the main crop of the tract. Where water facility exists, a second crop is grown on some of the paddy lands in winter. For these lands an early maturing variety is much in demand.

The "Danga" lands have only a few varieties. Most of these are coarse paddies yielding poor crop. "Bad" and "Kanali" lands have many more varieties. But the largest number of varieties are to be found in "Shole" lands.

Area under the work.—At Bankura Farm the total area under the work was distributed as follows :—

(a) Seed-bed plots . . . . .	. . . . .	. . . . .	. . . . .	5 acres.
(b) Test plots . . . . .	. . . . .	. . . . .	. . . . .	1.85 ..
(c) Pure line cultures . . . . .	. . . . .	. . . . .	. . . . .	1.70 ..
(d) Multiplication plots . . . . .	. . . . .	. . . . .	. . . . .	.55 ..
Total				6.6 acres.

At Suri Farm the total area under the work was distributed as follows :—

(a) Seed-bed plots . . . . .	. . . . .	. . . . .	. . . . .	4 acres.
(b) Tests and Observation plots . . . . .	. . . . .	. . . . .	. . . . .	3.9 ..
(c) Multiplication plots . . . . .	. . . . .	. . . . .	. . . . .	.2 ..
Total				4.5 acres.

Character of the season.—The following are the rainfall figures at Bankura and Suri :—

Bankura.

Name of month.	Normal rainfall in inches.	Amount of rainfall in inches in 1932.	Number of rainy days in 1932	Remarks.
January	0.51	<i>Nil</i>	<i>Nil</i>	
February	1.04	0.66	2	
March	1.25	<i>Nil</i>	<i>Nil</i>	
April	1.32	2.68	5	
May	4.84	4.34	8	
June	11.09	3.54	12	
July	13.11	11.73	25	
August	11.47	9.61	24	
September	8.74	6.46	15	
October	2.91	3.56	5	
November	0.64	1.79	6	
December	0.08	<i>Nil</i>	<i>Nil</i>	
Total				102

Suri.

Name of month.	Normal rainfall in inches.	Amount of rainfall in inches in 1932.	Number of rainy days in 1932.	Remarks.
January . . . . .	.40	Nil	Nil	
February . . . . .	.86	0.49	2	
March	1.04	Nil	Nil	
April	1.02	.19	1	
May	3.82	3.62	6	
June	10.73	4.63	11	
July	12.88	11.52	25	
August	12.75	9.60	19	
September	9.57	6.22	10	
October	3.40	2.88	3	
November	0.42	2.30	4	
December . . . . .	.07	Nil	Nil	
Total	56.96	40.85	81	

The distribution of rainfall was fair at Bankura. Sowing of seed-bed commenced on 29th May and continued for about five days. It commenced again on 12th June and continued up to 19th June. Certain series were re-sown on the 29th June. Transplanting was begun on the 22nd July and continued almost uninterruptedly up to the 31st of July. There was a spell of drought in June and the seedlings suffered heavily in some cases, and irrigation had to be done twice to keep them alive.

There was another spell of drought between 24th September and practically the end of October, and the crop, specially the high-land one, suffered considerably. Good showers at the beginning of November helped the low-situation-paddies considerably, but the medium-situation-paddies were damaged because they were flowering at the time.

The above remarks apply equally to Suri also.

Physical conditions of the experimental area and some difficulties regarding the plot layout.—The physical conditions obtaining in our experimental area to a fair measure represent the diverse conditions of this tract. The area is situated on a slope running from South to North. The whole of the experimental area is terraced in the fashion obtaining in the cultivators' fields. There is a wide range of variation in physical conditions (texture, fertility, water holding capacities and water supply facilities, etc.) ranging from the most coarse sandy leachy soils up in the line of slope to the most retentive, fertile soils in the low-lying areas. The physical variation from one situation to another is a fairly systematic one, though each of the different situations has its own physical conditions. The adoption of varieties with wide adaptability will go a long way to simplify the complex nature of agricultural problems arising out of the physical differences in the adjoining situations. Studies on adaptability will receive due share of attention next year.

Under the existing circumstances there are many real difficulties in the way of plot layout. There are two apparent causes accounting largely for the high experimental error both at Bankura and Suri.

(1) The area available for one particular test is inadequate for the layout of well-planned experiments necessary for reduction of experimental error.

(2) A test extends over many different situations with diverse physical conditions.

To facilitate further improvement, it seems essential at the outset to extend the area under one test as far as possible by reclamation of land, and next to bring it fairly to a uniform level, so as to establish a fairly uniform condition throughout the test.

Some areas have already been improved on the above-mentioned lines at Bankura and Suri.

Details of work :—

1. *Pure-lines.*—The pure-lines established previously include varieties and strains and number 490. In this tract, the chief criterion determining the right situation

for the successful growth of varieties is their period of flowering. The paddies were therefore roughly arranged in the field along the line of slope in order of their flowering time. One striking feature of paddies in this tract that needs mention here is that there is no self-defined agricultural group like *Aus* and *Aman*, as exists in the eastern parts of Bengal, but the flowering period of the collection as a whole presents a graduated series, ranging from about the middle of August to the middle of November. The varieties, however, were conventionally classified into the flowering broad groups according to their period of flowering.

- (1) *Aus*.—Suitable for the "Danga" land;
- (2) *Early Aman*.—Suitable for the "Bad" land;
- (3) *Inter Aman*.—Suitable for the "Kanali" land;
- (4) *Late Aman*.—Suitable for the "Shole" land.

Besides these conventional groups, there were the Bhutmuries and Badkalamkatia. The former group includes a large number of strains with minor differences in such physiological characters as water requirements, response to nutrition, etc., while the second group includes a large number of closely resembling varieties. The second group again, when arranged in order of their flowering time, presents two distinct humps and thus splits into two self-defined agricultural groups. The studies on pure-lines comprise the detailed study of morphological and physiological characters.

A. *Study of the morphological characters*.—A detailed study of all the morphological characters, along with some important agronomic characters such as height, tillering capacities, period of maturity, etc., was undertaken.

B. *Physiological characters* were studied in the following aspects:—

(I) *Study of growth characteristics*.—Preliminary studies on the nature of growth in different parts of the plant at different stages of maturity were made in several varieties.

(II) The differential response of varieties to extra nourishment obtained from extra border space was studied. The comparative response indicated by border plants was measured and expressed in the form of extra grain yield, and varieties were arranged according to their degree of response. This subject will be given closer attention next year.

(III) Drought-resisting capacities of several varieties were studied during various spells of drought from the early seed-bed stage till maturity, and some varieties which were found to be least affected by drought were marked out for future study.

(II) *Tests*.—Some promising types selected previously from each of the four different conventional groups mentioned under the head "Pure-lines" were tested in their respective situations both at Bankura and Suri, according to the latest methods of varietal and strain testing. Besides these, there were three more tests at Bankura, limited to the two botanical groups mentioned above, namely—

1. Bhutmuri selection test (*Aus* type).
2. Badkalamkati early hump test.
3. Badkalamkati late hump test.

Tests were also conducted at Suri of certain Kartik-paddies, occupying a medium situation in the line of slope and including varieties from the first three of the conventional groups mentioned previously. The results of all these tests are shown in Enclosure A.

(III) *Spacing Experiment*.—Spacing experiment was conducted with a view to study the effect of various grades of spacing on yield and other factors affecting yield, and to determine the best spacing for medium paddies. Results are shown in Enclosure B.

(IV) *Green Manuring Experiment*.—The possibilities of cultivation of high yielding late paddies on medium situations under green-manuring and suitability of three green manuring crops, namely, Dhaincha, Sunnhemp, Cowpea, was investigated. The detailed results of the experiment are shown in the Appendix C.

Economic possibilities of green-manuring in this part.—In general, the soils up in the slope are extremely deficient in organic content, and the problem of manure-supply (organic) is acute. Hence there are potentialities in green-manuring. This practice is however only possible in places with adequate irrigation facilities.

(V) *Uniformity Trials*.—Uniformity trials were conducted both at Bankura and Suri with different varieties in different situations. The data are being examined statistically.

(VI) *Multiplication of seed.*—Some previously selected varieties were multiplied for distribution of seeds.

Market Study.—Investigations were undertaken to study the marketing problem of the paddy crop in this area. In most places of rural areas the *fariak* go from village to village and buy paddy from house to house. In mill areas the cultivators bring their surplus stock of paddy to the mills in bullock carts. None of the rice mills have any godown for stocking big quantities of paddy, but buy paddy as required. The flow of supply is pretty constant.

The history of the rice mills is an interesting study. Most of the mills date from about 10 years ago. Before that time Dhenkihusked rice was exported from various centres. The chief centres were Rampurhat, Sainthia and Bolpur in the Birbhum district, Bankura in Bankura district, and Madpur, Panchkura and Radhamohanchak in Midnapur district. At that time the rice produced in these centres could be transported to Calcutta for export at a much cheaper cost, so that there was always a difference of about Re. 1 per maund in favour of these rices in comparison with Sada mota, Nagra and Patna. After the war there arose a big demand for the coarser rices of this tract to be exported to Ceylon, Mauritius, Madras and other places. The principle trade names were "Kalma" from Birbhum, "Kalamkati" from Bankura and "Dot-Golapi" from Midnapur. This demand of coarse rice at a cheaper price gave an incentive to the establishment of mills in the rice areas of these districts. For three or four years the mills did very good business and were exporting a lot of local rice through the Calcutta port. About three years ago a setback came in the trade. The difference in price in favour of the local rices began to disappear, and the demand gradually began to fall. At the present time no milled rice from this area goes to Calcutta to be exported outside. The price obtaining locally is at par with Nagra, Jhingasail and Patnai rices at Calcutta, and it does not pay to carry the local rices to Calcutta. The mill-owners are of opinion that the rices have struck the lowest level in price and further reduction in price will be ruinous. The result is that none of the mills are able to do full work. At present the produce of these mills are being taken upcountry; but the demand in those places is far below the supply and the mills are in a tight position.

The principal mill centres together with the paddies dealt are :—

	Paddies.	Trade names.		
(a) Birbhum district—				
Rampurhat	} Sindurmukhi	} Kalma.		
Mollarpur				
Sainthia				
Bolpur				
Suri				
Dubrajpur	} Dudkalma	} Kalma.		
(b) Bankura district—				
Bankura			} Badkalamkati	} Kalamkati.
Chhatna				
Ondagram				
Bishnupur				
Jhantipahari				
(c) Midnapur district—				
Radhamohanchak	} Many varieties of coarse paddies.	} Rose Golapi.		
Madpur				
Bullichak				
Panchkura				
Kolaghat				

Besides these big mills there are many mills operated by low-power oil engines, existing in many places and working mostly on commission basis, in husking the local paddies to meet the local needs. Sitasail, Bankchur, Badkhani and other finer paddies are often husked in these smaller mills, and carried to Calcutta where these fine rices sell at a premium rate, and some portion of them are exported to Persian Gulf, Egypt, South Africa, etc.

The loss of the export market for rice of this tract is a calamity which cannot be minimised or overlooked. The rayots are in many places unable to sell their paddy for want of demand or market. The *fariaks* have ceased to visit the villages for purchase, as it is no longer lucrative. The mills often refuse to buy cultivators' paddy

when brought to them because they have a stock of rice which until sold is a dead stock and prevents them from the purchase of paddy.

From trade reports it is seen that the rice of this tract used to go to the following places :—

Trade name.	Place of origin.	Place where exported.
Rose Golapi	Kolaghat to Madpur	Ceylon and other ports.
Bachhai-kalma	Rampurhat Mollarpur	Mauritius.
Dudkalma (Polished)	Do.	Persian Gulf.
Banktuli and Sitasail	Madpur	Mauritius and Natal.
Kalma	Balpur and Sainthia	Aden.
Kalamkati (manja) and Dudkalma.	Bankura and Birbhum	Persian Gulf and Red Sea ports.

Nagra, Patnai (boiled) and Balam appear to have captured these markets because they are better class rices and are now equal in price with the rices of this tract.

Final Remarks.—Next year we are formulating new schemes and extending our areas for experiment. The Agricultural Chemist, Bengal, has very kindly given up certain of his areas for inclusion in our experiments for which our thanks are due to him, our thanks are also due to Professor P. C. Mahalanabis and his assistant Mr. Sukhendu Shekhar Bose, Calcutta, for the kind and valuable help they are ungrudgingly rendering us in the Statistical side of our experiment. The Laboratory, threshing floor, and godown are completed and it is hoped, will be fully equipped before next season commences.

ENCLOSURE A.

N.B.—The figures in first column are weighments of 100 plants grain yield in tolas and those of the second column are the percentage yields in tola.

Per cent.

1. *Aus. test.*

1. (a) Bawkura Aus. test.

Area allotted 2; subplots 14 × 14 plants, replications 10.

Error	2.84	3.85
General mean	73.74	100.00
Jhulur 54	83.42	109.06
Jhanji 42	76.69	104.19
Berahati	73.69	99.93
Bhutmuri (local)	70.12	95.09
Ausdhan	67.72	91.83

2. *Bhutmuri tiller test at Bankura.*

Error	2.84	3.05
General mean	71.10	100.00
Bhutmuri 54	73.69	103.92
Bhutmuri (local)	71.35	100.35
Bhutmuri 13	70.72	99.46
Bhutmuri 15	70.41	99.02
Bhutmuri 27	69.14	97.24

(b) *Suri Aus.*

Area allotted .5 ; subplots 14 × 13 plants, replications 10.		Per cent.	
Error	3.83	5.14	
General mean	74.41	100.00	
Jhingasail	97.30	130.76	
Ashkata	86.10	115.71	
Nouchi	84.60	113.69	
Sada Aus (local)	81.70	109.80	
Newali	74.90	100.66	
Jhanji	74.70	100.39	
Carol	74.00	99.45	
Kelesh	73.30	98.51	
Ulusuku	73.20	98.37	
Berahati	59.80	80.36	
Bhutmuri	58.9	79.16	
Ausdhan	54.4	73.11	

2. (a) *Bankura early Aman.*

Area allotted .2 ; subplots 14 × 14 plants, replications 10.			
Error	3.70	3.24	
General mean	113.88	100.00	
Bhramarkanu	121.91	107.65	
Dahia	115.12	101.09	
Kalakuchi	113.23	99.42	
Badkalamkati (local)	111.05	97.50	
Jhingasail	107.99	94.82	

(b) *Suri early Aman.*

Area allotted .5 acre ; subplots 14 × 13 plants, replications 10.			
Error	4.65	3.70	
General mean	125.77	100.00	
Dahia	137.20	109.10	
Badkalamkati 65	135.40	107.65	
Bhramarkanu	133.10	105.82	
Jhingasail	130.60	103.84	
4			
—C.	129.30	102.80	
145			
Jhulur	126.80	100.82	
Bankalam	125.40	99.70	
Kalamkati	121.60	96.60	
Badrash	117.80	93.42	
238			
—			
1252			
Badrash (local)	110.50	87.86	

3. (a) *Bankura Inter Aman.*

Area allotted .2 acre ; subplots 14 × 14 plants, replications 10.			
Error	4.27	3.70	
General mean	115.30	100.00	
Boldar	127.83	110.86	
Dannarguri	115.55	100.21	
Lakshmpriya	113.66	98.58	
Kalamkati (local)	109.95	95.36	
Jhingasail	109.53	95.00	

(b) *Suri Inter Aman.*

Area allotted .5 acre ; subplots 14 × 13 plants, replications 10.		Per cent.
Error	5.19	4.94
General mean	103.00	100.00
Badkalamkati 26	117.50	111.90
Boldar	114.90	109.42
Kalamkati	114.3	108.85
Jhingasail 24	111.9	106.87
Sonagura	108.5	103.33
Bangchur	105.1	100.09
Sundarsail	103.40	98.47
Kalamkati (local)	103.30	98.38
Latisail	102.9	98.00
Jalsuka	101.5	96.66
K X Amrash	100.3	95.71
D X 1 (13)	97.2	92.87
Kelesh	95.00	90.47
Sitasail	94.5	90.00

4. (a) *Late Aman Test*—(Bankura).

Area allotted .2 acre ; subplots 14 × 14 plants, replications 10.

Error	5.71	4.12
General mean	138.64	100.00
Manikkalma (local)	146.94	105.98
Bhasamanik	145.09	104.65
Dudsar	142.39	102.70
Indrasail	131.43	94.08
Jhingasail	127.39	91.89

(b) *Suri late Aman.*

Area allotted .5 acre ; subplots 14 × 13 plants, replications 8.

Error	4.38	4.83
General mean	90.52	100.00
Katakaima	101.87	112.54
Bhasamanik	99.62	110.05
Sindurmukhi (local)	96.87	107.01
Dudsar	93.50	103.29
Kuttanena	92.25	101.91
Boldana	90.00	99.42
Sindurmukhi selected	89.25	98.60
Jhingasail	88.62	97.90
Kalikalma	88.50	97.76
Indrasail	87.00	96.11
Nagra/68/6	86.12	95.14
Govindabhogue	72.62	80.22

5. *Badkalamkati early hump at Bankura.*

Area allotted .2 acre; subplots 14 × 14 plants, replications 10.

		Per cent.
Error	3.36	3.07
General mean	118.99	100.00
Badkalamkati 52	125.17	105.19
Badkalamkati 42	120.70	101.43
Badkalamkati (local)	118.90	99.92
Badkalamkati 50	115.17	96.79
Badkalamkati 43	115.00	96.65

6. *Badkalamkati late Hump test at Bankura.*

Area allotted .2 acre; subplots 14 × 14 plants, replications 10.

Error	5.28	4.01
General mean	131.47	100.00
Badkalamkati 67	139.71	106.26
Badkalamkati 99	135.99	103.44
Badkalamkati 68	129.76	98.70
Baraa Kalamkati (local)	126.69	96.36
Kalamkati 103	123.19	93.70

7. *Kartik Paddy long strip test at Suri.*

Area allotted .9 acre; subplots 30' × 10.5, replications 9.

	Per cent.	Outturn per acre. Md. S. C.
Error	4.76	..
General mean	663.74	100.00
Latisail	770.77	116.12
Jhingasail	698.33	105.21
Dudsar	685.11	103.22
Jhulur	677.33	102.04
Dahia	663.00	99.88
D Z 1 13	648.33	97.67
Badrash selected	623.88	93.99
Badrash (local)	608.88	91.74
Bankalam	598.00	90.09

ENCLOSURE B.

(SPACING EXPERIMENT.)

Area allotted .3 acre; subplots 10' × 10'; replications 18.

	Per cent.	Outturn per acre. Md. S. C.
Error	4.91	4.38
General mean	112.08	100.00
5	126.94	113.26
7	118.28	105.53
9	106.50	95.02
11	96.61	86.19

ENCLOSURE C.

(GREEN MANURING EXPERIMENT.)

Area allotted .2 acre; subplots 28' x 10', replications 6.

		Per cent.	Outturn per acre. Md. S. C.
Error . . . . .	..	6.94	..
General mean	293.2	100.00	14 11 11
Dhaincha	328.6	112.07	16 0 12
Cowpea	316.1	107.81	15 6 6
Check	280.1	95.3	13 26 3
Sunnhemp	251.1	85.64	12 9 10

N.B.—Owing to bad germination the green manuring matter in the sunnhemp plots was very scanty.

PROGRAMME OF WORK FOR THE YEAR 1933-34.

Bankura.

I. *Collection of samples and isolation of pure lines.*—Collection from Bankura district is fairly complete. About 150 new varieties were collected last year from the neighbouring Districts of Birbhum and Midnapur. This year these different samples collected will be grown in separate plots and detailed study of their diagnostic characters will be made with a view to isolation of pure types.

II. *Study of the pure lines.*—(a) Studies of various morphological and physiological characters of the existing pure lines will be continued on lines followed last year.

(b) The following studies of pure lines will be undertaken in addition to those followed last year.

1. *Water requirements.*—This investigation will be confined to a few varieties on different situations.

2. *Adaptability.*—(a) Experiments will be conducted both at Bankura and Suri to study the performance of some selected varieties in different situations.

(b) Behaviour of selected paddy varieties under transplanted and Broadcast conditions.

III. *Effect of different manurial treatment in seed-bed on the growth of seedlings will be investigated.*

IV. *Green manuring experiment.*—This experiment will be continued on a somewhat elaborate scale this year. The upper situations as a rule are extremely deficient in organic content, and a supply of green stuff may prove profitable. The problems of farm yard manure supply in this part is extremely acute; consequently possibilities in this direction lie only in the supply of green-manure, which can be raised *in situ* with moderate labour and expense.

V. *Hybridization.*—This will be undertaken with a view to produce high yielding strains suitable to diverse conditions.

VI. *Selection of promising types from pure lines.*—As a result of last year's investigations, some promising types have been marked out from different situations by eye judgment, and studies commenced on the various factors underlying yield. The selected varieties will be grown separately and studied in all possible aspects, before further selection is made from them for inclusion in tests.

VII. *Tests*.—The Bhutmuri tests and the Badkalamkati Tests, having limited economic importance, will be discontinued, and the best types from these will be included in the Aus test. The rest of the tests will be remodelled on the following lines :—

1. Area will be extended and more varieties will be included.
2. Some of the tests, namely (a) Bad Late Hump (b) Inter-Aman Test and (c) Late-Aman test, will be given comparatively more area, as the types of land occupied by them represent about 75% of the lands of this district.
3. Best size and shape of sub-plots, adequate number of replications, as determined by the analysis of the uniformity trials will be adopted.

K. C. BANERJEE,
Rice Research Officer, Bankura.

ANNUAL REPORT OF THE RICE RESEARCH STATION, BENGAL, 1932-33.

(ii) *Chinsurah Station.*

Introduction.—The rice research work was started on the 1st June 1932 with financial aid from the Imperial Council of Agricultural Research, India, and the Empire Marketing Board, London. This is a grant in addition to the amount the Bengal Agricultural Department is spending for research work on Rice on the Chinsurah Farm.

Aims and Objects.—(1) Improvement by selection, hybridization and other plant breeding methods of the quality and yield of the different types of rices suitable for this tract.

(2) The improvement of Patnai Rice of the Sundarban tract with special attention (i) to its commercial possibilities and (ii) to its capabilities under the sweet inland conditions.

(3) The improvement of trade paddies other than Patnai, which commonly go under the name of "Bengals", such as—Kalmas, Nagras Jhingasail and the "Mota" rices.

(4) Introduction and extension of improved strains in suitable areas, with a view to produce an exportable surplus.

(5) To investigate the possibilities of increasing the trade in Rice of Bengal with other countries.

Establishment.—I held charge of the work from its inception till the end of the year.

The following staff was appointed in connection with this work.

1. Rice Research Officer	.	.	Babu S. C. Chakravarty, B.Sc., L. Ag with effect from 1st June 1932.
2. Senior Assistant	.	.	Mr. E. A. R. Banerji, M.Sc., with effect from 9th December 1932.
3. Field Assistant	.	.	Babu Jogendra N. Dey, with effect from 1st June 1932.
4. Fieldman	.	.	Munshi Golam Kadar, with effect from 1st June 1932.

Besides this newly appointed staff, Babus Satish Ch. Pal and Nalini Ranjan Sen of the Office of the Economic Botanist continued to work as before as Fieldman and Preparer respectively. As the research staff was appointed with effect from the 1st of June, i.e., after the sowings of the paddies in seed-beds were completed, last year's programme was mainly carried out without much change, except the experiments on uniformity trials, and hybridization, which had not hitherto been taken up on this station. A detailed report of the work is given below.

Tour.—The Rice Research Officer spent 82 days on tour during the year, in connection with the survey and collection of paddies with special reference to the types suitable for export trade, and also to obtain all available information from shippers and millers regarding the export trade of Bengal with other countries in rice. Mr. E. A. R. Banerji, Senior Assistant, spent 12 days on tour to undergo a course of training in statistics under Professor P. C. Mahalanobis. Babu Jogendra Narayan Dey, Field Assistant, spent 8 days on tour in order to collect samples of paddies in the District of Burdwan, Hooghly, Howrah and 24-Pargana.

Rainfall and Character of the Season.—The actual rainfall as recorded at the Chinsurah Farm is stated below :—

Name of month.		Normal rainfall.	Amount.	No. of rainy days.
			1932-33.	1932-33.
April	1932	2.46	2.71	4
May	"	5.85	9.32	9
June	"	10.51	10.76	10
July	"	11.28	5.94	21
August	"	11.64	10.60	20
September	"	8.40	5.72	11
October	"	4.09	1.56	4
November	"	0.66	4.74	7
December	"	0.19	Nil.	Nil.
January	1933	0.38	Nil.	Nil.
February	"	1.20	1.59	4
March	"	1.58	Nil.	Nil.
Total		58.20	53.04	90

The total rainfall during the year (53.04 inches) was not far below normal (58.20 inches). But the distribution was very unfavourable. The low rainfall in July, being only 5.94 inches against the normal rainfall of 11.28 inches, seriously handicapped the transplanting of Aman rice, and irrigation had to be done in order to complete transplanting in proper time. The low rainfall in September and October, and especially the long spell of drought between the end of September and the end of October, seriously affected the rice crop. The situation was however saved by a good shower in the beginning of November, which considerably helped the crop at the critical moment, strong wind and showers of rain in the middle of November did some damage to the rice crop owing to lodging.

Area under work.—The total area utilised during the period under report for Rice Research work at Chinsurah was distributed as follows :—

(a) Aus seed bed	0.6 acres.
(b) Aus test	3.1 acres.
(c) Aman seed bed	2.4 acres.
(d) Aman collection	3.0 acres.
(e) Aman test	6.4 acres.
(f) Seed multiplication	1.0 acre.
(g) Uniformity trial	1.0 acre.

Total . 17.5 acres.

Main Features of work.—*Pure line Cultures.*—A collection of 578 pure line types of transplanted Aman paddy was grown for observation and selection. Besides, a new collection of 154 types of Aman paddies—collected during the year 1931—was also grown for establishing pure lines. There was no collection of Aus paddy, but 11 types of Charnock sports were grown for observation and study.

The morphological and Agricultural characters of the existing pure-line types were studied in detail and observations recorded.

The growth of the Rice plant at various stages, the mode of tillering, the time and period of flowering, the opening and closing of spikelets, etc., were also studied in detail in a few pure-line types of Aus and Aman.

Selection.—A few promising types were selected from the existing collections with special reference to quality (size, shape, colour and consistency of grain suitable for export trade) and yield, with the object of testing them against the local variety during the next season.

Varietal Tests.—Five varietal tests were conducted at the Chinsurah Farm after Fisher's method of Randomised blocks, e.g.—

(1) *Aus small strip test.*—Seven selected pure-line strains were tested against standard local variety. The mean grain yields of the selected strains of Jhanji, Bhutmuri and Kele were more than that of the local variety, but their superiority is not statistically significant. The local variety, however, is significantly superior to Dhairal, Sonamukhi, Saru Aus and Surjamukhi all selected highland broad-cast Aus paddies of Dacca—suitable for East Bengal conditions (*vide* Enclosure A-1).

(2) *Aus long strip test.*—Four selected pure-line strains were tested against the local variety. Similar to the small strip test, the varieties Kele, Jhanji, Bhutmuri and local Kele are indistinguishable as regards their mean grain yields, but compared to Dhairal—one of the best heavy yielding strain of Dacca—all of them are significantly superior (*vide* Enclosure A-2).

The Dacca high-land Aus selections do not do well under the changed cultural conditions of transplantation generally obtaining in West Bengal. They are included in the tests to study their behaviours and adaptability under the new conditions.

(3) *Aman small strip test.*—Twenty selected pure-line strains of transplanted Aman paddy were tested against two standard local varieties, e.g., Nagra local and Patna local. (1) Patnai (Gosaba 3), (2) Bhasamanik, (3) Patnai (Gosaba 7), (4) D×1 (21), (5) Kalamkati, (6) Patnai (Barisal 19), (7) Bhasakalma, (8) Nagra 68/6, (9) Bankchur and (10) Nonabangura are significantly superior to local Nagra, while the first four only are significantly superior to local Patna. The selected strain of Bhasamanik stood second in order of merit and maintained its position as a heavy-yielding strain and gave an increased yield of about 25 per cent. over local unselected Nagra (*vide* Enclosure B-1).

(4) *Early Aman small strip test.*—Eleven early pure line strains of Aman varieties were tested against local Nehara. All the varieties were significantly superior to the local one. The most striking result in the test is that Nagra 41/14 is significantly superior to all the varieties in the test (*vide* Enclosure B-2).

(5) *Aman long strip test.*—Nine selected pure-line strains were tested against a standard local unselected Nagra. Nagra 41/14 and Kalamkati were significantly superior to local Nagra (*vide* Enclosure B-3).

Uniformity Trial Experiment.—A uniformity trial experiment was conducted with Bhasamanik (a selected pure line strain of transplant Aman paddy) in one of the acre-plots. The main object of this experiment was to determine (1) the optimum size of plot for field trials in this locality, and (2) the effect on yield of the position of the plot in the field. The former data is absolutely essential as in the early years of the life of a new selection, only small quantities of seed are available, and this necessitates laying down yield trials in small plots. The latter data is also necessary, as it gives us an idea of the soil and fertility gradients, and the ways by which this can be eliminated for the purpose of securing greater accuracy in results. The above results are being worked out.

Another marked feature of this experiment has been that we have taken our unit plots in this experiment very small, by which we hope to get a lot of valuable information.

In connection with this, I may mention here the valuable help we are receiving from Professor P. C. Mahalanobis and his Assistant Mr. Sudhendu Sekhar Bose.

Hybridization.—In addition to selection and production of improved strains, it was proposed to study the genetics of Rice with special reference to economic characters, such as length and breadth of grain, number of grains per tiller, consistency of grain, length of straw, date of flowering, etc.

With the above object in view, a few varieties of rice were crossed direct in the field, but owing to adverse weather conditions most of them were unsuccessful. Next season, being fully equipped, we hope to get the desired result by growing the parent plants in pots.

Survey and Collection of Paddy Varieties.—During the year, attention was mainly concentrated on the survey and collection of Patnai paddy, grown in the Sunderban tracts of 24-Parganas and Khulna. Patnai paddy, which thrives best under slightly saline conditions, is grown extensively in the Sunderbans of 24-Parganas where it occupies about 75 per cent. of the total paddy area, whereas its cultivation in the Khulna district is much restricted. Five distinct varieties of Patnai paddy, having different strains, are cultivated in those tracts. They are suitable for medium situation only, and are characterised by having long, bold, white and translucent grains.

Patnai paddies were found to be badly mixed with other types of paddies, thereby deteriorating the quality and yield. This is mainly due to natural crossing and negligence on the part of the cultivators.

Samples in ears of the different strains of Patnai and other varieties grown in the Sunderban tracts of 24 Parganas and Khulna were collected. Samples of paddies, with special reference to trade were also collected in the districts of Burdwan, Hooghly and Howrah. The total collection of paddy samples during the year under report was about 340.

Export Trade in Rice.—Rice is grown in Bengal chiefly for local consumption and the exportable surplus is very limited, being approximately 5 per cent. of the total production. This export trade, however, is of great importance to those areas which grow only the trade varieties. The chief of these is the Patnai Rice, which is exported under different trade names according to the method of preparation, e.g., (1) Seeta Rice (Hand-milled white Patna Rice), (2) Milled white Patna, (3) Milled boiled Patna. In the Bengal trade returns "Seeta Rice" and "Milled white Patna" are classed under the heading "Table Rice" while "Milled boiled Patna" classed under the heading "Bengal rice." Of these, Seeta rice is the variety chiefly exported to Europe for table purposes.

"Seeta Rice" finds ready market at Magra *hat* and Mathurapur (in the Diamond Harbour Subdivision), where the exporters and shippers purchase the gross rice direct from the cultivators or through middlemen, and after having partially cleaned and separated the broken grains, export the same to Europe. Cleaning and polishing of Seeta Rice to produce the appearance required especially by European consumers are being done in Europe by European Rice Mills.

In recent years the export of Patnai rice to United Kingdom has remarkably decreased. This is mainly due to deterioration in quality and to competition with special kinds of rice, e.g., Carolina Blue Rose, Fortuna, etc., grown in United States.

Other trade rices, which are exported chiefly to Persian Gulf, Egypt, Mauritius, Ceylon, Cape Colony, etc., under the general name 'Bengal rice', consist of the following varieties, e.g., (1) Bacha Kalma, (2) Dud Kalma, (3) Sadamota or boiled Sylhet rice, (4) Dot Golabi or Rose rice, (5) Sitassail, (6) Nagra, (7) Baktulsi, (8) Radhaganj, and other low quality cheap rice grown in Burdwan, Hooghly, Midnapur and other adjacent districts.

The export of the above varieties of rice also decreased considerably in recent years, chiefly due to competition with Siam, Indo-China and Burma.

Germination and purity tests.—All the seed of the recommended Departmental varieties of paddy that are sent from the Chinsurah Farm were tested before despatch for purity and germination.

Exhibition.—Samples of sundried and parboiled rices were prepared from paddy of the varieties recommended for the Imperial Gallery and India House. These, along with paddy and sheaves and samples of trade rices collected from Shippers and traders were sent to those places. Paddy samples were also sent to the World Grain Exhibition, Canada.

Final Remarks.—Our thanks are due to Professor P. C. Mahalanobis and his Assistant, Mr. Sukhendu Sekhar Bose, Calcutta, for the kind and valuable help they are ungrudgingly rendering us in the Statistical side of our experiments.

The laboratory, threshing floor and godown are completed, and it is hoped, will be fully equipped before the next season commences.

ENCLOSURE A-1.

Chinsurah Farm Aus paddy (small strip) test 1932-33. 8 varieties × 10 (Randomised Blocks).

Size of sub-plots—9' 9" × 9' 9".

Grain.	Jhanji (34).	Bhutmuri 36.	Kele pure line.	Kele local.	Dhairal.	Sona- mukhi.	Saru Aus.	Surja- mukhi.	Mean.	Standard error.
Mean grain weight of 100 plants in tolas.	73.35	70.80	70.05	65.55	55.35	54.75	44.95	42.85	59.70	2.78
Per cent. .	122.66	118.39	117.14	109.62	92.56	91.56	75.17	71.66	100.00	4.65
Straw.	Kele pure line.	Jhanji (34).	Kele local.	Bhutmuri (36).	Sona- mukhi.	Surja- mukhi.	Saru Aus.	Dhairal.	Mean.	Standard error.
Mean straw weight of 100 plants in tolas.	97.5	97.0	83.5	83.0	70.5	62.0	58.0	58.0	76.1	4.29
Per cent. .	128.1	127.4	109.7	109.0	92.6	81.4	76.2	76.2	100.0	5.6

ENCLOSURE A.-2.

Chinsurah Farm. Aus paddy (long strip) test 1932-33. 5 varieties × 10 (Randomised Blocks).

Area of sub-plots—1/40th acre. (121' × 9').

Grain.	Kele (pure line).	Jhanji (34).	Bhut- muri (36).	Kele (local).	Dhairal.	Mean.	Stand- ard error.
Maunds per acre	21.67	20.65	20.15	20.03	16.06	19.71	0.53
Per cent.	109.94	104.77	102.23	101.62	81.46	100.00	2.69
Straw.	Kele (local).	Kele pure line.	Bhut- muri (37).	Jhanji (34).	Dhairal.	Mean.	Stand- ard error.
Maunds per acre	29.1	27.9	26.0	23.7	20.2	25.4	0.8
Per cent.	114.8	109.8	102.2	93.9	79.6	100.0	2.3

andomised Blocks).

Size of sub-plots—9' 9" × 9' 9".

Chinsurah Farm.		Indra-sail.	Patnai (local).	Jata-kalma.	Dudsar.	D × I (15).	Nagra local.	Bad-Kalam-kati (26).	Sindur mukhi.	Nagra 36/13.	Mean.	Standard error.
Patnai 19 Bary.												
Kalam-kati 147.			130.2	125.8	123.1	122.2	120.7	116.8	111.9	133.5	4.32	
D × I 21.		144.1	97.52	94.22	92.20	91.52	90.40	87.48	83.81	100.00	3.24	
Patnai 7 Gosaba		145.0	108.60									
Bhesa-manik. 23 eba.		147.1	110.17									
				Bhesa-manik.								
				D Nagra 88/6.	Nagra local.	Bank-chur.	Bolder.	Patnai 23 Gosaba.	Bad-kalam-kati 26.	Mean.	Standard error.	
		183.0	173.5	172.0	159.0	213.06	10.3					
		Per cent.	13	85.8	81.4	80.7	74.6	100.0	4.8			

ENCLOSURE B.-2.

Chinsurah Farm early Aman paddy (Small strip) test 1932-33. 12 varieties × 10 (Randomised Blocks).

Size of sub-plots—9' 9" × 9' 9".

Grain.	Nagra. 41/14.	Dud- sar.	Lati- sail.	D × I 13.	Nehara selected.	Jhinga- sail.	Bhara- mar. ka u.	Badkal- mkati 165.	KXC 89.	C22X R22.	KXI 34.	Nehara local.	Mean.	Standard error.
Mean grain weight of 100 plants in tolas .	136.70	124.20	120.45	115.75	115.45	114.90	108.70	99.65	94.10	91.50	75.00	28.35	101.81	3.85
Per cent.	134.26	121.99	118.30	113.69	113.39	112.85	106.76	94.93	92.42	89.82	73.66	27.84	100.00	3.79
Straw.	D × I (13).	C22XR 22.	Dud- sar.	Lati- sail.	Nagra 41/14.	Jhinga- sail.	Nehara selected.	Bhar- mar- kanu.	Badkal- mkati 65.	KXC 89.	KXI 34.	Local Meharu.	Mean.	Standard error.
Mean straw weight of 100 plant- in tolas .	202.5	192.5	192.0	189.5	181.5	179.0	171.5	147.5	137.5	125.0	109.5	108.0	161.3	7.07
Per cent.	125.5	119.3	119.0	117.4	112.5	110.9	106.3	91.4	85.2	78.1	67.8	66.9	100.0	4.3

ENCLOSURE B-3.

Aman paddy (long strip) test 1932-33.

Chinsurah Farm 10 varieties × 10 (Randomised Blocks). Area of sub-plots—1/50th acre (124' 6" × 7').

Grain.	Nagra. 41/14.	Kalam- kati. 147.	Dud- sar.	Bhasa- manik.	Nagra. 68/6.	Lati- sail.	Nagra local.	Indra- sail.	Jhin- gasail.	D × I 13.	Mean.	Standard error.
Maunds per acre	37.07	36.99	36.92	36.90	36.28	35.69	34.33	33.35	29.32	29.19	34.6	0.88
Per cent.	107.1	106.9	106.7	106.6	104.8	103.1	99.2	96.3	84.7	84.3	100	2.56
Straw.	Jhin- gasail.	Kalam- kati- 147.	Dud- sar.	Nagra 41/14.	Indra- sail.	Bhasa- manik.	D × I 13	Lati- sail.	Nagra 68/6.	Nagra local.	Mean.	Standard error.
Maunds per acre	69.34	68.15	66.73	62.88	61.77	60.23	56.13	52.97	52.17	51.37	69.18	2.28
Per cent.	115.21	113.49	110.87	104.47	102.63	100.09	93.26	88.01	86.68	85.35	100.00	3.79

ANNEXURE II.

ANNUAL REPORT OF THE RICE RESEARCH OFFICER, BURMA, FOR THE YEAR 1932-33.

Introduction.—A five-year scheme for Rice Research financed jointly by the Empire Marketing Board and the Imperial Council of Agricultural Research was sanctioned by the Imperial Council of Agricultural Research in August 1931 and work connected with the scheme commenced at the break of the monsoon in June 1932. The original grant amounted to Rs. 2,41,736, but it has been specially requested that expenditure should be reduced as far as possible on account of the present financial stringency. The original scheme which provided for a small separate station and the recruitment of a special Research Officer was abandoned, and it was decided to utilise part of the existing Agricultural Station at Hmawbi situated on the Rangoon-Prome Road 31 miles north of Rangoon, and to place an officer of the Indian Agricultural Service in Charge of the Hmawbi Agricultural Station and the Rice Research Scheme.

This resulted in a saving in land acquisition, layout of the land, and to some extent on the buildings and equipment. It was necessary to erect a laboratory, drying shed, and seed drying platform only, as the additional accommodation was provided in existing buildings.

Centralisation has also the advantage of enabling the staff employed under the scheme to keep in close touch with workers dealing with other problems connected with rice cultivation and improvement thereby facilitating the co-ordination of work.

The buildings were completed in December 1932 except for laboratory fittings that were not finally completed till March 1933.

Soil and Climate.—The soil and climatic conditions are fairly typical of Lower Burma from where the whole of Burma's exportable surplus of rice comes, except the two coastal Divisions of Tenasserim and Arakan where the average rainfall is over 200 inches per annum compared with 85 inches to 100 inches in the other rice-growing tracts.

The soil of the paddy land is old clay loam alluvium with a stiffer subsoil, overlying at greater depths layers of slaty blue clay, sand and gravel. The soil dries out with great rapidity after harvest and bakes to a cement-like hardness as a result of which cultivation can only be effectively carried out during the monsoon.

Analyses of Hmawbi Farm paddy soil as carried out by the Agricultural Chemist, Burma, are shown below :—

Chemical Analysis.	Per cent.	Mechanical Analysis.	Soil per cent.	Subsoil per cent.
(1)	(2)	(3)	(4)	(5)
Insoluble Residue . . .	63.87	Gravel and stones . . .	..	..
Soluble Silica . . .	15.26	Fine gravel . . .	..	..
Ferric Oxide Fe ₂ O ₃ . . .	3.63	Coarse sand . . .	3.9	3.3
Alumina Al ₂ O ₃ . . .	10.07	Fine sand . . .	2.9	4.2
Lime CaO . . .	0.29	Silt . . .	33.1	24.1
Magnesia MgO . . .	0.29	Fine silt . . .	43.5	49.1
Potash K ₂ O . . .	0.57	Clay . . .	9.1	14.5
Soda Na ₂ O . . .	0.36			
Sulphuric Acid SO ₃ . . .	0.08			
Phosphoric Acid P ₂ O ₅ . . .	0.03			
Carbon dioxide CO ₂ . . .	0.02			
Organic matter and combined water . . .	5.53			
Organic Nitrogen . . .	.72			
Available Phosphoric acid . . .	.0029			
Available Potash . . .	.1047			

These soils are acid and have a pH value in the vicinity of 6.1 for the top six inches and 6.35 for the subsoil.

The year consists of two distinct seasons, a wet period of high humidity during the south-west monsoon from May till October during which the temperature ranges from a mean maximum of 84° F. to a mean minimum of 75° F.; and a dry period of low humidity from November till May. During the latter period there is a short cool spell in December and January with a mean maximum of 83° F. and mean minimum of 64° F., but this is followed by a hot dry period from February till the break of the monsoon about the middle of May during which the average mean maximum temperature ranges round about 97° F., and the mean minimum about 76° F., the highest maximum temperature recorded being 107° F. and the minimum 58° F.

The meteorological data recorded on Hmawbi Farm for the year under report are given in the statement below:—

Months.	Number of rainy days.	Monthly rainfall, 1932.	Normal monthly rainfall (previous 12 years.)	Aggregate rainfall from 1st January to the end of the year.		Mean Temperature.	
				1932.	Normal.	Maximum.	Minimum.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Inches.	Inches.	Inches.	Inches.		
January . . . . .	..	..	0.05	..	0.05	87	59
February	1	0.24	0.01	0.24	0.06	93	62
March . . . . .	..	..	0.28	0.24	0.34	97	68
April	1	0.20	1.61	0.44	1.95	99	75
May	7	1.63	8.88	2.07	10.83	98	77
June	21	15.15	18.61	17.22	29.44	96	76
July	28	23.19	23.45	40.41	52.89	84	75
August	15	13.05	21.48	53.46	74.37	86	76
September	16	13.81	14.57	67.27	88.94	84	76
October	12	9.80	6.73	77.07	95.67	86	76
November	2	0.29	1.86	77.36	97.53	87	73
December . . . . .	..	..	0.15	77.36	97.68	84	65
Total	103	77.36	97.68	77.36	97.68	..	..

The rainfall recorded during the year is by far the lowest on record, being 20 inches below the normal. The monsoon did not break till the first week of June, and there was practically no rain in May, which resulted in cultivation being about a fortnight later than usual. There was very heavy rainfall in the last week of July which caused a certain amount of flooding, and this was followed later by a period of low rainfall early in the third week of August which had an adverse effect on newly transplanted areas. The late rains, however, were good and a satisfactory crop was harvested.

Cultivation.—The area cultivated by the Rice Research Section was 10 acres. Ploughing commenced on the 10th of June, nurseries were sown from 20th to 28th June, and transplanting was carried out from the 20th July to 3rd August.

Harvesting commenced on the 24th November and was finished on 22nd December 1932. A dressing of Nificos containing 18 per cent. N, and 18 per cent P₂O₅ at the rate of 100 lbs. to the acre was applied to the area, as the fertility of the soil is not high and past experience has shown that it is inadvisable to apply farmyard manure to plant breeding areas, on account of the possibility of introducing "rogues" into the subsequent crop.

Staff.—The scheme was started on 1st June 1932, under the temporary supervision of Mr. R. Watson, I.A.S., Deputy Director of Agriculture, Southern Circle, but before this time a programme of work for the year had been drawn up by the writer while on special duty. U Saw Shwe, B.A.S., Class II, an officer with previous experience in plant breeding was appointed Assistant Rice Research Officer, as a temporary measure, on the 1st June 1932, and U Thein Aung of the Subordinate Agricultural Service was appointed Research Assistant on the 5th July 1932.

On return from leave on the 10th November 1932, I was appointed Rice Research Officer and assumed charge of the scheme on that date. Dr. B. P. Pal on his return from England, where he had been studying plant breeding as a Burma State Scholar, was appointed Assistant Rice Research Officer in place of U Saw Shwe from the 1st March 1933.

Two fieldmen were appointed from 1st June 1932, and a third was appointed from 1st February 1933, the fourth sanctioned post remaining vacant throughout the year.

Scheme of Work.—The rices of the country had already been classified by the Agricultural Department into five groups, according to length, breadth and thickness of grain, and the ratio of length to breadth, as shown in the statement below which has been included here for reference:—

Group Index.	Group name.	Dimensions of grains.			
		With husk.		Husked.	
		Length in mm.	Length Breadth.	Length in mm.	Length Breadth
(1)	(2)	(3)	(4)	(5)	(6)
A . . .	Emata . . .	Over 9.40	Over 3.30	Over 7.00	Over 3.00
B . . .	Letywezin . . .	8.40 to 9.80	2.80 to 3.30	6.00 to 7.00	2.40 to 3.00
C . . .	Ngassin . . .	7.75 to 9.00	2.40 to 2.80	5.60 to 6.40	2.00 to 2.40
D . . .	Midon . . .	7.35 to 8.60	2.00 to 2.40	5.00 to 6.00	1.60 to 2.00
E . . .	Byat . . .	9.00 upwards.	2.25 to 3.00	6.40 to 7.35	2.10 to 2.50

Most of the rices can be fitted into one or other of the groups and although a little overlapping in the length of the grain may be observed in the above classification it does not take place in the proportion of length to breadth, except in the E and A groups, which however are readily distinguished by other characters.

A grain which is broad in proportion to its length is described by millers as a bold grain, and generally speaking suffers less breakage in milling than long thin grains. A and B groups are thin grains, and C, D and E groups are bold grains.

Each of the groups is again divided into early, medium and late maturing varieties, but there is, speaking generally, an increasing life period from A to E among the unselected varieties now cultivated. The unselected varieties lack uniformity in size, shape and hardness of the grain, and also in other characters. Grain with a red pericarp which is an undesirable feature for milling, is present in unselected varieties in considerable proportions. A few awned varieties are also found, but awnless varieties are by far the most widely cultivated.

Although the requirements of the trade for the different world markets in which Burma rice is sold were known before the present scheme was started, a questionnaire was submitted to the four Chambers of Commerce in Rangoon to obtain the latest information regarding market requirements and the types in greatest demand in each.

The replies showed that the greatest demand is still, as has been the case in the past, for the Ngasein type of grain, but this type has suffered most in Western markets on account of competition from America, Spain and Italy, and the export of Burma rice to Europe is now only about half a million tons per annum, compared with over a million tons in 1913-14. In Eastern markets this type of grain is also in general demand, but in these markets it is subjected to increasing competition from Siam, Indo-China, and Japan. The Emata, Midon, and Bysat types are also sold in all markets, but they are relatively of less importance than the Ngasein types. The Letywezin types are in demand mainly for parboiling and they are sold in markets where cheapness is the main consideration.

The work carried out during the year has been of a preliminary character, based mainly on what has been in hand at Hmawbi Agricultural Station for a number of years with a view to intensifying it, and it may be described under four main headings:—

- (1) Work on Hybridisation.
- (2) Work on Pure Lines and Selections.
- (3) Genetical Studies including Correlation Studies.
- (4) Yield and Quality Tests.

Hybridisation.—A considerable number of crosses had been made on Hmawbi Agricultural Station during the last eight years with a view to obtaining improved types of rice for the world markets in which Burma has been experiencing increasing competition from other rice-producing countries.

A large amount of data regarding these had already been recorded, but the work had assumed such magnitude that the available staff could not cope with it.

Two hundred and one hybrid cultures, the progeny of crosses between local pure strains, and also between local strains and exotic varieties, together with all records relating to them were therefore taken over to the Rice Research Scheme for further and more intensive study.

The cultures were examined plant by plant in the field, and their physiological and morphological characters recorded. After preliminary selection in the field the cultures were examined plant by plant for grain characters. Hulling tests to determine the outturn of whole rice were carried out in the cultures of F_1 and F_2 generations. For this purpose an improved steel pounder with three mortars in one of which a parent standard variety was pounded was used, and a constant number of strokes (1,500) were applied in pounding. The outturn of whole rice from nearly all hybrids exceeded the parent varieties, some giving almost twice the outturn.

General notes regarding the different crosses are given below, as work connected with them was still in progress at the end of the year under report.

XF_2 (Ngasein C15-10 \times Ngasein C14-8) is a cross between two local pure strains with the object of trying to obtain a form with the good quality rice of C15-10, and a life period similar to or shorter than C-14-8, as C-15-10 is too long-lived for cultivation over a wide range of conditions in Burma, though it possesses rice of excellent quality.

Fifty F_2 cultures were under study during the year, thirty-five being discarded and the remainder carried on for future work. The life periods of different cultures ranged from 155 to 175 days, which is suitable for most conditions, and is shorter than that of any of the parents which are 190 and 180 days. Segregation for life period in this cross as well as in others now under study is transgressive. The rices though varying from culture to culture and also within the same culture are in all cases hard and translucent with little or no abdominal white, but the grain is not so big and bold as in cross Xa referred to below. The hulling percentages in those that have been retained are good and the rices approximate to the smaller Java types of Ngasein. Some of the culture are almost homozygous for the more apparent characters at least.

XaF (C15-10 \times C19-26) is a cross between two local strains with the same object as in cross X above. Seventy-three cultures were under study, and forty-three were discarded, the remainder being carried on for future work.

The general growth of the cultures derived from this cross was very good and better than in the preceding cross, and it is on the whole the more promising of the

two. The types of grain can all be fitted in to the Ngasein group, some of them being large, bold and translucent with practically no abdominal white and approaching the American Blue Rose rice in appearance and quality. The existing cultures ranged in life period from 155 to 175 days, and the hulling percentages of those that have been retained for further study are higher than any of the parents.

The cultures are still heterozygous for several characters.

Xb F₁ (C19-25 × C15-10) is the reciprocal cross of Xa above. Three F₁ cultures were under study, all of which were discarded on account of the comparatively poor quality of the grain, compared with that of the reciprocal.

Xc F₁ (C19-26 × C14-8) is a cross between two local strains with the same object as in the preceding crosses. One F₁ culture was under study but was finally discarded for poor quality grain.

Xe F₁ (Honduras × A16-34) is a cross between American Honduras and a local pure strain, both having much the same size and shape of grain, but the quality of Honduras is superior to that of the local strain. The object of the cross is to try to obtain a form producing grain similar to Carolina which will be suitable for cultivation under local conditions, as Honduras like all subtropical rices that have hitherto been tried is precocious when grown under the tropical conditions obtaining in Lower Burma, and it gives a yield of only about half that of local varieties.

Twenty F₁ cultures were under study during the year, ten being discarded and the remainder carried on for further study. The types of grain were generally hard and translucent, and growth varied from fair to vigorous, the cultures being heterozygous.

X/F₁ (A16-34 × Fortuna) is a cross between a local pure strain and the American variety Fortuna with the same object as in Xe.

Fifteen F₁ cultures were under study, eight being discarded and the remainder retained for further study. The grain is not so good in this cross as in Xe, but the growth is much the same in both. The cultures are still segregating for several characters.

Xg F₁ (B15-1 × Honduras) is a cross between a local strain and Honduras with the same object as the preceding two crosses. Two F₁ cultures were under study both of which were discarded for comparatively poor quality grain.

Xh F₁ (C19-26 × Honduras) is a cross between a local strain and Honduras. Three cultures were under study, all of which were finally discarded for comparatively poor quality grain.

Xi F₁ (D17-88 × Aikokku) is a cross between a local strain and a Japanese variety Aikokku. Both have much the same type of grain as regards size and shape, but the kernel of the local strain is rather soft and chalky while that of the Japanese variety is hard and translucent. The object of the cross is to try to produce a form suitable for local conditions with grain of the quality of the Italian, Spanish and American "Japan" rices that have competed so successfully with Burma rices in recent years in Western markets, as it has been found that the sub-tropical rices Japan cannot be successfully cultivated in Burma.

Fifty F₁ cultures were under study, 27 being discarded and the remainder retained for further study. Growth in the field varied from fair to vigorous, but the cultures are still segregating.

The grain is generally bold and translucent. Partial sterility has been fairly common in some cultures of this cross, but this is a problem that it is proposed to investigate more fully from next year onwards. Some of the cultures, however, are promising.

Xm F₁ (Shinriki × D17-88) is a cross between Japanese Shinriki and a local variety with the same object as in X

Five F₁ cultures were under study two of which were discarded, on account of general lack of vigour, compared with those of the

Xo F₁ (C15-10 × Blue Rose) is a cross between a local pure strain and American Blue Rose. Both parents have much the same type of grain but that of the American variety is the more translucent. Two cultures were under study but only one of them proved to be a genuine cross. Partial sterility was marked in this F₁ culture and the problem is still under study.

The following crosses were made during the year, the first three mainly for the improvement of quality, and the remainder for genetical work on the inheritance of

characters, the most important of which are, translucency and opaqueness in the grain, size and shape of grain, and abdominal white in the grain :—

1. C15-10 and American Blue Rose.
2. C19-26 and American Blue Rose.
3. Byat (Bilat Kaukkyi) and Blue Rose.
4. Md.D 29-166 and A28-6.
5. C15-10 and A28-6.
6. D17-88 and C-15-10.)
7. C15-10 and D17-88.) } Reciprocal.
8. D17-88 and B26-12.)
9. B26-12 and D17-88.) } Reciprocal.
10. Md. C28-17 and D17-88.
11. A28-6 and Minthamauk.
12. A28-6 and Mohmyaw.
13. C15-10 and Kauknyin.

It is doubtful if it will be possible to carry all these beyond the F₂ generation on account of the work that their study will involve, and only those that appear to provide the most suitable material for the proposed investigation will, therefore, be carried beyond that stage.

Pure Lines and Selections.—One hundred and forty second-year selections previously selected on the Hmawbi Farm and comprising 49 Ematas, 28 Letywezins, 49 Ngaseins, 16 Midons and 2 Byats were under study, all of which were examined plant by plant in the field as in the case of the hybrid cultures. Data were recorded regarding tillering, length of panicles, length of life period, weight and size of grain, habit of growth, and colouring in different vegetative parts.

At the end of the year the data were still being analysed as a basis for future work, in connection with the study of pure line selection and also hybridisation. Data that have been recorded in previous years in connection with pure line selection are also being studied and it will take some time to complete the work.

Of these selections, one hundred and sixteen were of indigenous varieties, and twenty-four were exotics from America, Japan, Java, and Siam. The subtropical varieties of Japan and America do not appear to be suitable for cultivation under local conditions. They are precocious and mature in 90 to 100 days compared with 150 to 180 which is about the range for most cultivated varieties of the country; the yield of grain from the subtropical varieties is only about half of that from local strains. Most of the Java and Siamese varieties are fairly similar to local varieties but in most cases they are rather too long-lived for cultivation over a wide range of conditions in Burma. The varieties hitherto obtained from these countries have not been pure and several cultures have been isolated for further study.

Seventy-nine of the pure lines were finally discarded mainly on account of the comparatively poor quality of grain, and the remainder, with the exception of the exotics, are to be handed back to the Botanical Section, Hmawbi Farm for further study next year, as the staff under the Rice Research Scheme will be fully employed in other research work and work connected with the crosses now under study.

Genetical Work.—The genetical work carried out during the year has been of a preliminary nature. A large amount of data that have been recorded on Hmawbi Farm in connection with pure line selection and more recently in connection with hybridisation was still under investigation at the end of the year under report as staff was not available for the work till towards the end of the year.

The mode of inheritance in a "rogue" found in a pure strain D17-88 under distribution was investigated and the "rogue" was found to be the result of a cross with some other strain not yet identified. The progeny showed segregation for colour in the vegetative parts, for grain characters, etc., and grain from selected plants will be grown for further study.

Inheritance of colour was studied in the cross A16-34 × Fortuna.

A16-34 belongs to type I and Fortuna to type VII. Seven F₂ plants were grown, six of type VII and one of type I.

One type I plant and one type VII plant were homozygous but the remaining five type VII plants showed segregation giving simple 3:1 ratio of coloured to non-pigmented plants, with the exception of No. 35 which gave a 2:1 ratio. There is

evidently a very complete linkage between the various colour factors, similar to that noted by Hector in India.

Apparent segregation on the panicle for pinkish and white grains was noticed in plants from a Coimbatore strain. As in no case did a panicle produce all pinkish or all white grains it will be necessary to grow grains of both colours for at least another generation to see whether the variation in colour may not be purely physiological or possibly pathological.

Segregation on the panicle or chalky or translucent grains had been previously noted in a cross between glutinous and non-glutinous rice. An examination of panicles from two cultures of D17-88 and Aikokku cross, suspected of segregating however failed to establish segregation within plants or panicles of the same plants. Both parents are non-glutinous.

As noted in a previous paragraph crosses were made during the year for research on the inheritance of size, shape, hardness and translucency of grain, as the main research problem to be tackled but it is also proposed to study "hybrid vigour" and partial sterility.

Correlation work between yield and other characters was commenced during the year and for this purpose four hundred plants of each of four varieties grown on another part of the station were selected. In the field the following records were made—height of each plant, number of tillers, flowering date of main stem in each plant, flowering date of each tiller of each plant, and in the laboratory where work was still in progress at the end of the year, weight of each plant, weight of grain per panicle and per plant, and length of each panicle were being recorded. The grain from tillers emerging on the same day (within a variety) is being bulked to be tested for quality as far as is possible with the small amounts available, as there is a theory that grain in the later tillers is usually smaller and softer than that in the earlier formed tillers. The work will take several months to complete.

In the coming year it is proposed to commence studies on growth and yield on the lines of Engledows work on wheat. Yield and quality are both of great importance in Burma as the crop finds its way into so many markets of the world, and it is the crop on which the prosperity of the country mainly depends.

To determine the effects of different methods of drying paddy sheaves after harvesting on breakage in hulling a preliminary test was carried out with one of the pure strains A16-34 grown on the farm. It was found that there was no appreciable difference in outturns of whole rice from samples dried in the sun and under shade for periods of five, ten and fifteen days respectively, but it has been found from past experience that rice exposed to the sun for a long time becomes sun cracked and breaks readily in hulling. In order to find out the maximum period the sheaves may be left exposed to the sun without sun cracking of the rice a further experiment is necessary, as it would appear to be longer than fifteen days under the conditions obtaining during the year under report.

Yield Test.—Five yield tests in four randomised blocks, and one Latin square were carried out, there being six replications in each case. Notes were recorded on flowering, ripening and hulling of the strains under test. The statistical analyses of the yield figures are summarised in Appendix I.

Twenty-seven strains were discarded for poor yield or quality or a combination of both, and those that have been retained will be handed over to the Botanical Section of the Farm for further test.

Expenditure and Accounts.—The original amount allotted under Supplies and Services was Rs. 10,000 of which Rs. 820 was reserved with the High Commissioner for India, London, for the purchase of stores from England. The total expenditure under this head for the year ending in 31st March 1913, was Rs. 5,463-6-6.

Out of Rs. 4,540 allotted under Contingencies, Rs. 2,120-13-6 was spent during the year under report. The expenditure incurred under these two primary units during the year 1932-33 is shown in Appendix II.

Receipts.—No sale receipts were realised as the stock was still in hand at the end of the year under report.

J. W. GRANT,
Rice Research Officer, Burma.

APPENDIX I.
YIELD TEST NO. 1.

Strain	A16-34	A26-26	A26-27	B15-1	A29-9	A29-22	B29-19	A30-4	A30-15	B27-2	B29-6	B30-27	Mean	S.E.	Remarks.
Average yield of grain in lbs. per acre.	2,080	2,075	1898'75	1971'25	1943'75	1,970	2062'5	1923'75	2,125	2162'5	2073'75	1826'25	2010'2	78'36	Did not pass the Z test.
Average yield per cent.	103'97	103'23	94'47	98'07	96'70	98'01	102'61	95'71	105'72	107'59	103'17	90'86	100	3'90	

YIELD TEST NO. 2

Strain	B15-1	A22-53	A28-8	A28-6	A26-3	A29-1	A26-4	A28-5	B30-2	B26-12	A30-17	B27-9	B28-10	B29-5
Average yield of grain in lbs. per acre	1663'75	2,220	2167'5	2,001	1,779	2,002	1,865	1,925	1,960	1682'5	2,494	1,930	1,784	1,911
Average yield per cent.	89'07	118'84	116'03	107'12	95'24	107'17	99'84	103'05	104'93	90'07	133'51	103'32	95'50	102'30

Strain	B29-23	C27-5	C29-7	C29-14	C30-10	C30-13	XF, 133	XF, 128	XF, 136	B24-92	Mean	S.E.	Remarks.
Average yield of grain in lbs. per acre	1,944	1,871	1,891	1,734	1,547	1,681	1847'5	1,685	1,658	1,550	1,868	31'78	Passed the Z test.
Average yield per cent.	104'07	100'16	101'23	92'83	82'82	89'99	98'58	90'20	88'65	82'98	100	1'70	

YIELD TEST NO. 3.

Strain	C19-26	A29-20	A26-3	A30-1	A28-7	C24-71	A30-19	B24-92	B29-15	B30-9	C27-4
Average yield of grain in lbs. per acre	1871'25	2443'75	2048'75	1543'75	2,200	2,185	1771'25	1,720	1593'75	1911'25	1,803
Average yield per cent.	102'79	123'25	112'57	84'80	120'84	120'000	97'84	94'48	87'54	104'98	99'70

Strain	C29-17	C30-14	Ngathalan	XF, 133	XF, 129	XF, 135	Mean	S.E.	Remarks.
Average yield of grain in lbs. per acre	1568'75	2062'5	1706'25	1722'5	1588'75	1421'25	1820'44	53'78	Passed the Z test.
Average yield per cent.	86'17	113'29	98'72	94'61	87'20	78'97	100	2'88	

YIELD TEST No. 4.

Strain	C14-8	C25-11	C24-4	B30-8	X133	X128	X135	A26-9	A26-30	Theikpan Ngakyi	C15-10	Mean	S.E.	Remarks.
Average yield of grain in lbs. per acre.	1,603	2,535	1,952	1,993	1,957	1,763	1,465	2,168	1,978	1,458	1,663	1,867	45.29	Passed the Z test.
Average yield per cent.	85.86	135.73	104.55	106.75	104.82	94.43	78.47	116.12	115.95	73.09	89.34	100	3.20	

YIELD TEST No. 5.

Strain	D17-38	D30-18	D30-23	D30-6	D30-7	D29-1	Mean.	S.E.	Remarks.
Average yield of grain in lbs. per acre	1759.3	1608.8	1,788	1901.6	2023.3	1989.7	1830.1	30.20	Passed the Z test.
Average yield per cent.	96.13	87.91	93.68	103.91	110.56	107.63	100	2.70	

APPENDIX II.

Statement showing expenditure in connection with the Burma Rice Research Scheme for the year ending the 31st March 1934.

SUPPLIES AND SERVICES.—Allotment for the year Rs. 9,180.

Laboratory.	Imple-ments.	Seeds.	Wages.	Manure.	Books.	Unclassified.	Total.
Rs. A.	Rs. A.		Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
989 10	271 8	NIL.	2,680 2 6	138 9 6	213 13 9	1,169 10 9	5,463 6 6

CONTINGENCIES.—Allotment for the year Rs. 4,540.

Furni-ture.	Postage and Tele-grams.	Trans-port.	Type-writers.	Books.	Stationery.	Un classi-fied.	Total.
Rs. A.	Rs. A.	Rs. A.	Rs. A.	Rs. A. P.	Rs. A.	Rs. A.	Rs. A. P.
964 13	225 0	23 13	545 0	117 2 6	128 2	116 15	2,120 13 6

PROGRAMME OF WORK OF THE RICE RESEARCH OFFICER, BURMA.

FOR THE YEAR, 1933-34.

(Hmawbi Agricultural Station.)

Paddy Experiments.—(1) Continued observation on residual effects of (a) Varietal response to fertilisers, (b) Application of fertilisers at different times, (c) Optimum dressing of Nicifos, (d) Relative efficiency of Ammonium Phosphate fertilisers, and mixtures of Nitrogenous phosphatic fertilisers, (e) Comparative effect of Lime and Basic Slag on "Bad Patch" (f) Fertilisers on late sowing.

(2) Effects of different dressings of Nicifos fertilizer applied annually.

(3) Varietal broadcast sowing versus transplanting.

(4) Pot experiment to study effect of fertilisers on "withered tips" in paddy.

(5) Fallow experiments.

(6) Manuring of nurseries experiment.

Botanical Section.—(1) Pure Line Selection work with District varieties, eighty-eight strains.

(2) Maintenance plots and multiplication of pure strains under, or for distribution, viz., A16-34, A28-6, A28-8, A29-20, B24-19, C30-3, C19-26, C14-8, C15-10, C24-71, C29-17, D17-88, B28-14 and C28-15.

(3) Yield Tests (a) Early paddies, five strains, (b) Medium lived paddies, thirty-five strains, (c) Long lived paddies, six strains, (d) Deep water paddies, five strains.

(4) Investigation of the effects of different water supplies in the field from flowering to ripening date on the quality of grain.

(5) Hulling tests of paddies under test.

(6) Germination and purity tests of paddies under distribution.

(7) Preparation of exhibits for District Shows, and of samples and specimens for records.

(8) All other Botanical work connected with paddy in the Southern Circle.

Horticultural Section.—(1) Filling up and extending areas under mango, citrus, and Kew-pineapple.

(2) Continuation of investigation of the best indigenous stocks for the grafting of mangoes, and sapota, and for the budding of citrus.

(3) Continuation of the propagation of fruit plants by grafting, budding and gootie for distribution in the districts.

(4) Manurial treatment of fruit trees.

(5) Effect of pruning, root pruning, and ringing on the fruiting of different species

(6) Continuation of the study of the African Oil Palm with reference to oil production, and its suitability for cultivation under Hmawbi conditions.

(7) Study and control of insect pests and fungus diseases of the different species.

(8) Trials with different cover crops.

(9) Well irrigation experiments in the dry season on different species.

Education.—Continuation of the Nine Months' Course of Training for the sons of landowners and cultivators.

Rice Research Scheme financed by the Imperial Council of Agricultural Research, India.—(1) Study of 168 hybrid cultures in F_3 , F_5 , F_4 , F_7 , and F_9 generations from crosses between local strains, and local strains and foreign varieties.

(2) Study of twenty-four subtropical varieties from Japan, Formosa, China and America.

(3) Genetical studies connected mainly with :—

(a) Inheritance of colour in the vegetative parts of the plants and in the grain.

(b) Inheritance of sterility in crosses between local strains and subtropical varieties.

(c) Inheritance of grain characters, including quality.

(d) Hybrid vigour.

(4) Investigation into growth and development of paddies with reference to the following main points :—

(a) Germination and growth in the nursery.

(b) The effects of transplanting.

(c) Tiller formation throughout the period of growth and "Critical period."

(d) Ear formation.

(e) Factors that may be associated with yield, for correlation work.

(5) Yield tests of ten cultures of two crosses in the F_7 , and F_9 generations respectively.

(6) Investigation into the effects of different methods of drying and storing of grain on quality and milling.

J. W. GRANT,

Rice Research Officer, Burma.

APPENDIX XL-B.

NOTE DATED THE 3RD FEBRUARY 1934, BY SECRETARY, ON SUBJECT No. 31. APPLICATION FROM THE GOVERNMENT OF BENGAL FOR A GRANT OF Rs. 21,600 SPREAD OVER FIVE YEARS FOR A SCHEME OF RESEARCH ON THE BIO-CHEMICAL AND PHYSICO-CHEMICAL PROPERTIES OF RICE AT THE DACCA UNIVERSITY.

Attention is invited to the attached letter (Annexure I) from the Government of Bengal No. 1 dated the 2nd January 1934 forwarding a scheme (Enclosure I to Annexure I) for rice research drawn up by the Biochemical Section of the University of Dacca. The scheme involves so far as the Council is concerned, an expenditure of Rs. 21,600 spread over a period of five years, and is for the consideration of the Advisory Board. In this connection reference is invited to the attached scheme (Annexure II) of research work on the chemical and other properties of rice drawn up by the Government of Madras which is being referred back to the local Government for the elucidation of certain matters of detail.

2. The Vice-Chairman to the Council considers that it will be an advantage to have the scheme (Enclosure II to Annexure I) examined in the first instance by the Committee which considered the progress reports on rice research schemes at the time of the last meeting of the Advisory Board held in August 1933 and which consisted of the following gentlemen :—

1. The Vice-Chairman, Imperial Council of Agricultural Research. (Chairman).
 2. The Agricultural Expert, Imperial Council of Agricultural Research.
 3. Mr. R. G. Allan, Director of Agriculture, United Provinces.
 4. Dr. W. Burns, Director of Agriculture, Bombay.
 5. Prof. J. C. Ghosh.
 6. Rao Bahadur D. Ananda Rao, Offg. Director of Agriculture, Madras.
 7. Mr. D. R. Sethi, Director of Agriculture, Bihar and Orissa.
 8. A representative of the Department of Agriculture, Bengal.
 9. Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.
 10. Rao Bahadur B. Viswanath, Government Agricultural Chemist, Madras.
 11. Prof. P. K. Parija, Ravenshaw College, Cuttack.
 12. Mr. M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.
- Secretary, Imperial Council of Agricultural Research, Secretary, *ex-officio*.

In addition Lt. Col. A. J. H. Russell, Public Health Commissioner with the Government of India has also been asked to serve on this sub-committee if possible as the scheme involves a study of human nutrition problem as well. The Committee will meet at 2-45 P.M. on Tuesday, the 20th February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi: Its report will be circulated to the Advisory Board in due course.

ANNEXURE I.

COPY OF LETTER No. 1, DATED THE 2ND JANUARY 1934, FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT, CALCUTTA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Subject :—Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

With reference to your letter No. F.-6(1)/33/G., dated the 6th December 1933, on the subject mentioned above, I am directed by the Government of Bengal (Ministry

of Agriculture) to forward herewith, for inclusion in the Agenda of the meeting of the Advisory Board to be held in February 1934, the undernoted schemes, which have been approved by the Provincial Agricultural Research Committee, Bengal together with relevant extracts from the minutes of the meeting of the Committee held on December 7, 1933, and to say that the local Government recommend the schemes subject to the condition that no financial liability devolves on them.

2. One hundred and fifty spare copies each of the schemes will be forwarded to you direct by the Director of Agriculture, Bengal.

• • • • •

5. Scheme for Rice research drawn up by the Biological Section, Chemical Laboratory, University of Dacca.

ENCLOSURE I.

Scheme for Rice Research drawn up by the Biochemical Section, Chemical Laboratory, University of Dacca.

Biochemical and Physico-chemical investigations of the various samples of rice grown in Japan are considered to be very useful subjects of study and many publications on this subject by Japanese investigators have appeared in the last decade. These relate mostly to the proteins of rice seeds (1), on the effect of the degree of polishing of rice on its absorption (2), on rice-oxidase (3), and similar subjects (4). It must be observed, however, that at present much better methods are available for investigating the same problems.

European and American investigators have dealt with rice proteins and rice-starch mostly in connection with their investigations on proteins and starch from other cereals (5). Many investigations have of course been carried out on the Vitamin B, content of rice polishings.

Sen (6) has carried out a preliminary chemical study of the rices of Bihar and Orissa. Sen's paper also gives references to earlier work on the subject. Recently the Agricultural Chemist to the Government of Bengal has done some preliminary chemical analysis of a few types of Dacca rices (7). Both these investigations, it should be pointed out, have concerned themselves with the determination of moisture, ether extract, ash, total nitrogen, woody fibre and of some of the inorganic constituents like lime, phosphoric acid, and potash.

No systematic investigation on the physico-chemical properties, on the chemical composition, on the enzymic digestibility, on the nutritive value and on the vitamin content of the different varieties of Indian rice appears to have been undertaken. Investigations of the different properties of the same variety of rice grown under different manurial treatment have not also been done. It is therefore proposed to carry out a systematic and comprehensive investigation of the different varieties of rice grown in different parts of India from the abovementioned standpoints. All the investigations will be carried out with pure line strains in collaboration with the Department of Agriculture. Experiments would be made with parboiled and sundried rice and with polished and unpolished varieties.

Physico-Chemical properties.—Mr. G. V. Jacks, Deputy Director of the Rothamsted Experimental Station, in a letter to Professor Ghosh on this subject says, "I am afraid we have been unable to find anything very pertinent on this subject. We have searched our own files thoroughly and we have also made enquiries from the Imperial Institute and people who might have worked on it, but with very little success."

One important property of different varieties of rice that should be examined is the water absorbing power and the time taken to absorb the maximum amount of water. This would enable us to choose those varieties of Indian rice which would be able to compete with American trade rices like Carolina and Blue rose which fetch higher prices in Great Britain and other parts of the Empire because of their capacity for absorbing a greater amount of water.

Another important physical property which might be examined is the fuel value of different varieties. This might be easily done with the help of the "Oxy-calorimeter" of Benedict and Fox which is being used in the Nutrition Laboratory of Carnegie Institution of Washington, Boston. This apparatus (8) enables us to determine the calorific value from the volume of oxygen required for combustion.

Bio-Chemical study.—It is proposed to study thoroughly the chemical composition of rice with special reference to its nutritional value. Not only the percentage of other extract will be determined, but qualitative and quantitative determinations will be made of substances like sterols and phosphatides which are very important from the standpoint of nutrition. This study will be all the more facilitated because of the micro-chemical methods which are in vogue in this laboratory. Preliminary investigation of other extract of rice in this laboratory shows the presence of sterols. For the determination of rice protein it is customary to estimate the total nitrogen and multiply it by 6.25. It must be remembered that all proteins are not equally efficient for nutritive purposes. Thus Mitchell (9) by means of some feeding experiments on rats showed that the biological values of proteins from different sources were quite different.

The following table summarises his results :—

Protein from.	Biological value.
Milk	93
Corn	72
Oats	79
Rice	86
Potato	63
Yeast	83
Casein	71

Chemical analysis can give us some idea about the nutritive values of different rice proteins when the amounts of the essential amino-acids like cystine, lysine, tryptophane, tyrosine and probably histidine, proline and arginine which the animals cannot synthesise and must, therefore, receive in the form of foodstuffs for their growth, if the proteins are determined. It is, therefore, proposed to isolate the proteins from rice by successive extractions with (a) water, (b) solutions of neutral salts like 10 per cent. sodium chloride solution (c) dilute alkaline solutions, and with (d) 70-80 per cent. alcohol. The nitrogen content of the residual rice will also be determined. The proteins will then be hydrolysed and an attempt made to estimate quantitatively the abovementioned essential amino-acids. This is really a very difficult task and methods have not yet been perfected. Fischers' Ester method (10) and Dakin's method (11) do not come into consideration as they require very large amounts (100-500 grms.) of protein to start with and moreover do not afford a quantitative separation and estimation of any particular amino-acid. Hoffmann's method (12) which requires only 0.5-1 gm. of protein characterises a protein by distributing the nitrogen content of its hydrolytic decomposition products into three groups (a) ammonia nitrogen, (b) basic nitrogen, (c) non-basic nitrogen and Osborne (13) adds a fourth fraction, (d) humin nitrogen. By following the suggestions of Gortner and Holm (14) a quantitative measure of tryptophane can be obtained by Hausmann's method. Van Slyke's method (15) which is being tried in this laboratory has the advantage of requiring a relatively small amount (3 grms. or less) of protein and permitting a quantitative determination of arginine, histidine and lysine. The cystine comes about 30 per cent. too low.

Cystine and lysine can also be biologically determined by means of feeding experiments with rats. This will be referred to in a later section.

Quantitative determinations of sulphur by Pregl's and also by Ter Meulen's micro-methods will also be undertaken.

It is also proposed to perform the routine determination of cellulose, ash and moisture.

As regards the inorganic constituents besides the determinations of lime, phosphoric acid, and potash, qualitative and quantitative investigations for the presence of rare metals like manganese and if one might be allowed to say, copper, which have been recently shown to play a very important part in the prevention of anaemia, will also be made. It might be mentioned that Boyd and De (16) have recently applied the method of quantitative spectroscopic analysis to the determination of traces of manganese in urine. Examination of rice grown under manurial treatment of traces of manganese and copper salts might be undertaken.

Nutritional experiments with animals.—These experiments will be carried out from three view-points, viz., (i) biological determination of the essential amino-acids cystine and lysine; (ii) determination of biological value of rice proteins; and (iii) estimation of vitamins.

(i) *Biological determination of cystine and lysine.*—This might be done as recommended by Sherman and Words (17) by comparing the gains in weight during a period of 6 weeks made by standard albino rats (initial age 23-29 days) on a basal diet of limited cystine content but adequate in all other respects with the gains made by strictly comparable animals on the same diet supplemented by known additions of pure cystine (or by known additions of rice protein whose cystine content is to be determined).

It would be interesting to estimate both chemically and biologically the amounts of the essential amino-acids of the same varieties of rice grown under different manurial conditions.

(ii) *Biological value of proteins.*—This determination is very important since the biological value of a protein determines its nutritive value. It is proposed to follow the method of Chick and Roscoe (18) and of Fixen (19) who have improved upon the method of Mitchell (20). Adult male rats of 300-450 grms. weight in metabolism cages described by Hopkins and Ackroyd (21) with detachable wire floor introduced by Boas (22) and glass separators of Gross and Connell (23) to effect quantitative separation of urine and faeces might be employed for the experiments. The basal nitrogen expenditure will be first determined by using nitrogen free diets. In succeeding experiments the same diets would be used with added rice protein in varying proportions (up to about 16 per cent. of the total dry diet). Care would be taken to provide for the adequate supply of vitamins B₁ and B₂ in whose absence, as has been shown by Fixen, there is a considerable decline in appetite and the intake of calories becomes too low to allow reliable figures to be obtained for the calculation of biological values.

The relative nutritive values of rice proteins might also be determined as has been done by McCollum and co-workers (24) and by Mitchell (25) and by others (26) by maintenance experiments on rats. The consumption of food is generally *ad libitum* but it is essential as Mitchell points out that record of good intakes should be kept.

It would be really interesting and useful to determine the nutritive values of protein from the same variety of rice grown under different manurial conditions, specially in view of the observation of McCarrison (27) on millet and wheat.

Vitamin content.—Some attention (28) appears to have been bestowed on some varieties of rice with regard to their Vitamin B₁. It must be said, however, that quantitative determinations in terms of international units proposed by the Health Section of the League of Nations have not been done. It is proposed to examine the different varieties for the content of all the vitamins although it might be presumed that the amounts of Vitamins A, C, D are not likely to be large. Polished and unpolished rice as well as rice polishings would be examined.

Vitamin A.—According to "Vitamin—a Survey of Present Knowledge" issued by the Medical Research Council in 1932, only whole grains of rice and wild rice contain some Vitamin A. It is now proposed to make a search for this vitamin in all varieties of Indian rice.

Determinations would be made with young rats immediately after weaning (about 40 grms.). The breeding stock would be so fed that the young rats are not endowed with excessive reserves of vitamin A as has been done by Gudjonsson (29). The test animals would be allowed to exhaust their reserves of Vitamin A, as indicated by cessation of growth, by being fed on a basal diet providing adequate amounts of Vitamins B and D. After this, doses of the test substance, rice, would be administered.

The values obtained by the biological method would be compared with those obtained from Carr and Price (30), blue values obtained with the Lovibond's Tintometer of the blue colour with antimony trichloride. The intensity of absorption at 323 might also be profitably measured.

Vitamins B₁ and B₂.—Rice, specially rice polishings, is a rich source of Vitamin B₁. The Vitamin B₁ would be estimated by curative tests on young rats. This method of Smith (31) consists in the determination of the minimal dose of the test material required to effect a cure of acute polyneuritis in young rats which have been reared after weaning on a basal diet free from the Vitamin B complex, supplemented by autoclaved brewer's yeast to provide Vitamin B₂, and by cod-liver oil. Some growth tests with rats (32) will also be made.

Incidentally it is proposed to test the calorimetric method proposed by Spruyt (32) for estimating the anti-beri-beri vitamin percentage of rice. Since pure preparations of Vitamin B₁ have been definitely shown to contain sulphur (32b) it would be interesting to find out the variations of Vitamin B₁ content of rice when sulphur dressing or sulphur containing manures are applied to the rice fields.

Determinations of Vitamin B₁ will be made by means of growth tests in which comparison is made between the amounts of materials needed daily by young rats to promote growth at a given standard rate, when these are administered as additions to basal diets adequate in all respects and lacking only in Vitamin B₁ (33).

Vitamin D.—Young rats in which rickets would be produced by feeding them for about 3 weeks on a diet devoid of Vitamin D and having a high calcium and low phosphorus content (McCollum's diet No. 3143), would serve as experimental animals. Material to be tested would then be fed and determinations made by the estimation of ash contents of the femora bones (34). An attempt will also be made to use the X-ray photography method by collaboration with the Mitford Hospital, Darca.

In all the above experiments albino rats would be used and coprography would be avoided by using special cages.

Vitamin C.—Young growing guinea pigs (about 350 grms. in weight) would be employed for the purpose. The method adopted by Host and his collaborators at the Lister Institute (35) is proposed to be employed.

Effect of different manurial treatment on the vitamin content of rice would also be determined.

Enzymic digestibility.—It is proposed to find out the enzymic digestibility of different varieties of rice, parboiled and sundried, polished and unpolished and both new and old. Action of Takadiastase, Saliva, vault-diastase and diastase preparation from pancreas and similar enzymic preparations will be tried. The method of Willstatter, Waldschmidt-Leitz and Haase (36) will be adopted to follow the course of the reaction. It would also be interesting to find out if the pure starch from all the varieties of rice are digestible at the same rate. The enzymic digests of the different rices might be analysed to find out how they differ from one another and in what respects.

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The scheme will not involve the Imperial Council of Agricultural Research in any capital or recurring expenditure due to cost of apparatus, chemicals and equipment. The investigation will be supervised by Dr. Kalipada Basu, D.Sc. (Dacca), Ph.D. (Munich), who has been appointed Biochemist in the University of Dacca. It is, however, necessary to appoint two Research Assistants on the scale of Rs. 160—10—200 for a period of 5 years. The expenditure on the part of the Council will be as follows —

Recurring expenditure :-

	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
	Rs.	Rs.	Rs.	Rs.	Rs.
Two Research Assistants on Rs. 160 - 10—200 each per mensem	3,840	4,080	4,320	4,560	4,800
Total expenditure for 5 years=Rs. 21,600.					

ENCLOSURE II.

EXTRACTS FROM THE MINUTES OF THE 7TH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD ON THE 7TH DECEMBER 1933.

* * * * *

9. Scheme for rice research drawn up by the Bio-Chemical Section Chemical Laboratory, Dacca University. The scheme was considered to be of great importance and was approved.

* * * * *

Investigation in the quality of rice.

Rice is the staple food of the majority of the people in the province and there are definite indications to the effect that people in the rural parts—as for instance in Coimbatore district—are now increasingly taking to rice diet. The attempts of the

breeder has all the time been concentrated on improving the yield and no work has so far been done to improve the quality with special reference to human nutrition. In the west breeding for higher yields goes hand in hand with breeding for improvement in quality. A thorough knowledge about the variations in the nutritive properties of rice is very essential so that armed with this knowledge the breeder can attempt to combine higher yields with quality or better nutritive value.

2. The work of McCarrison and others has shown that the main nutritional principle in rice is vitamin B₁ and that the bran contains most of this principle which is almost wholly removed by the milling and polishing processes before it comes to the consumer. It has been found in this section that varietal differences exist in the thickness of this bran layer. It is quite possible that varietal variations exist as regards their nutritive value. It is generally believed that short duration rices are poorer in quality than the long duration ones. Though evidence exists to warrant such belief, a scientific explanation is wanting. Similarly it is considered that red rice is more nutritious than white rice. This has to be verified, and, if it is real, we have to determine whether this difference is related to the thickness of the bran layer. Even the rices raised in different methods of cultivation vary from their nutritive point of view as is seen from the results of McCarrison's experiments on rices sent from Pattambi grown under dry and wet conditions. The wet crop was found to be poorer in nutritive value.

3. Secondly par-boiled rice is generally considered more nutritious than raw rice, though a scientific explanation is wanting to warrant this statement. What the effect of par boiling is on the chemical composition and the nutritive value of rice has to be determined by following the nature of bio-chemical changes undergone by the grain during the process of par-boiling. This should be studied particularly in the case of fresh unstored grain as it is believed that par-boiling very definitely eliminates the digestive disorders caused by using raw rice from the same source. The nature of the transformations undergone by the proteins of rice during par-boiling and the extent to which that treatment enriches the husked rices have also to be determined. The influence of par-boiling on the vitamin contents, particularly of B₁ and B₆ of the grain have to be investigated and conditions determined for the maximum conservation of those constituents in the finished product. It has been suggested recently that the better nutritive value of par-boiled rice is due to the diffusion of the Vitamin B₁ from the outer layers into the endosperm during the par-boiling process.

4. Thirdly the question of storage and its effect on the quality and nutritive value of rice requires investigation. Raw rice prepared from fresh paddy immediately after harvest not only gives a highly gelatinised preparation on cooking but also leads to diarrhoea and other digestive disorders if used continuously. Apart from the difficulty in husking fresh paddy without breakage, the quantity of cooked rice is very much less in the case of fresh grain than in the case of grain stored for some time. The only way of satisfactorily using freshly harvested grain is to prepare par-boiled rice out of it. The nature of the chemical changes taking place during storage and also the significance of such changes in relation to the nutritive value of rice prepared out of them would require careful scientific study, and whether such changes can be accelerated or retarded by the different methods of storing obtaining in the country requires investigation. The period and method of storage adopted with fresh grain before it can be made suitable for consumption vary considerably and there are apparently varietal differences. The problem of storage involves physiological investigations on the respiration and respiration products during storage.

5. Lastly rice varieties differ with regard to their texture and they may be classified as hard and soft. Most of the Madras rices with few exceptions (G.E.B. 24 is one) have to be classified as soft when compared to the North Indian rices like Patna which are all hard. There is no doubt that hard rices are superior in quality and obtain better prices on the market. While the genetics of this character is already under study, the chemical and nutritional differences, if any, between the hard and soft rices require investigations. In this study the glutinous rices also should come in as they form an intermediate group between the hard and soft rices. The hardness and softness has a definite relationship to the milling qualities of the grain as the hard rices are easier to mill without breakage.

6. I have discussed the details of the investigations with the Professor of Bio-Chemistry at the Indian Institute of Science, Bangalore and a comprehensive scheme of work has been drawn up. While the histological studies on the bran layer of the rice grain will be continued at Coimbatore, the chemical and nutritional studies will have to be done in Bangalore where expert guidance and unlimited facilities already exist. The problem of storage will also be tackled in Coimbatore and the necessary

standard materials for the experiments, raw and par-boiled, fresh and stored rice, etc., will be supplied from Coimbatore.

7. The successful carrying out of the investigations would involve the appointment of an assistant and a fieldman specially earmarked for the work for a period of at least three years. A suitable assistant with the necessary qualifications to undertake the investigations is available in the section and he can learn the necessary technique after a few months' stay in Bangalore.

STUDIES ON "QUALITY IN RICE" PROGRAMME ON RESEARCH.

I. Effect of parboiling on the Chemical Composition and Nutritive value of rice.—

(a) (i) Starting from fresh (unstored) grains of the same standard varieties of paddy (to be chosen by the Paddy Specialist) raw and parboiled rice would be prepared according to recognised methods. The bran and husk to be carefully separated in each case, dried and stored for subsequent examination.

(ii) Preliminary chemical examination of the different products. Examination of ether and alcohol solubles, analysis for starch according to Davis and Daith or any other standard method, total nitrogen and minerals.

(iii) In view of the importance of nitrogen distribution in the study, analysis should be conducted under the following heads—General division into:—

- (1) Water soluble;
- (2) Salt soluble;
- (3) Alcohol soluble;
- (4) Alkali soluble and
- (5) Coagulable and non-coagulable fractions after previous peptisation of the nitrogenous compounds by alkali.

(b) Detailed distribution of nitrogen either in the whole material or in the different fractions according to any recognised method of examination—Van Slyke, Dakin, Kossel or other methods.

Examination of the above data with special reference to the determination of the mechanism of nitrogen transformations during parboiling. Direct experiments have also to be conducted studying the effect of heating the grain with water on different forms of nitrogen at various stages. Addition of water or salt extractable proteins to raw rice and studying the effect thereof on the mode of cooking, standing storage under water and other properties which distinguish parboiled rice from raw rice. The object of this experiment will of course be to reconstruct the changes attendant on the process of parboiling by actual demonstration of the changes by adding the nitrogenous extractives to raw rice.

II. Relative growth promoting qualities of raw and parboiled rice from the same grain.—These experiments are to be carried out with albinos for general growth and with birds for polyneurites. Since it is probable that the constituents distinguishing parboiled rice from raw rice would be mainly nitrogenous in character, it is suggested that the animal experiments should be carried out by substituting the basal supply of casein with cooked *dal* to stimulate the conditions prevailing in the East particularly Indian homes. It is not however to be inferred that the removal of casein is expected to make any difference with regard to the development of polyneurites. It is only hoped that the difference in nutritive value arising from the coagulated nitrogen of parboiled rice would become evident when other rich and more concentrated forms are not supplied together with it. The animals thus fed would receive food *ad libitum* together with the cooked vegetables. In addition to the experimental animals, a set of control animals receiving the standard basal diet with wheat-chappaty, milk, green vegetables, etc., would also be maintained. The experimental animals would not receive any butter, but a calculated amount of bazaar ghee would be added to their diet.

As since distinct from polished raw rice, parboiled and polished rice is said to contain vitamin B, some experiments are also to be conducted to test the observation. Some colorimetric studies according to Spruyt's method are also to be made and the results correlated with those of feeding experiments.

III. *The effect of storage on rice.*—(i) Chemical Examination of rice and bran prepared out of grains of a standard variety (the specimens to be supplied by the Paddy Specialist) stored for varying lengths of time. In addition to the general preliminary examination, a detailed analysis will be conducted with reference to the transformations attendant on the different carbohydrates and nitrogenous compounds during storage. The effect of such changes on the products obtained after cooking should also be determined. Physical measurements such as viscosity might also be usefully employed for determining changes in the composition of the products obtained on boiling.

(ii) In view of the perceptible difference in the extent of gelatinisation starch when the grain or rice stored for different periods of time is cooked, some experiments should be carried out under *in vitro* conditions to determine the extent of hydrolysis of the product thus obtained by the action of different digestive ferments. Since even unstored rice loses its undesirable qualities on being parboiled, the observations should be extended to that preparation as well.

(iii) Animals experiments should next be taken up the details of work being similar to those outlined for the previous research. The studies could be conducted concurrently with those of the previous series if sufficient number of animals are available.

To begin with two standard methods of storing rice will be taken up for investigation. In connection with this investigation some respiration experiments with stored grains will be undertaken, in Coimbatore, the nature and quantity of gases evolved determined from time to time.

IV. *Effect of duration of crop the 'Quality' of rice.*—In view of the large number of varieties of grain that are available for this work it is suggested that in the earlier stages, researches for the present be confined to two varieties only—one of about three months duration and popularly believed to be not very wholesome and the other of at least 6 months' duration and generally believed to be nutritious.

The details of the chemical examination of the two varieties would be similar to those outlined for parboiled rice. Since it is not improbable, however, that there may be some fundamental difference with regard to the distribution of nitrogen in the proteins associated with the two varieties, special attention would be paid to this aspect of the research. In this connection, it is pointed out that the earlier research of Rosenheim and Kajjura and a few others would require to be checked by the improved present day methods.

Special attention will also be paid to the distribution of minerals in the ash which also constitute factors in determining nutritive values of the grains, a short duration crop having probably less mineral matter to draw upon during the period of growth than one of long duration.

The relative Vitamin B contents are also to be compared first by Spruyt's colorimetric method and if necessary checked by subsequent feeding experiments. The general growth-promoting values are also to be evaluated according to methods already described.

7. *The origin and nature of certain special characteristics in rice, their bearing on the nutritive value of the grain, colour, scent, hardness, glutinous character and such other attributes.*

In the case of coloured rices, the chemical examination will be extended to the isolation, identification and determination of their nutritive value of such of the colouring materials and such other constituents as are associated with them.

In the case of scented rices, the identity of the volatile constituent as also its concentration will be determined. There is evidence to suggest that the presence of scent in rice is an inherited quality.

The nature of the constituents that determine the hardness or otherwise of rice would also call for special attention particularly with regard to the make up of the amylose and amylo-pectin fractions of starch. The mode of association of nitrogen with the grain would also come in for careful study.

It is believed that the glutinous rice is rich in destrins. Since degradation products of starch and destrins as well as the soluble forms of starch are degradations forms from the more developed polysaccharides it would be of interest to follow the transition in the chemical make up of the starches from the hard, soft and glutinous rice and to determine the mechanism of the evaluation of the one from the other.

Further researches on the above and related characteristic constituents would depend on the results of the preliminary chemical examination of such other materials as also from such other information as can be collected from the popular experience regarding the actual usage of such grains.

APPENDIX XLB(i).

SUPPLEMENTARY NOTE DATED THE 23RD FEBRUARY 1934, BY THE SECRETARY, ON SUBJECT NO. 31, PROCEEDINGS OF THE SECOND MEETING OF THE COMMITTEE ON RICE RESEARCH SCHEMES, 22ND FEBRUARY 1934.

Subject 31.—Application from the Government of Bengal for a grant of Rs. 21,500 spread over five years for a scheme of research on the bio-chemical and physico-chemical properties of rice at the Dacca University.

Professor Ghosh in introducing the scheme, explained that the Dacca University had established a Biochemical Department with a Reader in Biochemistry who had undergone special training in the biochemistry of cereals; this was largely the result of a suggestion from the Bengal Department of Agriculture that there was a need for research work of this character. The Biochemist was also engaged in teaching M.Sc. students and required two research assistants. He considered that the programme of work contained in the printed scheme was too extensive for the staff proposed and therefore he now suggested that all the work on the vitamins of rice should be continued at the School of Tropical Medicine Calcutta where the Professor of Biochemistry has already begun work on this subject, two papers on the Vitamin B content of trade rices having been published by him in 1933 in the Journal of Indian Medical Research. Professor Ghosh understood that there would not be much difficulty in doing the work there with varieties of rices selected by the agricultural departments. If this part were omitted, he thought that the Dacca University could undertake the rest of the scheme.

2. Mr. Allan considered that the programme of work was still too large for the staff which it was proposed to employ and that it would be much better to concentrate on one or two of the more important aspects. Rao Bahadur B. Viswanath suggested that the plan of work still required modification and he did not think that Professor Ghosh had received full information about the work already carried out in India on the chemical composition of Indian rices. He referred to the work which had been done at Coimbatore Agricultural Research Institute in co-operation with Colonel (now General Sir Robert) McCarrison. This work was published in 1924. As regards the nutritive value of different rices, the South India experiments indicated that the Kistna Valley rice was superior to Bihar rice which in turn was better than Tanjore, Bengal coming next and Burma last. But it seemed rather doubtful whether the differences between individual varieties would be important. Marked differences in nutritive value were more likely to exist between large growers. It was also fairly well established that the lower nutritive value of polished rice was due to the reduction in the content of minerals and proteins. He would suggest that work might be concentrated on three lines, viz., the determination of the amino-acids in different rices, the study of the mineral content of rices and the effect of manurial treatment on nutritive value. Nutrition experiments with animals were difficult and expensive and he considered that it would be wise to get as far as possible by chemical methods first. It was also very desirable that co-operation with the sanctioned scheme at Bangalore and the scheme proposed for Madras should be arranged. He would suggest the omission of the nutrition experiments with living animals at present.

Lieutenant Colonel Russell, Public Health Commissioner to the Government of India said that he was rather surprised to hear that the Tropical School of Medicine was in a position to undertake a new major research without additional staff and funds but he would discuss the matter at Calcutta very shortly when he was visiting the Tropical School of Medicine. His personal view was that if that institution was to take over the portion of the programme of work suggested, it would need more research assistants, more animal attendants, more animal accommodation and an increased grant for working expenses. He had doubts whether Calcutta was really suitable for nutrition experiments of this character. General McCarrison's work had shown that an equable climate was most important because it was necessary to eliminate outside factors. Work of this type meant using hundreds of animals for each experiment as a statistical analysis of the results was essential. He would discuss the matter with the Principal and Professor of Biochemistry at the Tropical School very shortly.

3. In the course of further discussion, it was suggested that the objections to Calcutta as a centre for nutrition experiments with animals might also apply to Dacca. Lieutenant Colonel Russell then suggested that the scheme should be referred to General McCarrison for advice and opinion generally and especially in regard to the suitability of Calcutta and Dacca for nutrition work. Other members of the Committee suggested that General McCarrison might be asked whether he could undertake any part of this research.

Dr. Burns said that the effect of differential manurial treatment on the nutritional value of rice was important and perhaps the only portion of the scheme which was strictly agricultural. It was agreed that General McCarrison's comments on this question should be invited and the possibility of doing work of this nature in Bengal and Dacca.

Lieutenant Colonel Russell agreed with the emphasis which Rao Bahadur Viswanath placed on the determination of the amino-acids.

4. Professor Ghosh pointed out that the Dacca Laboratory was specially well equipped for work on micro-chemical analysis. He agreed that the study of amino-acids was essential but would also point out the importance of studying the changes in digestibility which occurred after storage and also the changes which took place when rice was par-boiled.

The general feeling of the Committee was that the work to be done should be divided between Dacca, Coimbatore and Bangalore and that the matter should be further considered at the next meeting of the Advisory Board.

5. Lieutenant Colonel Russell emphasised the extreme importance of restricting the work which it was now proposed to carry out to rices grown under known conditions. All members agreed to this.

Finally, it was agreed that this scheme together with the pending scheme from Madras and the sanctioned scheme for work at the Indian Institute of Science should be sent to General Sir Robert McCarrison with a note of the Committee's discussion, inviting his opinion and advice. It was also agreed that before writing to General McCarrison an enquiry should be made from provincial Agricultural Chemists as to what work had been carried out and was actually in progress at the present moment and a summary of this should be sent also. Lieut. Colonel Russell kindly offered to assist in the preparation of the draft to General McCarrison.

APPENDIX XL-C.

NOTE DATED THE 23RD JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 32. APPLICATION FROM THE GOVERNMENT OF BENGAL FOR A GRANT OF RS. 20,812 SPREAD OVER THREE YEARS FOR A SCHEME OF RESEARCH ON THE PHYSIOLOGY OF THE RICE PLANT BY DR. S. P. AGHARKAR.

Attention is invited to the attached letter from the Government of Bengal, No. 1, dated the 2nd January, 1934, forwarding a scheme (Annexure) for research work on the physiology of the rice plant submitted by Dr. S. P. Agharkar, Head of the Department of Botany in the Calcutta University. The scheme involves so far as the Council is concerned a non-recurring expenditure of Rs. 2,500 and a recurring expenditure of Rs. 18,312 or a total expenditure of Rs. 20,812 spread over a period of three years. It has been approved by the Bengal Provincial Agricultural Research Committee and supported by the Government of Bengal and is now for the consideration of the Advisory Board.

2. It may be pointed out that the author of the scheme seems to have over-looked the difference between yield per plant and yield per acre, the effect of tillering capacity on optimum spacing and the effect of spacing on tiller production.

3. The Vice-Chairman to the Council considers that it will be an advantage to have the present scheme examined by the Committee of the Council which examined the progress reports on rice research schemes at the time of the last meeting of the Advisory Board held in August 1933 and which consisted of the following gentlemen :-

1. The Vice-Chairman, Imperial Council of Agricultural Research (Chairman).
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. Mr. R. G. Allan, Director of Agriculture, United Provinces.
4. Dr. W. Burns, Director of Agriculture, Bombay.
5. Prof. J. C. Ghosh.
6. Rao Bahadur Ananda Rao, Offg. Director of Agriculture, Madras.
7. Mr. D. R. Sethi, Director of Agriculture, Bihar and Orissa.
8. A representative of the Department of Agriculture, Bengal.
9. Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.
10. Rao Bahadur B. Viswanath, Agricultural Chemist to Government, Madras.
11. Prof. P. K. Parija, Ravenshaw College, Cuttack.
12. Mr. M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.

This Sub-Committee will meet in the Conference Room, First Floor, Imperial Secretariat Buildings, South Block, New Delhi, at 2.45 P.M. on Tuesday, the 20th February 1934 and its report will be placed before the Board in due course.

ANNEXURE.

COPY OF LETTER NO. 1, DATED THE 2ND JANUARY 1934, FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT, CALCUTTA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

Ninth meeting of the Advisory Board of the Imperial Council of Agricultural Research.

With reference to your letter No. F. 6 (1)/33/G., dated the 6th December 1933, on the subject mentioned above, I am directed by the Government of Bengal (Ministry of Agriculture) to forward herewith, for inclusion in the Agenda of the meeting of the Advisory Board to be held in February, 1934, the undernoted* scheme, which has been approved by the Provincial Agricultural Research Committee, Bengal, together with relevant extracts from the minutes of the meeting of the Committee held on December 7, 1933, and to say that the local Government recommend the scheme subject to the condition that no financial liability devolves on it.

2. One hundred and fifty spare copies of the scheme will be forwarded to you direct by the Director of Agriculture, Bengal.

*Scheme for research work on the Physiology of the Rice plant by Prof. S. P. Agharkar of the Calcutta University.

EXTRACTS FROM THE PROCEEDINGS OF THE 7TH MEETING OF THE BENGAL PROVINCIAL
AGRICULTURAL RESEARCH COMMITTEE HELD ON THE 7TH DECEMBER 1933.

Scheme for research work on the physiology of the Rice plant—by Dr. S. P. Agharkar, Head of the Department of Botany, Calcutta University.

Dr. Agharkar submitted a revised scheme and explained the modifications. It was agreed that the Department should give Dr. Agharkar every assistance in providing lands at Chinsura or elsewhere. The scheme was approved.

A SCHEME FOR RESEARCH WORK ON THE PHYSIOLOGY OF THE RICE PLANT.

Yield in paddy may be calculated as *number of tillers per plant* \times *spikelets per tiller* \times *average weight of unit number of seeds*. In any investigation in the growth and nutrition of the plant in general and for varietal selection, therefore, attention must be directed to conditions influencing one or all of these factors. According to information available at present, (i) number of tillers per plant is largely dependent upon environment and to a small extent on heredity, (ii) spikelets per tiller are predominantly dependent upon heredity and to a small extent on environment and (iii) weight of unit number of seeds is almost exclusively dependent upon heredity. Study of factor (i) which is mainly physiological is outside the scope of ordinary agriculturist but is of the greatest importance to all workers on rice irrespective of the area where they may be located. Numbers (ii) and (iii) being largely problems of cultivation may be left to workers concerned mainly on the selection of improved strains of paddy.

A study of the general and the varietal physiological behaviour of the rice plant with a view to determine the conditions leading to the development of the plants securing the maximum yield under the available conditions is the main concern of the proposed investigation and it presents the following major aspects :—

1. *Investigations on water requirements of the rice-plant* under different conditions to determine the critical stages of watering.

In order to determine these, it is proposed to conduct investigations regarding (i) the degree of adaptation of the different varieties of rice to differing conditions of water, (ii) the scientific significance of the practice of growing different varieties of rice in varying depths of water in the field and also (iii) the inter-relation of the level of water in the field and the stage of the growth of the plant. Water-logging in the field hinders the normal development of the tillers and the later tillers in rice are generally not available for increasing the yield of grain. In this connection the inter-action of the level of water in the field and the stage of growth of the plant may be best availed of to prevent the production of the later tillers. In practice the depth of water in the field at a particular stage of the plant may be directly controlled in the irrigated areas and in other localities adjusted by the time of sowing or transplanting as mentioned below. The results of these investigations will also form the basis for an accurate determination of the optimum water requirements of varieties investigated.

The technique employed will be (i) to grow plants of different varieties in pots under varying conditions of moisture in the soil as well as (ii) to grow them in specially constructed tanks containing different depths of water at different stages of growth. It may also be necessary to study the effect of varying the amount of oxygen dissolved in the water.

2. *Studies on the practice of transplantation of rice* in order to determine (i) the factors producing the optimum number of tillers beyond which tillering does not increase yield and therefore should be prevented, as well as (ii) the most favourable period for transplanting in single and double crop fields.

Experience with cereals, e.g., barley, rice, etc., has shown that the early stages of growth are those of rapid uptake of nitrogen and other nutrient substances. It is,

therefore, likely that under controlled conditions of water-supply, and where transplantation can be made without undue loss of vigour of the seedlings, an addition of nutrient substances to the seed-bed would increase the yield. If this should be substantiated, even less fertile soils, *e.g.*, in Bankura, may be made to yield good crops of rice, by manuring the plants in the seed-bed before transplantation.

In this connection a study of the root system and the rate of growth of the different varieties would be of great importance and eventually enable varieties to be selected for increased yield under different environmental conditions.

3. *Determination of the food requirements of rice-plants* so as to determine the most favourable period of the supply and starvation of N, K₂O and P₂O₅.

A study of the food requirements of the rice plants and more particularly of the varietal differences in the utilisation of the various food constituents would afford a sure basis for selection purposes and furnish data for a deeper consideration of the problem outlined under 2 above.

In all the proposed investigations the physiological behaviour of the plant will be studied at various stages of growth in order to understand thoroughly the significance of the various processes involved. This has been shown to be necessary by the work done on barley in the Institute of Plant Physiology of the Imperial College of Science and Technology (London) and Cotton in the Sudan (*see* reference Appendix I).

The behaviour of the different varieties will be expressed in quantitative terms so that their performances can be accurately compared.

Professor Dastur in Bombay and Professor J. C. Ghosh in Dacca are investigating problems of rice physiology in general. These studies will yield valuable results, which however, can only be utilised for practical purposes if the differences in the behaviour of the varieties cultivated under varying conditions of life are also known. In the scheme proposed above it is intended to direct special attention to this aspect of the problem.

The work will be done in the Botany Laboratory of the Calcutta University and the garden attached to it, where facilities for general work in plant physiology exist. The laboratory is further equipped with all necessary apparatus for systematic morphological, ecological and cytological work and has a good reference library attached to it. Instruments for recording the various climatological factors are also available. The University authorities are prepared to allow these facilities to be used for the proposed scheme and will also meet the cost of ordinary chemicals, gas and electricity. In addition the Calcutta University has sanctioned a special non-recurring grant of Rs. 1,200 for necessary preliminary work in connection with this scheme, which has already been started.

It is expected that the Agriculture Department of the Government of Bengal will afford necessary facilities for field work in connection with the investigation, as they have done in the case of the Dacca University scheme.

It will, however, be necessary to appoint a Special Research Fellow with necessary training in plant physiological research and a research scholar to work under him as additional staff for this purpose, as the Ghosh Professor of Botany owing to his other duties will not be able to devote his whole time to the work.

It will also be necessary to provide some special apparatus and a pot-culture house in connection with the scheme. Provision for travelling in connection with the field work will also have to be made and contingent expenditure incurred.

The probable total expenditure, non-recurring and recurring is given below:—

	1st year. Rs.	2nd year. Rs.	3rd year. Rs.
<i>Recurring—</i>			
1. Research fellow, Rs. 250—25—500	3,000	3,300	3,600
2. Research Assistant, Rs. 100—10—150.	1,200	1,320	1,440
3. Laboratory boy, Rs. 15—1—20	180	192	204
4. Mali, Rs. 15—1—20	180	192	204
5. Travelling allowance	600	600	600
6. Chemical and contingencies	500	500	500
Total	5,660	6,104	4,543

Total Rs. 18,312

Non-recurring—

	Rs.
1. Pot-culture house with pots etc.	1,500
2. Eight cement tanks, 10' x 7' x 2' 6" (each)	500
3. Apparatus	500
Total	2,500
Grand total	20,812

S. P. AGHARKAR,

Head of the Department of Botany, Calcutta University.

• APPENDIX I.

(1) A Physiological Study of Varietal Differences in Plants, Part I, Gregory, F. G., and Growther, F.—Ann. Bot. XLII, page 757, 1928.

(2) Physiological Studies in Plant Nutrition, Parts I, II, and III.—Ann. Bot. XLIII, page 119, 1929; Ann. Bot. XLIV, page 147, 1930, and Ann. Bot. XLVI, page 367, 1932, and other unpublished works.

(3) The Inter-relation of Factors Controlling the Production of Cotton under Irrigation in the Sudan; Gregory, F. G., Growther, F. and Lambert. A. R.; Jr. Agri. Sci., 1932, 22, 617-638.

APPENDIX A-L-D.

NOTE DATED THE 24TH JANUARY 1934, BY SECRETARY, ON SUBJECT NO. 33. APPLICATION FROM THE GOVERNMENT OF THE CENTRAL PROVINCES FOR A GRANT OF RS. 10,088 SPREAD OVER FOUR YEARS FOR RESEARCH WORK ON THE "GANGAI" PEST OF RICE—ENTOMOLOGICAL WORK UNDER THE SCHEME OF RICE RESEARCH ALREADY SANCTIONED BY THE COUNCIL FOR THE CENTRAL PROVINCES.

Attention is invited to the attached letter (Annexure I) from the Government of the Central Provinces, No. 48-1052-XIV, dated the 8th January 1934, containing an application for an additional grant under the scheme of rice research in the Central Provinces already sanctioned by the Council (at a total cost of Rs. 1,08,800 spread over 5 years), for entomological work on the "Gangai" pest of the rice crop. The scheme involves, so far as the Council is concerned, an expenditure of Rs. 10,088 spread over four years, and is for the consideration of the Advisory Board.

2. The Vice-Chairman to the Council considers that it will be an advantage to have the present scheme examined in the first instance by the Committee which considered the progress reports on rice research schemes at the time of the meeting of the Advisory Board held in August 1933 and which consisted of the following gentlemen:—

1. The Vice-Chairman, Imperial Council of Agricultural Research (Chairman).
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. Mr. B. G. Allan, Director of Agriculture, United Provinces.
4. Dr. W. Burns, Director of Agriculture, Bombay.
5. Prof. J. C. Ghosh.
6. Rao Bahadur Ananda Rao, Offg. Director of Agriculture, Madras.
7. Mr. D. R. Sethi, Director of Agriculture, Bihar and Orissa.
8. A representative of the Department of Agriculture, Bengal.
9. Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.
10. Rao Bahadur B. Viswanath, Government Agricultural Chemist, Madras.
11. Prof. P. K. Parija, Ravenshaw College, Cuttack.
12. Mr. M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.

Secretary, Imperial Council of Agricultural Research, Secretary (*ex-officio*.)

This Sub-Committee will meet on Tuesday, the 20th February 1934 at 2.45 P.M. in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi. Its report will be circulated to the Advisory Board in due course.

ANNEXURE I.

COPY OF LETTER NO. 48-1052-XIV, DATED THE 8TH JANUARY 1934, FROM THE REVENUE SECRETARY, GOVERNMENT OF THE CENTRAL PROVINCES, AGRICULTURE DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Grant-in-aid from the Imperial Council of Agricultural Research for certain schemes of Research in the Central Provinces.

I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward a copy of letter No. 5551, dated the 12th/13th December 1933 (Annexure II) from the Director of Agriculture, Central Provinces, together with the undermentioned six schemes and to recommend them for the favourable consideration of the Imperial Council of Agricultural Research. The schemes are being printed and 150 copies of them will be furnished to you in due course.

(4) Scheme for research on the Gangai pest of Rice (Annexure III).

2. These schemes have been considered by the Provincial Agricultural Research Committee on the 9th December 1933 and approved by that body. The local Government has also accepted them. I am accordingly to request that they may be placed before the Advisory Board of the Imperial Council of Agricultural Research at its next meeting to be held in February 1934.

ANNEXURE II.

COPY OF LETTER NO. 5551, DATED THE 12/15TH DECEMBER 1933, FROM THE OFFO. DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES, TO THE SECRETARY TO GOVERNMENT, AGRICULTURE DEPARTMENT, CENTRAL PROVINCES.

I have the honour to attach herewith six schemes of research which were placed before the Provincial Agricultural Research Committee on the 9th December 1933 and recommended for transmission to the Imperial Council of Agricultural Research for the provision of funds. The Provincial Agricultural Research Committee placed them in the following order of importance :—

Schemes for Research on the	Orange Crop.	} A
"	" Oilseeds	
"	" Potato Storage.	} B
"	" Gangai Pest of Rice	
"	" Sann Hemp.	} C
"	" Pan Cultivation.	
*	*	*

The Gangai pest of Rice has made itself very prominent this year in Bilaspur, Mandla and Raipur and areas of other districts. The pest appears to be creeping steadily westwards and if steps are not taken to investigate it and find control measures, the whole of the rice area will become liable to attack. The insect is known to cause damage in Bengal, Bihar and Orissa and Madras, so that the scheme put forward is of All-India importance and thus deserves the support of the Imperial Council of Agricultural Research.

ANNEXURE III.

ADDITIONAL GRANT UNDER THE RICE RESEARCH SCHEME FOR ENTOMOLOGICAL WORK.

Many reports of damage to paddy have been received this year, all due to what is locally called "Gangai" or sometimes "Ponga". In parts of Bilaspur district and in Mandla, the loss is extensive and the pest appears to be spreading westward and will soon affect the whole of the rice tract.

The Entomologist to Government visited affected areas and identified the insect as (*Pachydropis oryzae*) a small mosquito like a fly.

The known methods of dealing with the pest have been recommended, viz., early sowing, fertilizing to obtain vigorous growth before the fly is due to appear about August and the use of light traps.

Little, however, is known about the insect and there are several important points on which information is lacking, e.g.—

- (1) How the insect behaves and how it carries over from crop to crop.
- (2) Has it any alternative food plants during the paddy season?
- (3) *Kodon* plants were reported to have been similarly damaged. Is the same insect responsible for damage to both crops or are two species concerned?
- (4) Are any wild grasses found near paddy fields subject to this pest?
- (5) How can the natural enemies of the pest (many larvae were found parasitized this year) be multiplied and used to the best advantage?

The Entomologist to Government has to devote his time to teaching and other research work and is unable to carry out this necessary investigation. I therefore apply to the Imperial Council of Agricultural Research for the following staff, etc., to be attached to the Rice Research Scheme for the Central Provinces but to work under the direction and supervision of the Entomologist to Government :—

	First year.	Second year.	Third year.	Fourth year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Entomological Assistant, Central Provinces Subordinate Service at Rs. 100—5—115.	1,200	1,260	1,320	1,320	5,160
2. Field men at Rs. 25 each	600	600	600	600	400
3. One chaprasi at Rs. 11	1·2	132	132	122	528
4. Travelling allowance	300	300	300	300	1,200
5. Contingencies	200	200	200	200	800
Total	2,432	2,432	2,552	2,612	10,088

Laboratory accommodation, apparatus, etc., will be supplied by the Central Provinces Government and the work, as mentioned above, will be directed and supervised by the Entomologist to Government, Central Provinces.

APPENDIX XLI.

NOTE DATED THE 22ND FEBRUARY 1934 BY SECRETARY ON SUBJECT No. 35. REPORT OF THE "PROGRESS REPORTS" COMMITTEE, 22ND FEBRUARY 1934.

PRESENT :

Diwan Bahadur Sir T. Vijayaraghavacharya. (Chairman).
 Dr. W. Burns.
 Mr. B. C. Burt.
 Mr. P. H. Carpenter.
 Professor T. Ekambaram.
 Dr. J. C. Ghosh.
 Mr. V. N. Likhite.
 Dr. W. McRae.
 Mr. S. K. Mitra.
 Professor J. N. Mukherjee.
 Dr. Nazir Ahmad.
 Professor P. K. Parija.
 Mr. M. A. Sampathkumaran.
 Mr. C. V. Sane.
 Mr. H. R. Stewart.
 Mr. G. T. Tait.

1. *Subject 35 (i).—Agricultural Meteorology Scheme, Poona.*—The Committee recommend that, in view of the fact that the grant for this scheme had to be cut down, attention should be concentrated on a limited number of items of work. Generally speaking, it is considered that the experimental rather than the statistical side will be found of most immediate use to agricultural research workers. Special attention might be devoted to the following items :—

Statistical Section.—Study of experimental farm data and long range weather forecasts.

Experimental Section.—Micro-climatology (including the related statistical analysis in due course).

The measurement of air temperature, soil temperature and plant temperature by thermo-couples (item 12); Soil temperature, soil moisture and soil evaporation (item 10).

The Committee are not quite clear as to what is proposed under item 9 (effective rainfall) and they suggest that, before work on this item of the programme is extended, a study should be made of the 25 years records of the drain gauges from Pusa and Cawnpore and also of the Rothamsted drain gauge experiments. It is doubtful whether there is need for further work with percolation gauges of the type mentioned except in connection with specific schemes of agricultural work, e.g., at the dry farming station.

The Committee consider that item (d)—advice on statistical analysis of data—of the Statistical section should be omitted in future except when it relates to meteorological data. The Council has already made arrangements for assistance to agricultural workers in the statistical interpretation of the results of field trials and of general biological data.

Subject 35 (ii).—Final report of Professor P. K. Parija on the scheme of research work on water hyacinth in Bihar and Orissa. (Appendix XLI-B.)

The Committee invite attention to the summary on page 25 of the report which indicates the results of practical value. The questions which the scheme was intended to investigate have been successfully answered and the effect of reproduction from seeds on the eradication of water hyacinth has been definitely established. It has been shown that as the seeds can be dormant up to five years, an annual for several years clearing of ponds, tanks, etc., is necessary in order to secure complete eradication but that this annual clearing can be postponed to a comparatively late date in

the season (in Orissa end of September) and that one such clearing is sufficient. The reasons for certain failures to destroy water-hyacinth by spraying with plant poisons have also been elucidated. If read with the Bulletin published by Mr. Peck, I.C.S., which details the history of the successful operation on the eradication of water hyacinth in Orissa, the report shows that water-hyacinth can be eradicated by mechanical means.

The Committee approved the report and recommend that it be published in the Indian Journal of Agricultural Science. They would like a popular summary to be published also if this can be arranged.

Subject 85 (iii).—Report on the work done on the scheme of research on the effect of ions on the growth of plants by Dr. S. S. Bhatnagar, during the period February 1931 to August 1933. (Appendix XLI-C.)

This scheme has been extended until May 1934 so that final report will be due before long. The Committee observe that in the present progress report not all the data have been presented and that the statistical significance of the results has not been stated and is not calculable from the data given. They recommend that before the final report is prepared, all the experimental data should be suitably tabulated and submitted to the Statistician to the Council for statistical analysis in order that the results of the experiments may be clearly presented.

It is suggested that in the next report all concentrations should be stated in molar quantities rather than percentages.

APPENDIX XLI-A.

NOTE DATED THE 22ND JANUARY 1934, BY SECRETARY, ON SUBJECT No. 35 (i). ANNUAL REPORT OF THE AGRICULTURAL METEOROLOGY BRANCH OF THE INDIAN METEOROLOGICAL DEPARTMENT, POONA, FOR THE YEAR ENDING THE 21ST AUGUST 1933.

In June 1930, the Advisory Board recommended a scheme for the establishment of a new branch of Agricultural Meteorology at the Indian Meteorological Department, Poona, which was approved by the Governing Body at its meeting held in July 1930. Details of the scheme will be found in Appendix XIV (pages 66 to 102) of the printed proceedings of the meetings of the Advisory Board held in June 1930. Owing to financial stringency, however, the scheme could not be started on the scale approved by the Governing Body; it was accordingly sanctioned on a reduced scale for a period of three years in the first instance and was started with effect from the 22nd August 1932.

2. The first annual report (Annexure) on the working of the scheme for the period ending the 21st August 1933, which has been received from the Director General of Observatories, Poona, is submitted for the consideration of the Advisory Board. In view of the fact that, owing to financial stringency, the original scheme had to be cut down, any indication by members of the Board as to which sections of the work promise to be of special value would be appreciated.

ANNEXURE.

ANNUAL REPORT OF THE AGRICULTURAL METEOROLOGY BRANCH (FINANCED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH), INDIA METEOROLOGICAL DEPARTMENT, FOR THE FIRST YEAR ENDING 21ST AUGUST 1933.

The scheme of Agricultural Meteorology originally sanctioned by the Imperial Council of Agricultural Research was held up owing to the retrenchment campaign of 1931. The Government of India later reviewed the schemes sanctioned by the Council and decided that, rather than postpone the scheme of Agricultural Meteorology until the financial situation improved, it should be proceeded with on a reduced scale for the first three years. The restricted scheme was to be initiated by a single Agricultural Meteorologist assisted by a staff of one Professional Assistant, two Senior Observers or Computers and three Junior Computers. Dr. L. A. Ramdas who was selected for the post of Agricultural Meteorologist took up his new duties at Poona on the 22nd August 1932. The staff was recruited and the new Agricultural Meteorology Branch started work at the Meteorological Office, Poona, towards the end of the month. During the first few months a large amount of time was naturally devoted to the training of the staff and to other preliminary work.

The work of the new Branch comes under two heads:—(a) Statistical and (b) Experimental or Biological. In his letter No. 28/Agri., dated the 5th January 1932, the Vice-Chairman of the Imperial Council of Agricultural Research had indicated that "it is desirable that both the statistical and the biological branches of the Scheme should go forward though on a reduced scale in order that a definite start may be made in this new branch of Agricultural science". with this object in view arrangements were made to commence work under both aspects of the Scheme and to maintain uniform progress as far as possible

The available staff was allotted duties as follows:—

One Professional Assistant.	}	I—Statistical work.
One Senior Observer or Computer.		
One Junior Computer.		
One Senior Observer.	}	II—Experimental work.
One Junior Observer.		
One Junior Observer—III—General work, correspondence, typing accounts, etc.		

Besides the above staff, a few Honorary research scholars joined the Branch in April and May 1933 in order to undertake investigational work on problems relating

to Agricultural Meteorology. Their devoted work helped to make progress to a considerable extent. At the moment of writing this report the following students are working in the Branch:—

- (1) Mr. P. K. Raman, B.A.
- (2) Mr. M. K. Paranjpe, B.Sc.
- (3) Mr. M. S. Katti, B.Sc.
- (4) Mr. R. K. Dravid, B.Sc.

In the following pages a brief report of the work done by I—the Statistical, II—the Experimental and III—the General Sections of the new Branch is given.

I.—Statistical Section.

(1) The programme of statistical investigation of past agricultural and meteorological statistics is to begin with a critical enquiry of the available data on the "area sown" and "yield per acre" of crops for the various districts and presidencies in India and proceed, after careful selection, to correlate some of them with the meteorological data. Accordingly the Agricultural Meteorologist got into touch with the various provincial agricultural departments with a view to collect the available Season and Crop Reports and the data of some of the experimental farms. These original records were mostly received on loan and as they could not be kept for a long time it was necessary to keep copies of the data relating to the important crops before return. This was done in the case of the Punjab, the United Provinces and Burma during the year.

For the Bombay Presidency the fact that Poona is also the headquarters of the Director of Agriculture, proved fortunate as access to original records could be had at any time. In view of this special facility it was decided to make a start with the study of weather in relation to the yields of cotton in the Bombay Presidency and adjacent cotton tracts.

As a preliminary the distribution of different competing crops in the presidency was studied. The annual cotton yields per acre for the various districts of the Bombay Presidency for the period 1889 to 1931 were then computed from the acreage and out-turn figures. The yields per acre were then correlated with rainfall and temperature. The yield figures usually showed a secular trend. These trends were eliminated by poly-nominal curve-fitting and generally it was found that the correlations improved. The regression equations between yield, rainfall and temperature were calculated. Such forecasting formulae have been worked out for the Khandesh, Ahmednagar, Ahmedabad, Belgaum and Bijapur districts; further work on the remaining cotton growing tracts in the Bombay Presidency and elsewhere in India is being continued. Dr. Normand's Performance Test will be applied to these formulae before work on other crops is taken up. The yield per acre of cotton is seen to be dependent, among the weather factors tried, upon the rainfall in the early and late monsoon months and the temperature in the months of September, October and November.

(2) *Experimental Farm Data.*—(a) *Bombay Presidency.*—Experimental farm data have been received from many centres. Amongst these the data of a few farms in the Bombay Presidency were selected for examination. One of the research students has recently undertaken this problem and progress is being made in collecting the detailed meteorological data from the numerous records of the Meteorological Department.

(b) *Cawnpore (U. P.).*—The U. P. Government deputed Mr. Srijal Singh of the Agricultural College, Cawnpore, for training in the Agricultural Meteorology Branch for a period of one and a half months with effect from the 16th May 1933. Mr. Singh examined the original records of the historic farm at Cawnpore which he had brought with him as arranged. The few uniform series of crop yields, e.g., the 'kharif' standard series of maize for the period 1885-86 to 1913-14, the 'Rabi' standard series of wheat for the same period and a few shorter series, were carefully extracted from the old records. The trends in the wheat series were eliminated; further work on correlation with weather factors as recorded at Cawnpore remains to be completed.

(3) *Statistical analysis of meteorological factors for purposes of forecasting temperature.*—The Plant Pathologist to the Government of Bombay enquired whether it would be possible to give forecasts of maximum temperature for certain districts in the winter months. The problems of forecasting maximum temperature a month ahead and a week ahead respectively was taken up for study. A beginning was made with the maximum temperature of Poona. It was found that the mean monthly

maximum temperatures of each of the months October, November, December, January, and February or what may be called the dry months were highly correlated with the neighbouring months. The investigation was further amplified by taking weekly means of maximum temperature during the period 30th October to 31st December and working out regression equations between the maximum temperature of a week and that of each of the preceding four weeks. The forecasted values were found to be in fair agreement with the actuals. A paper on this subject has been submitted for publication as a 'Scientific Note of the India Meteorological Department'. Further work on a few other selected stations in India has been taken up.

(4) There are no experimental records of evaporation in India for a series of years and for a large number of stations as in the case of rainfall. Recently, with the help of one of the research students, a theoretical investigation of the water-evaporating power of the air layers near the ground in different months of the year was taken up. It may be remarked that the evaporating power of the atmosphere is a very important meteorological factor influencing plant life. The mean monthly evaporation figures calculated from the meteorological factors for different months of the year and for about 100 representative stations in India suggest that it may be possible to estimate the combined effect of weather factors, other than rainfall, by the calculated evaporating power of the atmosphere in different years. The subject is still under investigation. The need for the systematic recording of the daily evaporation at a large number of places in a uniform manner appears to be urgent.

(5) *Statistical analysis of micro-climatic observations recorded at the Agricultural Meteorological Observatory at Poona.*—In the next section dealing with "Experimental work" mention will be made of micro-climatological and other observations. Some of these data, especially where simultaneous records of the same meteorological elements are obtained under different surroundings (as for example, in the open and inside different crops) call for careful statistical analysis. The Statistical Section of the Agricultural Meteorology Branch undertook this work also, with the part time help of two of the research students.

(6) *General.*—(a) Soon after the formation of the Agricultural Meteorology Branch it began to be realised that one comptometer and one calculating machine placed at its disposal by the India Meteorological Department would be quite inadequate for the large amount of statistical work before the Branch. Proposals were therefore submitted to the Imperial Council of Agricultural Research for sanctioning the purchase of two more calculating machines in the first instance, in order to equip a fairly adequate statistical laboratory. Funds were sanctioned for this purpose by the Imperial Council of Agricultural Research and the machines are being ordered.

(b) Mr. K. V. Joshi, Cotton Physiologist, Surat, made a request that the meteorological data collected by him at Surat during a period of six years should be scrutinised, especially with a view to checking the reliability of his instruments and the method of taking observations adopted by him. This analysis was completed with the assistance of a member of his staff and a report on the subject was furnished to Mr. Joshi.

(c) At the special request of the Director of Agriculture, Bombay Presidency, Dr. R. J. Kalamkar, the Professional Assistant, analysed during his leisure time the uniformity trial data collected at the Padegaon Sugarcane Research Station.

(d) Advice on statistical analysis of data was also given to a number of other agricultural workers, on request.

11.—Experimental.

(7) The experimental part of the programme required a considerable amount of preliminary work before its initiation.

Agricultural Meteorological Observatory.—The meteorological data which have been collected for the past 50 or 60 years by the India Meteorological Department at about 200 stations in India refer to conditions generally un-influenced by vegetation or other local disturbing causes like buildings, trees, etc. In order that the significance of these data for agricultural purposes may be clearly brought out, it is, first of all, necessary to find out by experiment how far crops modify the general weather. Further, the micro-climate of the crops themselves may vary considerably from the observations record inside an area surrounded by crops. Owing to the impetus given to such fundamental investigations by the activities of the International Commission on Agricultural Meteorology, many countries in Europe have already started investigations on this subject. Some of the resolutions adopted by the Empire Meteorologists' Conference, Agricultural Section, 1929, aimed at similar detailed studies

in the British Empire also. It was therefore decided to start an Agricultural Meteorological Observatory at the farm of the local Agricultural College, firstly to compare observations recorded there with those recorded in the Meteorological Office, Poona, and secondly in order to compare the observations recorded in the Agricultural Meteorological Observatory with those recorded inside some of the surrounding crops. With the co-operation of the Director of Agriculture and the Principal of the Agricultural College, a suitable plot at the centre of the farm, 130' x 90', was selected in October 1932. The plot was cleared and the installation of routine instruments was completed by the end of November. The instruments were loaned by the India Meteorological Department for a short period. The proposed observatory was, however, intended to record not only routine meteorological observations but also study micro-climatology evolve suitable instruments for such work, standardise instruments and methods of observations and in general, undertake a detailed study of the meteorology of the air layers near the ground. It was therefore decided that the Agricultural Meteorology Branch should obtain a full complement of meteorological instruments already available in the market, and supplement these by either designing new instruments or adapting the existing ones to the new requirements. Accordingly proposals were submitted to the Imperial Council of Agricultural Research and instruments worth about Rs. 3,000 were ordered from abroad in February 1933. Most of these new instruments were received during the last month of the period under review and are being tested and installed.

Observations of atmospheric pressure, air temperature and humidity, rainfall, wind velocity and direction at the level of crops, evaporation, soil temperature and moisture, percolation, duration of sunshine, etc., were recorded at the observatory. Most of these observations were recorded daily at 5 hours I. S. T., 8 hours L. M. T., and 14 and 17 hours I. S. T. daily. Besides the eye-reading instruments several self-recording instruments were also installed for obtaining continuous records of the meteorological elements. New instruments for the measurement of (a) evaporation from free water surface and from a wet cloth, (b) percolation and (c) evaporation from the soil, were designed and made with the help of local private workshops. For making working models of small pieces of apparatus it was found advantageous to equip a small work-shop table in the Agricultural College itself and a few small tools were therefore purchased locally.

(8) *Micro-climatology*.—The results obtained from the micro-climatological observations collected during the winter and spring of 1932-33 are being discussed in a series of papers which will be submitted shortly to the Imperial Council of Agricultural Research for publication. It may be sufficient to remark here that the 'local climate' inside the crops is different from that of the surrounding free atmosphere and that it is not related in a simple manner to the general climate especially during the day time when solar insolation is most active. At a given instant the temperature and humidity regimes in different crops differ from each other as well as from those of the free atmosphere. So far as solar radiation is concerned, the top of the crop acts like an active surface layer just as the bare soil surface does in the open. Amongst factors controlling the climate of the crops are the amount of moisture in the soil over which the crop stands, the height and density of the plant population, and the screening of solar radiation by foliage with corresponding decrease in the warming due to absorption of solar radiation at the surface of the ground. Micro-climatological observations will be continued inside a few crops where the plants are grown at different seed-rates in order to examine how the micro-climate changes with the density of plant population.

(9) *Effective Rainfall*.—To study percolation in relation to rainfall it was considered desirable to measure the percolation through soils of different depths. A series of percolation gauges 3 feet square in cross section and 6", 1', 1½', 2', 3' soil depths was therefore installed in the observatory. Preliminary observations were made during the last two months. These have to be examined in relation to the actual amount and intensity of rainfall and evaporation from the soil surface. Further work on a smaller scale under controlled conditions in the laboratory has been undertaken by one of the students and the necessary apparatus is being made locally.

(10) *Soil temperature, soil moisture and soil evaporation*.—The measurements of soil temperature and evaporation from a series of eye-reading instruments have been tabulated in a form suitable for study. The India Meteorological Department also loaned to this Branch two continuously recording soil thermographs. The records obtained from these instruments along with the observations of soil moisture promise to be very interesting when studied in relation to rainy and non-rainy periods.

(11) *Frost-hazard in relation to the temperature distribution near the soil*.—The problem of frost is an important one so far as Northern India is concerned, but

observations of air temperature near the ground have been confined in the past to a single level very near the soil at a few stations. From investigations carried out at Poona, Agra, and Madras during the winter of 1931, it has been found that the variation of temperature at night in the air layers near the ground is not the same at all heights and that the region of maximum frost hazard is likely to be at some level above the ground level under the conditions prevailing above bare flat ground. With a view to extend these studies to areas surrounded by crops a series of gas minimum thermometers was exposed at different levels over the bare ground in the observatory and some preliminary observations were made during clear weather. These studies will be continued during the ensuing autumn and winter with several sets of instruments (1) in the open above bare soil, (2) above a grass plot and (3) inside crops.

(12) *Thermo-couple installation for the measurement of air temperature, soil temperature, plant temperature, etc.*—It is often necessary to take observations at a large number of levels above ground. The Assmann Psychrometer is mostly used for this purpose. In order further to decrease the work involved in taking a series of observations, experiments were made to find the best method of utilising thermo-couples for measuring temperatures of air and soil. A small hut was built for housing a galvanometer and the thermo-couple installation was set up near this hut. For measurement of air temperature, a series of thermo-couples provided with specially devised radiation-proof screens was fixed on a post 10 ft. high. For measurement of soil temperatures another series of thermo-couples was embedded in the soil after suitably insulating the connecting wires under the soil. The connections from all these thermo-couples were led into the hut by means of a bare wire net work fixed to insulators on suitable stands. The terminals were then connected to a specially devised switch-board. The observer sitting inside the hut could thus take a whole series of measurements in five minutes by simply sliding the contact from point to point. A similar switch-board connected to the same galvanometer could also be used for measuring temperatures of plants, leaves and stem. The work in connection with this installation was mostly done by one of the research students and an account of the equipment along with a discussion of its performance is under preparation. Professor Apte of the Botany Section of the Ferguson College who was very much interested in the measurement of temperatures of plants, leaves, etc., has also recently commenced work in collaboration with the research student. It may be mentioned that the above equipment was built up at a comparatively small cost and that a satisfactory galvanometer for the work was obtained from the Junior Workshop Company at Poona.

(13) Besides undertaking detailed observational work on a regular basis the observatory also standardised the instruments received from the Cawnpore Agricultural College, the Sugarcane Research Station at Padegaon and the Rice Breeding station at Nagina, U. P. The instruments of Padegaon were set up by the Senior observer of the Branch according to standard practice inside the bare plot selected for the observatory by the Agricultural Meteorologist. The observer at Padegaon was also given training in taking observations by our senior observer.

(14) Mr. Sripal Singh who was deputed by the United Provinces for training in agricultural meteorology was given detailed instructions in experimental work and it is hoped that the Agricultural College at Cawnpore will undertake similar work in their farm. The Agricultural Meteorologist has been in close touch with the Principal and some work is likely to be started there during the ensuing autumn or winter.

(15) The observatory is proving very valuable as a training ground for agricultural meteorological workers and a large number of visitors and students were shown round the observatory and its working explained to them in detail.

(16) On request, the Agricultural Meteorologist has been co-operating with Dr. K. C. Mehta who is in charge of the research on "Cereal rusts". The serotype received from him is being exposed regularly on the tower of the Meteorological Office and the records are being forwarded to him regularly for study.

(17) *The measurement of solar radiation and night sky radiation.*—The total energy received by a horizontal surface of unit area in unit time from the sun and the sky is an important meteorological factor. For the measurement of this fundamental element suitable instruments were selected and proposals for their purchase were submitted to the Imperial Council of Agricultural Research. The sanction was received recently and orders have been placed for their purchase. For the measurement of nocturnal radiation, one of the research students constructed a thermopile consisting of 40 elements and the instrument is under test.

(18) Towards the end of the period under review the observers have been working under the constant menace of the plague epidemic and every effort is being made to keep up the continuity of the observations.

(19) The Agricultural Meteorologist is indebted to the Director of Agriculture, Bombay, and the Principal of the Agricultural College, Poona, for their valuable co-operation in providing facilities for conducting the experimental work inside the college farm.

III.—General.

(20) Some idea of the administrative activities of the new Branch will be gathered from the following paragraphs.

With a view to extend some of the problems of Agriculture in relation to weather and to meet workers engaged in Agricultural Research in India, the Agricultural Meteorologist attended the Science Congress held at Patna in January 1935. He also met various officials of the Department of Agriculture, Bihar and Orissa, assembled at Patna and later visited the Agricultural Research Institute at Pusa, the office of the Director of Commercial Intelligence, Calcutta, the Agricultural College, Cawnpore, and a few other places. At all the places visited it was found that the Agricultural Departments were keenly interested in starting work on agricultural meteorology in their centres. Requests for advice on meteorological matters were also received from a number of officers in charge of agricultural research financed by the Imperial Council of Agricultural Research. It was accordingly found necessary to issue a few general circulars dealing with the details of agricultural meteorological work, specifications of instruments, their cost, method of taking observations, etc. Proposals for the publication of an agricultural meteorological 'supplement' to the "Instructions to Observers in second and third class observatories" of the India Meteorological Department were drawn up. It was decided to undertake this publication and also reprint the "Instructions to Observers" after revision and draw up forms for the meteorological registers for use at agricultural farms. Considerable progress has been made in this work and the manuscript of the agricultural meteorological supplement is nearly ready. The illustrations are now in the course of preparation and it is hoped to send these to press shortly. A general circular issued to the various agricultural departments ensured that there would be a good demand for these publications.

(21) A draft scheme for recording precision observations of the growth and yield of crops was prepared and sent to some of the agricultural workers in India. Their criticisms have been received and it is proposed further to discuss this draft scheme during the ensuing session of the Science Congress at Poona. The matter is under correspondence with the President Elect of the Agricultural Section of the Science Congress.

(22) As a result of personal contact it has been possible to secure the co-operation of the departments of Agriculture in Bihar and Orissa, the United Provinces and the Punjab. At the Agricultural Meteorologist's suggestion the Director of Agriculture, Bihar and Orissa, has agreed to start second order observatories at the research stations under his charge. A list of instruments that will be required for these stations was sent to the Director of Agriculture and the latter has promised to purchase and send them when received for standardisation at Poona. Instructions to observers and advice regarding certain special instruments have been sent to some of the farms in the United Provinces. The active co-operation extended by the Agricultural College at Cawnpore has already been referred to. In the Punjab, the proposals of the Agricultural Meteorologist for revising work at all the farms in the province have been accepted by the Principal of the Agricultural College at Lyallpur who, it is understood, has forwarded the proposals for sanction to the Director of Agriculture of the Punjab. The Agricultural Meteorology Branch has promised active co-operation when these proposals for revision are given effect to. During the period under review, instructions regarding equipment, method of observations and other technical advice were given on request by correspondence to 21 research stations and institutions or workers. The Appendix to this report contains a list of the parties to whom such co-operation was extended. The Agricultural Meteorologist has recently arranged to visit Coimbatore and Madras to get into touch with the workers there.

(23) Shortly after the inauguration of the Agricultural Meteorology Branch, the International Commission on Agricultural Meteorology at its meeting held at Munich in September 1932, elected Dr. Ramdas, the Agricultural Meteorologist as a member of the Commission. This gave considerable facilities for discussion of scientific topics with some of the prominent members of the Commission like Dr. Rudolph Geiger. A very interesting monograph entitled *Microklima und Pflanzen klima* has been contributed by the above worker to the "Handbook der Climatology" (Bd. 1 Teil D with 29 illustrations). As an English translation of this monograph would be very useful to the Branch and would, if published, also be very useful to agricultural

workers in India, Mr. S. Atmanathan of the Meteorological Office kindly undertook and completed the translation at the Agricultural Meteorologist's request. Mention has already been made about the research scholars who have undertaken work in the Agricultural Meteorology Branch. Recently the University of Bombay has admitted the Agricultural Meteorologist as a recognised 'University Teacher'.

(24) It is found that there is a general desire among agricultural workers to receive weather forecasts a week or more ahead. There is no doubt that such forecasts would prove extremely useful to agriculturists if they could be given. This is however a matter which would require very careful and extensive preliminary research and, if sufficient facilities by way of additional staff and funds for such investigations are made available, it may be possible to extend the scope of the activities of the Agricultural Meteorology Branch.

(25) The India Meteorological Department is greatly indebted to the Directors of Agricultural Departments and Institutions in the different provinces and the various agricultural workers in the country for their valuable co-operation with the new Branch.

S. K. BANNERJEE,

(Offg. Director General of Observatories.)

POONA;

The 14th September 1933.

ENCLOSURE I TO ANNEXURE.

No.	Name.	Address.	Nature of co-operation extended by the Agricultural Meteorology Branch.
1	Dr. K. C. Mehta	Professor of Botany, Agra College .	Experimental work with Aeroscope during specified seasons, and information regarding upper winds.
2	Mr. N. V. Kanitkar	Soil Physicist to the Government of Bombay.	Advice regarding equipment for 1st class observatories at Sholapur and Bijapur in connection with the new Dry Farming Scheme.
3	Dr. R. D. Rege	Crop Physiologist, Sugar-cane Research Scheme, Padegaon.	Observatory site selected, instruments standardised and installed according to standard practice; observer trained.
4	Rao Saheb B. P. Vagholkar	Chief Agricultural Officer, Sugar-cane Research Scheme, Padegaon.	Advice regarding lay-out and discussion of uniformity trial data at special request of Director of Agriculture, Bombay.
5	Mr. K. V. Joshi	Cotton Physiologist, Surat	Advice regarding accuracy and significance of his meteorological records and on methods of correcting them; advice regarding discussion of his precision records.
6	Dr. B. N. Uppal	Plant Pathologist to the Government of Bombay.	Issue of warnings of frost and rain in certain districts of the Bombay Presidency during autumn and winter was arranged with the Weather Section of the Poona Meteorological Office.
7	Director, Imperial Institute of Agricultural Research, Pusa.	Pusa	Proposals were forwarded on request, for re-organisation of Agricultural Meteorological work at Pusa.
8	Principal, Agricultural College, Cawnpore.	Cawnpore	Detailed proposals forwarded on request, for starting Agricultural Meteorological work at Cawnpore; a member of the College staff who was deputed to Poona was trained both in Statistical and Experimental work; one instrument standardised.
9	Director of Agriculture, Bihar and Orissa, Patna.	Patna	Detailed proposals forwarded on request, regarding meteorological equipment for (a) research stations and (b) ordinary farms in the Province.

No.	Name.	Address.	Nature of co-operation extended by the Agricultural Meteorology Branch.
10	The Superintendent	Anakapalle Research Farm, Madras Presidency. . . .	Advice regarding instruments to be purchased for his farm.
11	The Manager	Central Experimental Farm, Gwalior	Advice regarding instruments to be purchased for his farm.
12	The Chief Agricultural Officer	Sind, Karachi	Advice regarding instruments to be purchased for his farm.
13	Principal, the Punjab Agricultural College.	Lyalpur	Detailed proposals for re-organisation of Agricultural Meteorological work in the Punjab were forwarded on request.
14	Director of Agriculture, Bhopal State.	Bhopal	The Director expressed a desire to start detailed work; full proposals were forwarded to him for purchase of necessary instruments.
15	Assistant Paddy Specialist, U. P., Nagina.	Rice Research Station, Nagina	Detailed instructions for using certain instruments; two instruments received for standardisation being attended to.
16	Director, Nizamiah Observatory	Nizamabad	Shown details of our experimental work at observatory during his visit to Poona; he has promised to advise farms in Hyderabad State regarding Agricultural Meteorological work in consultation with this Branch.
17	Cotton Research Botanist	Agricultural College, Coimbatore	Repair of hygrograph and its calibration (instrument recently received).
18	Mr. H. L. Khanna	Sugarcane Specialist, Sugarcane Research Station, Musaffarpore.	List of instruments to be purchased for his farm supplied and discussion on equipment for measurement of solar radiation.
19	Deputy Director of Agriculture, Orissa Range.	Cuttack	Advice regarding meteorological equipment to be purchased for his research farm.
20	Deputy Director of Agriculture, South Bihar Range.	Patna	Advice regarding meteorological equipment to be purchased for his research farm.
21	Principal, Agricultural College, Coimbatore.	Coimbatore	Advice regarding Agricultural Meteorological work and suggestions for equipment.

ENCLOSURE II TO ANNEXURE.

Staff of the Agricultural Meteorology Branch.

Agricultural Meteorologist.

Dr. L. A. Ramdas, M.A., Ph.D. (Cal.).

Professional Assistant.

Dr. R. J. Kalamkar, B.Sc., B.Ag., Ph.D. (London).

Senior Observers.

- (1) Mr. V. Satakopan, M.A.
- (2) Mr. K. M. Gadre, B.Ag.

Junior Observers.

- (1) Mr. S. A. Jall, B.A.
 - (2) Mr. S. Gopal Rao, B.A.
 - (3) Mr. A. V. Sukhatme, M.Sc.
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APPENDIX XLI-B.

NOTE, DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT NO. 35 (ii), FINAL REPORT OF PROFESSOR P. K. PARIJA ON THE SCHEME OF RESEARCH WORK ON WATER HYACINTH IN BIHAR AND ORISSA.

In April 1930, the Council sanctioned a scheme of research work on water hyacinth by Mr. P. K. Parija, Professor of Botany, Ravenshaw College, Cuttack, for a period of one year in the first instance. The scheme was given effect to from April 1930 but as the work had not been completed on the date of its termination in April 1931, sanction was obtained for its extension for a further period of one year, viz., till April 1932. As, however, the work could not be completed by the 31st March 1932, sanction for a further extension up to the end of July 1932 was obtained from the Governing Body by circulation. The first progress report on the scheme was considered by the Advisory Board at its meeting held in June 1931, vide pages 28 and 172-176 of the printed proceedings of the meetings of the Board.

2. The Final report (Annexure I) by Professor Parija entitled "An Account of the physiological investigations on water-hyacinth" has now been received and is for the consideration of the Advisory Board. In this connection a copy of a pamphlet (Not Printed) entitled "Report on the Eradication of Water Hyacinth in Patna" by Mr. N. F. Peck, C.B.E., I.C.S., which has been received from the Government of Bihar and Orissa, is also circulated for the use of the Advisory Board.

3. The Vice-Chairman to the Council considers that it will be an advantage if the report is first considered by a Sub-Committee consisting of:—

- (1) The Vice-Chairman, Imperial Council of Agricultural Research (Chairman), *ex-officio*.
- (2) The Agricultural Expert, Imperial Council of Agricultural Research.
- (3-7) The Directors of Agriculture, Bombay, Bengal, Punjab, Bihar and Orissa and Assam.
- (8) The Director, Imperial Institute of Agricultural Research, Pusa.
- (9) Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
- (10) Professor J. C. Ghosh, Dacca University.
- (11) Professor T. Ekambaram, Madras.
- (12) Dr. Nazir Ahmad, Director, Technological Laboratory, Matunga, Bombay.
- (13) Professor P. K. Parija, Ravenshaw College, Cuttack.
Secretary, Imperial Council of Agricultural Research (Secretary) *ex-officio*.

This Committee will meet at 2.45 p.m. on the 22nd February 1934 in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi, and the report of the Sub-Committee will be placed before the Board in due course.

ANNEXURE I.

AN ACCOUNT OF THE PHYSIOLOGICAL INVESTIGATIONS ON WATER HYACINTH.

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SECTION I.—INTRODUCTION.

The work, of which an account is given below, was undertaken in 1929 at the instance of Mr. N. F. Peck, I.C.S., the then Collector of Cuttack. Mr. Peck gives a full account of his campaign against water-hyacinth in his book which was published in 1930. He mentions there (44-67) how the reappearance of water-hyacinth in carefully cleared tanks was puzzling him and his officers and how he and I solved the puzzle.

It was thought necessary to study the water-hyacinth plant with a view to clearing up obscurities in the life history of the plant, hoping that some indication may be obtained as to the mode of eradication. The Imperial Council of Agricultural Research got interested in the matter and made a grant for continuing the work for two years and a month, without which it would have been impossible to do much.

In presenting the following brief account of the research work done, I have described the work under different sections with a separate summary at the end of each. Finally I have given a general summary for ready reference. Each separate section is written in the form of a separate paper by itself and can be printed as such if necessary.

It is not necessary here to give the details of the morphology of the water-hyacinth plant. Various workers have already pointed out the morphological peculiarities of this water weed. The references noted at the end in the general bibliography may be consulted for details. It seems desirable to compile a handbook of all the available information on water-hyacinth but that is not the task at present.

It is sufficient to state here that the water-hyacinth although generally a floating weed, is capable of growth on moist land. It has, therefore, adaptive characters both for water and land. In water it reproduces chiefly by vegetative methods, although it sets seeds quite frequently in these parts at least.

The seedlings germinate in the beginning of the rains, grow rapidly under suitable conditions and attain maturity in three months, producing flowers by September. Although the plant flowers almost all the year round, it does not set seed except at the beginning of the cold weather. Capsules are only produced towards the end

of September or the beginning of October. It seems to be a question of temperature. In these parts the temperature about this period is 75-7°F. to 85°F. The fact that the spike bends often into water after the flowers wilt, is well known. It is needless to give details of how the capsule matures and seeds are discharged. It is sufficient to state that the capsule bursts and gets detached from the spike on maturity and falls down. The seeds sink to the bottom of the tank and lie buried in the mud.

When the tanks get shallow in summer, the wading birds may disperse the seeds in their feet, as suggested by Dr. Brühl, from tank to tank. How the seeds that are exposed to the sun get dried up and thus become fit to germinate when they receive moisture, is described elsewhere.

Evidence as to the period of viability of seeds may be cited here. Some seeds have been stored in the laboratory with a view to finding out the maximum period of viability. From observations in the field, it is certain that seeds remain viable for five years at least. A tank in the district of Cuttack was cleared during the autumn of 1927, and has been kept free of water-hyacinth since then. Last July some seedlings were collected from the tank, thus proving that there were some seeds still in the tank which retained their viability for five years. There is, however, the remote possibility that the seeds might have been brought into this tank from outside. This is not likely as the tanks round about had all been cleared.

One imagines that the hard seed coat and the almost anoxic conditions in the mud at the bottom of the tanks helps the seeds in retaining their viability. As Cole observed, the concentration of oxygen in mud 10 ft. below the surface of water is only about 0.1 c.c., per litre. This means there is practically no oxygen near the seeds. This presumably helps the seeds to keep the testa intact and prevents germination. When the seeds get access to oxygen again they germinate. The germination has already been described and the facts have been corroborated in Burma.

In this brief report only experiments from which definite and interesting results could be drawn have been given.

I am indebted to the Imperial Council of Agricultural Research for their grant. I take this opportunity to express my thanks to Mr. T. C. N. Singh for his very valuable help in preparing the report.

SECTION II.—DORMANCY OF THE SEEDS OF WATER-HYACINTH

By

P. Parija and B. K. Kar,

A.—CAPSULE.

The seeds of water-hyacinth are contained in a trilobular capsule and are heavier than water when ripe. When the capsule bursts, the seeds from bent spikes are discharged into the water and sink to the bottom (Plate I, figs. 8, 9—not printed). The capsule is somewhat like an elongated cone with its base attached to the spike and is contained within the funnelshaped, accrescent and persistent base of the perianth. It is due to the presence of this perianth that the capsule seems to be a little bigger than what it really is (Plate I, figs. 1, 2—not printed). The length of the capsule is about 1.2 cm. and the longest diameter is 9/4 cm. The ovary is trilobular containing a total of 50-60 seeds wherever the loculi happen to be completely filled with them; but in many cases the mature seeds are found only in the upper region of the capsule, the basal portion either containing imperfect ones or none at all. This might be due to incomplete fertilization.

B.—SEED.

The seeds are minute with an oval base and tapering apex with which it is attached to the wall of the ovary. The dimensions of the seeds are: length 16-21 mm.; diameter (at the thickest zone) 12-16 mm. On the seed-coat there is a number of longitudinal ridges, viz., 12 to 15 in number. These are not found in immature seeds, but develop as the latter mature. Although fairly clearly seen on green seeds from undehiscent capsule, these ridges, nevertheless become very

prominent in dry seeds. In a transverse section of the seed, the ridges appear to be a skeleton to support the flesh which dries up or decays in time. On the epidermis of the seed, the fleshy layer is still visible as a thin line joining the ridges (Plate I, fig. 7 not printed). A transverse section of the seed coat shows an outer and an inner integument. As the ovule is anatropous, the micropyle is not terminal but is situated a little towards one side, just below the point of attachment of the seeds to the wall (Plate I, figs. 6, 11—not printed). The embryo is surrounded by a rather thick endosperm which is covered by a hard ribbed seed-coat. The embryo agrees in essential details with the seeds of the Pontederiaceae.

C.—DORMANCY.

Müller as far back as 1883 noted that seeds of *Eichhornia crassipes*, require previous drying as a necessary condition for their germination. He failed to germinate freshly harvested seeds. These, however, germinated later when sown again after a period of desiccation. Ludwig demonstrated this in case of the seeds of *Mayaca fluviatilis*. Since then several investigators have studied the subject of delayed germination in water plants, and almost all of them have come to the conclusion that germination is delayed if the seeds are continuously immersed in water and it is accelerated if they are subjected to a period of drying.

Crocker has shown experimentally that hard seed coats of the water plants hinder germination by limiting the water supply and that drying followed by soaking seems to induce rupture of the coats and thus to allow growth to begin. Later on Crocker and Davis (1914) confirm the earlier view by a detailed study of *Alisma plantago* where the dormancy of the achenes is due to the mechanical restraint exercised by seed coats.

This explains the crop of seedlings in large numbers just at the beginning of the monsoons. The intense heat of the summer months totally dries up the soil with the embedded seeds which with the beginning of the rains, get suitable temperature and moisture for their germination. We undertook to investigate the dormancy of the water-hyacinth seeds in the hope of throwing further light on the question. The investigation was divided under three subheads, viz. :—

- (i) Period of rest.
- (ii) Resistance of the seed coat.
- (iii) Oxygen supply.

(i) Period of rest.

Freshly harvested seeds of water-hyacinth do not germinate. It was thought perhaps the embryo is not fully-developed when the seeds are thrown out into the water from the dehiscent capsule and the period of rest is necessary for the full development of the embryo. In order to know the condition of the embryo, seeds at all stages of development were collected, namely—

- (a) green seeds from green capsule,
- (b) mature seeds from green capsule, and
- (c) seeds from dehiscent capsule.

The hard seed-coat was ruptured by means of a needle at the antipoda end to avoid injuring and thus allowing the fixing solution (Chromacetic acid) to have access to the embryo. They were then microtomed. As a result of a close examination of our micro-preparations, it has been found that even seeds taken from green mature capsules show a fully developed and complete embryo with plumule, radicle and vascular strand (Plate I, figs. 3, 4, 5—not printed). The embryo is, thus, fully formed in mature seeds and this could not, therefore, be the cause of dormancy.

The fully developed seeds collected in November 1930 and dried for two and half months were kept submerged in water. Side by side some freshly collected seeds during the same month, were submerged in water without any drying. Even after seven months none of these seeds showed any sign of germination. After this period, they were allowed to dry up perfectly for four months by occasionally keeping them in the sun. When watered again almost all of them germinated after three days (Plate I, fig. 10—not printed). That drying helps germination was observed by Müller, Ludwig and others. Crocker is of the opinion that drying

followed by soaking, causes a considerable per cent. of coats of *Eichhornia* seeds to crack along the fluting. We shall presently see that the testa offers not only mechanical resistance to germination but also prevents the entry of oxygen and thereby retards germination. In fact we shall adduce evidence that insufficiency of oxygen is one of the causes of dormancy of wet seed. Alternate drying and wetting probably loosens the testa, thereby removing the mechanical resistance as well as facilitating the entry of oxygen.

(ii) *Resistance of the seed coat.*

The seed coat offers mechanical resistance but is not impervious to water; for when soaked seeds are ruptured, the radicle protrudes out within an hour, which shows that water had got in and the embryo had swollen but the resistance of the testa and the insufficiency of oxygen were preventing further germination. Text figures a—h (not printed) illustrate the various stages in the development of a seedling from a ruptured seed. In nature, apart from the effect of alternate drying and wetting, the hard testa is probably acted upon by bacteria or softened by some chemical action. The results of some experiments done with a view to soften the testa to facilitate germination are shown below:—

Treatment on the seed coats.	Number of seeds treated.	Number of seeds germinated.	Number of days taken in germination.	Percentage germination.
				Per cent.
Bacterial culture (Hay-bacilli) .	8	1	10	12.5
Yeast culture	15	3	15	20
Algal film	6	2	10	33
Dilute H ₂ SO ₄	6	Nil	Nil	Nil
Potassium Phosphate . .	16	2	2-10	12.5
Freezing mixture	6	2	8	33
Cracking the testa (Mechanical means).	10	4	8	40
Removing the testa (Micropylar end).	10	10	1-2	100
Removing the testa (Antipodal end).	10	Nil	Nil	Nil
Warm water (42°C) . . .	8	1	7	12.5

(iii) *Oxygen supply.*

We have seen that the testa is not impervious to water. It is, therefore, likely that some oxygen gets in with water. The amount of oxygen thus entering must vary according to the depth of water at which the seeds lie, because the concentration of dissolved oxygen varies with depth. Cole has found that the oxygen concentration decreases rapidly with the increase of the depth, from 4.97 c.c.s. per litre at the surface to 0.14 c.c.s. at a depth of 10 ft.

In any case the amount of oxygen entering with the water let in by the testa cannot be sufficient for the resumption of growth by the dormant embryo. Attention was drawn to this possibility of oxygen acting as a limiting factor to

germination by the fact that in the field germinating seeds are always found on the surface of the mud and germination takes place after a shower of rain. The function of the rain seems to be, besides supplying the moisture, to expose the seeds which are carried over with mud, and thus give access to oxygen into the seeds. In tanks which had steep sides and filled quickly with water, very few seedlings grew up as compared to those which had sloping sides.

In such situations, seeds receive moisture over a large area. Besides moisture, seeds receive oxygen, if they lie on the surface. It is probably for this reason that seeds exposed by rain, germinate rapidly and therefore, seedlings are plentiful after a shower of rain. That want of oxygen has something to do with delayed germination was confirmed by our laboratory experiments. Seeds dipped simply in tap-water, take a long time to germinate, but if ordinary air or oxygen is bubbled through the water, the seeds germinate much quicker as shown in the table below :—

Treatment of the seeds.	Number of seeds treated.	Percentage of germination.			
		3rd day.	4th day.	5th day.	7th day.
(1) In tap water	9	Nil	Nil	Nil	Nil
(2) In airbubbled water . .	9	Nil	Nil	Nil	44%
(3) In oxygen bubbled water	9	Nil	22%	55%	55%

When the seeds from the tap-water were removed after 7th day and dipped in oxygenated water, they germinated and behaved similarly as in (3). There may be two possible explanations of this effect of oxygen on germination. Firstly greater concentration of oxygen in the water surrounding seeds ensures sufficient supply of the gas for the resumption of growth by the resting embryo. Secondly, oxygen may affect the testa in some manner resulting in the softening of the latter and thereby removing the mechanical resistance.

D.—SUMMARY.

The seeds of water-hyacinth remain dormant for at least one season, i.e., November to June and retain their viability for several years. It is found that :—

- (a) The embryo is fully developed when the capsule bursts, and thus the underdevelopment of the embryo cannot be the cause of dormancy, as fully developed embryos are found in green seeds.
- (b) The seed coat is the main cause of dormancy :—
 - (i) by offering physical resistance, as the seeds could be made to germinate by rupturing the coat with a scalpel.
 - (ii) by preventing the entry of oxygen, as seeds could be made to germinate by bubbling oxygen through the water in which seeds were soaked.
- (c) This confirms the suggestion put forward by one of the authors that the mud covered seeds in the fields do not germinate for lack of oxygen.

SECTION III.—GERMINATION OF SEEDS OF WATER-HYACINTH.

In a preliminary note one has described the various stages of germination in detail. Those observations were based on the various stages of seedlings collected in the field under natural conditions. Since then we have been able to germinate a large number of seeds in the laboratory which confirms the previous observations.

It has been noticed that the embryo is fully formed at the time when the seeds are shed from the capsule into the water, and the micropyle is at one end of the seed (Plate I, figs. 6, 11—not printed). As observed by us, the cotyledon-

first emerges through the micropyle as a knob-like protuberance. When seen under the microscope, the apex is seen (not printed) a little projected with a very slightly raised circular ring having dots on its surface. The projected apex is the radicle which later on grows out as the root and the dots on the ring are the papillae from which numerous fine unicellular hairs grow out as a frill encircling the radicle (Plate II, fig. 7—not printed). The same frill is also observed in the seedlings of *manochoria*, a close relative of water-hyacinth. Different stages of the germination of the *Manochoria* seed are given in test-figure 2. The function of these root hairs is very interesting. Arber says that in *Hippuris*, *Elatine hexandra* and many Helobiæ such as *Zannichellia* the poor development of the radicle is often compensated for, at an early seedling stage, by the production of a tuft of very long root hair, which grow out from the 'collet' or junction of hypocotyl and root. From field observations we have found that germinating seeds in all cases have been found on the surface, and germination takes place in the beginning of the rains or whenever the humidity, soil moisture and temperature are suitable. It is invariably found that a crop of seedlings appears after a shower of rain which seems, besides supplying the moisture, to expose the mud-covered seeds, and thus give them access of oxygen. The function of the root hairs appears to prevent the young seedlings from being washed away, and save the delicate radicle from being broken off. The root hairs anchor the cotyledon to the suitable soil, and when it is safely fixed the radicle tip grows and bores its way into the soil and establishes the plant. They might as well perhaps be serving as temporary absorbing organs for the plant as long as the radicle does not become active.

The cotyledon grows out first, and if even after the limit of its length is reached the radicle is not in suitable soil to grow, the hypocotyl intercalated and the radicle is carried to a suitable depth and then its growth begins. During this time the cotyledon is green and probably supplements the plastic material in the seed. This explains why we find no hypocotyl in seedlings growing in very damp mud, because here the radicle is in suitable surroundings and soon becomes active. In some seeds germinated (in the laboratory) in water in a test tube we invariably found the presence of the hypocotyl in them (Plate II, figs. 4, 5—not printed). The hypocotyl, however, does not develop in seeds that germinated on soil or in those which were transferred to soil soon after the protrusion of the cotyledon (Plate II, fig. 6—not printed).

Such intercalation in the axis takes place in other monocotyledons also such as rice. If the grains are sown at great depths, the coleoptile is carried up into the air by an intercalated piece of axis between the coleoptilar node and the scutellum, while on the other hand, if the grain is sown on the surface, this intercalation does not develop.

What happens in *Eichhornia* is altogether different. If the seed germinates on the surface and the mud is suitably moist, then there is no hypocotyl, while if the water content falls below the required minimum, the hypocotyl is intercalated to carry the radicle down to proper depth.

The first leaf grows out when the radicle has become fixed in the soil. The tip of the cotyledon still remains in the seed.

Once the seedling is established, linear leaves come out in succession and form a mosaic. But there is no distinction between leaf-blade and petiole at this stage. It must here be noted that the leaves in mature *Eichhornia* appear dimorphic. The ligule of the older leaf covers the younger leaf as a membranous sheath and appears to be a different kind of leaf. In reality there is only one kind of leaf. In the leaves of a mature plant, the petiole swells into a "pseudo-bulb". There is no fixity of age when the "pseudo-bulb" appears, although the linear leaves of the seedlings produce aerenchyma (Plate II, fig. 8—not printed). Seedlings grown in pots, the soil of which was kept moist but not saturated, did not produce swollen petioles till they were four weeks old, while seedlings transplanted in earthen pots standing in water and thus having saturated mud, produce them in 14 days. One fact was clearly established that the seedlings require copious supply of free water in the soil for their healthy growth.

SECTION IV.—FLOATING OF WATER-HYACINTH SEEDLINGS.

It has been noted before that the growth of seedling is affected by the amount of moisture. Now it has been observed that if water be lacking and the soil poor, the leaves of the seedlings after a certain age spread horizontally, while if water

is plentiful and the soil is rich, the leaves grow upwards. The first type of plant when submerged either does not float up at all or if it floats up at all, it takes a very long time to do so. |

The other type in which the leaves grow upwards invariably floats up. The leaves execute a paddling movement. First moving upwards during 12 hours and then moving down. This coupled with the buoyancy of the leaves supply the necessary energy for detaching the plant at the surface of cleavage already observed. |

It was further observed that light hastens the floating. This is as should be expected, as light promotes photosynthesis and leads to accumulation of plastic material for growth and formation of meristem of the cleavage zone and also help the paddling movement which is no doubt a turgor movement. Boresch has observed by a series of experiments that the inflated form of petiole can be induced by full light, low temperature and free swimming life, whereas the converse conditions tend to be associated with the elongated form of petiole. |

It has been noted before that floating always takes place in the evening between 5 and 7 o'clock. Apart from confirming this fact, it was found that there are two periods in the day when seedlings float up, namely, between 7 to 11 in the morning and 4 to 8 in the evening. This is probably associated with the temperature. |

SECTION V.—EFFECT OF HYDROGEN ION CONCENTRATION ON THE GROWTH OF WATER-HYACINTH.

Hydrogen ion concentration plays a very important role in the metabolism of plants. The physiological action of the free hydrogen ions is considerable and a slight change in the hydrogen ion concentration may have a critical effect. Water hyacinth plant is amphibious in habit and grows where there is water. It was, therefore, thought that it might have a definite optimum range of pH value for its healthy growth. If this range could be found, then by changing the pH value of the water, it might be possible to check the growth and spread of water-hyacinth. Experiments were carried out to note the pH value of water where water-hyacinth was growing normally and also to see the effect of change of pH value on the growth of water-hyacinth. |

All the experiments were done under conditions as nearly natural as possible. Big earthen pots were sunk into the ground in the open and plants were grown in them. Thus pH value could be controlled and the conditions approximated to the field conditions. |

Our first endeavour was to see whether the water contained in the pots made up to a known pH value changes by itself without water-hyacinth plants growing in it. Two tubs were taken. To one an acid (H_2SO_4) was added to make the pH value up to 4.5 and to the other NaOH was added to make pH value up to 9.0. For twelve days it was kept under observation and pH value daily measured colorimetrically with 'Merck' Universal Indicator. It was found that pH values both on alkaline and acid side became constant after a preliminary rise or fall. |

When the above experiment was repeated with the water-hyacinth plant growing in water, it was found that pH values both from the acid and alkaline range gradually changed towards the neutral value and after some time remained within a range between 6.0—8.0. |

Thus water-hyacinth like most plants is able to flourish within a definite range of pH values, namely 6.0—8.0. Having thus determined the range of pH value for growth of water-hyacinth, experiments were arranged for measuring growth in pH values on either side of this range. |

Seven tubs of the same size and depth were taken. All of them were filled with tap water. One was kept as a control without acid or alkali being added to it (pH 7.0—7.5). In the other tubs requisite volumes of H_2SO_4 and NaOH solutions were added to have pH values ranging from 4.0—5.0; 5.0—6.0; 6.0—7.0; 7.0—8.0; 8.0—9.0; 9.0—10.0. Plants of nearly the same age and development were allowed to grow in the respective tubs. Equal number of plants, with equal number of leaves, were taken in each case and the pH value was measured daily, care being taken to keep the pH value constant. |

Growth rate was measured in terms of volume on each fourth day; the measurement being carried on up to the 36th day. In measuring growth rate, we took the volume of the plant as our basis. This gives a fairly accurate idea of the growth

rate, as in the case of the water-hyacinth, the leaves persist for a long time and they certainly did persist during the period of experimentation. The volume was measured by taking out the plants from the tubs, and keeping them slantingly (from 5—10 minutes only to avoid drying up) on a rack so that superfluous water might drain off. They were next kept in a sufficiently broad graduated cylinder. Then by placing a mica sheet on the top of the plants they were pushed down and were dipped into the water by means of a dissecting needle. The same mica sheet and the needle were always used till the end of the experiment, so that the volume of the sheet and the needle could be neglected. In this way we could find the total growth of the plants including the growth of the roots, expansion of the bulbs and the growth of the leaves. The percentage growth rate was calculated and the results represented in the table below. |

Percentage growth of water-hyacinth in different concentrations of H-ion.

pH.	4.0— 5.0.	5.0— 6.0.	6.0— 7.0.	Control.	7.0— 8.0.	8.0— 9.0.	9.0— 10.0.
1st day . . .	100	100	100	100	100	100	100
4th day . . .	133	128	150	137	123	119	110
8th day . . .	133	143	170	181	145	154	116
12th day . . .	150	157	200	243	200	173	136
16th day . . .	172	180	300	337	281	196	144
20th day . . .	180	183	320	387	300	208	150
24th day . . .	183	196	390	468	309	215	155
28th day . . .	183	212	460	500	381	238	155
32nd day . . .	183	236	525	550	400	250	155
36th day . . .	183	242	580	600	445	269	155

From the text-figure 3 where the above results are plotted we can see that growth rate is highest in the control. Then comes pH 6.0 and pH 8.0. In other ranges of pH, growth rate is comparatively very much checked, so much so that at both the extremes pH 9.0—10.0 and 4.0—5.0 after a time the growth is totally checked. If we take the growth rate on a particular day, in different values and plot them together then we get a curve shown in text-figure 4 (not printed). Olsen following a statistical method in determining the relation between distribution of plants and H-ion concentration, found that every species has got an optimum range of H-ion concentration. His curve of frequency of a number of species closely resembles our curve of growth rate in the water-hyacinth. |

From our experiments conceived without the knowledge of Olsen's work, it shows that the distribution of water-hyacinth could be checked by altering the H-ion concentration of the medium but it is doubtful how far this may be practicable. When one has to deal with large stretches of water, it is difficult to change the H-ion concentration. There is an optimum at 7.0 and a fall on both the sides. The results thus showed that water-hyacinth like most plants was able to flourish within a considerable range of pH values, though a definite optimum could be distinguished.

The question naturally arises how the plants and especially the roots which always remain suspended in water adapt themselves to such extremes of pH values as 4.0—5.0 and 9.0—10.0. Though the growth rate is totally checked, yet the plants survive. The roots which are liable to be more affected we find that instead of soft and flexible roots, they have become hard and somewhat brittle. Instead of fine laterals covering throughout the length of the root all of them have been shed except a frill near the tip.

Although the growth of water-hyacinth was checked by changing the H-ion concentration beyond the tolerable range on either side, and some plants died, yet many plants continued to live. This we think is due to the antagonistic action of calcium present in the water-hyacinth plant. Many workers have shown that calcium does antagonise the effect of H-ion concentration. In the case of water-hyacinth, the cells are rich in calcium oxalate crystals. These must be escaping from decayed leaves and falling into the medium, probably antagonise the effect of H-ion concentration.

We shall see later in another connection, the antagonising action of Ca and K.

SUMMARY.

(1) The water whose pH value was made to 9.0 keeps constant without water-hyacinth growing in it; but with water-hyacinth tends towards 7.0 and keeps constant at pH 8.0. ;

(2) The water whose pH value was made to 4.0 keeps constant without water-hyacinth growing in it, but with water-hyacinth tends towards the normal and keeps constant at pH 6.0. ;

(3) Like most plants water-hyacinth is able to flourish in a very wide range of pH values though a definite optimum could be distinguished.

(4) Growth rate on either side of the optimum range of pH value is checked, but the plants are not killed. ;

(5) Calcium present in the leaves as raphides, antagonises the hydrogen ion concentration, however small the quantities may be, by escaping from the dead leaves which decay in the water. ;

SECTION VI.—DROUGHT RESISTANCE IN THE WATER-HYACINTH

By

P. Parija and B. K. Kar.

Water-hyacinth plant is capable of growing as a water as well as a land-plant. It is a common field observation that water-hyacinth survives in tanks from which all the water has dried up, and the soil is just moist to support plant life. Therefore, it was thought desirable to study how the plant adapts itself to this environment to tide over the period of drought during the summer season. With this end in view experiments were planned and performed to find out :—

- (i) The relation of water content of the soil to the survival of water-hyacinth.
 - (ii) The change in the osmotic pressure in the cells of water-hyacinth when it migrates from water to land and is subjected to gradual desiccation, and
 - (iii) The root development as water content of the soil decreases.
- (i) *The relation of water content of the soil to the survival of water-hyacinth.*

The relation of water content of the soil to the survival of water-hyacinth was found by allowing equal number of plants of the same age and growth to grow in earthen tubs of the same size. The same quantity of soil with similar texture and water holding capacity was used. The plants were allowed to grow in the tubs for twenty to thirty days so that the plants might adapt themselves fully and develop land roots. They were kept in the green house and irrigated daily with equal quantities of water. When they had fully established themselves into the ground, the tubs were brought out from the green house and kept under the sun. The experiments were done in the month of April when both the soil and the atmosphere were dry. The initial water content of the soil was found by boring out a certain weight of the soil from a definite depth from two or three places and allowing it to dry up in a hot air-oven at 80°C. The average value was taken. This gives the absolute water content of the soil. Then the plants were kept under conditions of drought, i.e., the daily water supply was cut off. A number of pots with water-hyacinth growing in them were experimented upon and arranged in series. After every three days of drought three pots were watered and water content of the soil and the osmotic strength of the cells of the stem were noted just before watering them. The number of plants surviving after watering were also noted as shown in the Tab' No. I.

TABLE NO. I.

(Showing relation of water content of the soil to the survival of water-hyacinth.)

Days of drought.	Water content absolute in % soil.	Relative water content in % saturation value.	% survival.
3 days	12.7%	39.9%	100%
6 days	9.4%	29.5%	100%
9 days	6.6%	20.75%	62%
12 days	1.8%	5.7%	25%

It is, therefore, seen that though the water-hyacinth is an aquatic plant, yet, when grown as a land plant, it can survive in very low water content of the soil—5.7 per cent. of the saturation value. The effect of drought is first felt by the transpiring leaves which begin to wilt from the farthest end of the veins or *vicinetia*. Hence it was thought desirable to find out the water content of the soil when the tips of the leaves begin to wilt. This would give the 'wilting co-efficient of the soil' which, according to Briggs and Shantz, means the moisture content of a soil, expressed as a percentage of its dry weight, at a time when the leaves of a plant growing in this soil shows the first signs of permanent wilting. This will give the minimum quantity of soil moisture available for the roots, from which absorption by the roots could take place. The average content of the soil when wilting sets in, in case of water-hyacinth is 80 per cent. of the dry weight. In terms of relative water content in percentage saturation, we find that the water-hyacinth plant shows signs of permanent wilting at 25.35 per cent. (Table No. II) of the saturation value. But even when the plants were subjected to drought amounting to 5.7 per cent. (Table No. I) of the saturation value, 25 per cent. of them were found to survive. It therefore shows that although the effect of drought is very early felt by the water-hyacinth plant it has a great capacity of resistance. This is further corroborated by the fact that osmotic strength of the cells of the stem increases to a great extent.

TABLE NO. II.

(Showing the percentage of water in the soil when water-hyacinth shows signs of permanent wilting.)

No. of obs.	Wt. of the soil.	Wt. of the air dried soil (kept in the sun).	Wt. contents in grms.	Percentage water content.	Relative water content in per cent. saturation value.
1	16.59 grms.	15.425 grms.	1.165 grms.	7.3%	22.9%
2	12.683 "	11.515 "	1.168 "	9.2%	28.99%
3	12.622 "	11.8 "	0.822 "	6.5%	20.4%
4	10.46 "	9.494 "	0.976 "	9.3%	29.2%
			Average .	8.0%	25.35%

(ii) *The change in the osmotic pressure of the cells of water-hyacinth.*

The osmotic concentration of the cells of the stem at different periods of drought was measured by contraction and expansion method, as the plasmolytic method was found unsuitable. By means of a sharp cork-borer, the core of the stem with portions of cortex all round it, was bored out in order to have equal diameter of discs of tissue in all the experiments. From this cylindrical core sections of equal thickness

were cut off and dipped in graded molar solutions. They were then measured by means of a fine divider, and plotted against concentration of the solution on a graph. By extrapolation where the curve cuts the abscissa-axis, the osmotic strength was found. When the values of osmotic strength were plotted against the number of days of drought we get a curve rising gradually (text-figure 5—not printed). This increase in the osmotic strength explains how the plant is able to absorb an adequate supply of water from the dry soil.

(iii) *The root development as water content of the soil decreases.*

Coupled with high osmotic strength the root development and the transpiring surface also are affected. The total length of the roots in the floating forms were found out. The root washing *in situ* was done in plants growing as land plants and under drought to find out the depth of the roots and the total length in order to compare the root development with the transpiring surface, the total area of the leaves was found by tracing the outline of the leaves on paper and measuring the area by means of a planimeter. It was found that the ratio of the total leaf area to that of the total length of the roots decreases from 5.6 to 2.5, under the conditions of drought.

The stem portion of the water-hyacinth plant, which is protected by leaf bases, resists the drought to a great extent on account of the presence of mucilage at the axils of the leaves. Life persists in the inner cone of the stem for a considerable period under drought, when to all outward appearance it seems dead. Slight traces of moisture would revive it to sprouting again.

SUMMARY.

Water-hyacinth is capable of growing as a land plant and resist a considerable degree of drought. It was found that—

- (a) Water-hyacinth can survive in a very low water content of the soil, i.e. 5.7 per cent. of the saturation value.
- (b) The osmotic strength of the cells in the stem of water-hyacinth increases as it migrates from water to land and is subjected to gradual desiccation. From about 6 atms. in floating plants it rises to about 17 atms. under drought.
- (c) The ratio of the total leaf area to that of the total length of the roots decreases from 5.6 to 2.5.

SECTION VII.—EFFECT OF POISONS ON WATER-HYACINTH.

This is not the first time that the effect of poisons on the water-hyacinth has been studied. Various authors have tried various poisons on the plant. Mr. Kenneth MacLean, tried a number of such poisons. Our object was to re-investigate this problem. With this end in view, water-hyacinth was grown in pots and solutions of inorganic poisons were added to the water. Of all the poisons tried, CuSO_4 and BaCl_2 seemed to produce the greatest effect.

On account of the cheapness of CuSO_4 ; a detailed investigation was undertaken of this salt. Solutions of various strengths were made up and water-hyacinth plants were put in them and effect noted. Various concentrations were tried on the water-hyacinth and *Pistia*, ranging from 0.006 per cent. to 0.024 per cent. It was found that a concentration of 0.018 per cent. or more killed the water-hyacinth while *Pistia* was killed even with a concentration of 0.006 per cent.

It was noted that the lower concentrations were not so effective as the higher ones, and repeated applications were necessary to produce lethal effect, while in comparatively stronger solution one dose was sufficient to produce the effect.

It was further noticed that when plants had been grown in sub-lethal concentrations for some time, they could tolerate higher concentrations better than plants which were put in these solutions for the first time. Thus the plants which had been growing 27 days in 0.006 per cent. solution of CuSO_4 , were not killed even if the concentration was raised 0.018 per cent. through 0.012 per cent., while plants grown in 0.018 per cent. CuSO_4 , directly die off.

Another interesting observation was that although most plants died off, occasionally one found in one or two pots a few plants surviving the application of CuSO_4 .

It was suspected that this survival might be due to antagonism of Calcium. The water-hyacinth plant has a large number of raphides in its cells, which are crystals of calcium oxalate. If one or two leaves decayed, they would liberate these crystals into the water and it was thought possible that the calcium was antagonising the action of copper and hence some plants were found surviving the application of CuSO_4 . This suspicion was confirmed by subsequent experiments, as described below.

Mr. B. N. Sinha conducted a set of experiments in which water-hyacinth plants were floated in glass jars containing 3,000 c.c.s. of water to which had been added CuSO_4 and various calcium salts as noted in the following table. There was a control in water alone.

TABLE.

Water-hyacinth plant No.	Chemicals mixed with 3000 c.c.s. of 0.05% solution of CuSO_4 .
1	None (control).
2	1.0 gr. calcium nitrate.
3	1.0 gr. " chloride.
4	1.0 gr. " carbonate.
5	1.0 gr. " phosphate.
6	1.0 gr. " fluoride.
7	1.0 gr. " Oxalate.
8	0.75 gr. " "
9	0.5 gr. " "
10	0.25 gr. " "

After 24 hours it was observed that No. 5, i.e., the plant which received CuSO_4 and calcium phosphate had suffered least and the plant No. 8, i.e., the one which received 0.05 per cent. CuSO_4 and 0.025 per cent. of calcium oxalate was the next best. Even after 48 hours No. 5 continued to be the best. This indicates that calcium phosphate antagonises copper sulphate to a greater extent than calcium oxalate. On the third day, however, the plant receiving calcium oxalate showed signs of poisoning as indicated by wilting and browning of leaves. This investigation is being continued further.

Observations recorded here seem to explain why spraying experiments have failed on a field scale. The reasons may be two-fold. Firstly, lethal concentration of the spraying fluid might not be reached and secondly, various antagonising salts might be present in the water which would nullify the effects of poisons applied.

While experimenting with CuSO_4 , it was noticed that the leaves showed signs of wilting and browning at the edges. That meant that either the absorption of water was adversely affected by the application of CuSO_4 or the transportation was favoured, in either case producing a negative water balance. In order to determine this, experiments were planned and Mr. S. M. Sircar carried them out to determine the effect of various concentrations of CuSO_4 on the absorption and transpiration of water-hyacinth. The apparatus used was a simple one as shown in the photograph below (not printed). Absorption was measured by the fall in level in the narrow limb and the transpiration by loss of weight of the whole system.

The results are shown in the adjoining graph (text-fig. 7—not printed). Although the question is still under investigation it is clear that absorption has a tendency to lag behind transpiration. That the roots of water plants are affected by CuSO_4 is corroborated from the study of the effect of CuSO_4 on *Pistia*. It will be described later that the roots fall off on treatment with CuSO_4 .

SUMMARY.

Copper sulphate was found to be the most effective poison against water-hyacinth, the minimum lethal dose being 0.018 per cent.

It was observed and experimentally verified that calcium salt antagonise CuSO_4 , calcium phosphate being more effective than calcium oxalate.

A preliminary study on the effect of CuSO_4 on the absorption and transpiration was made. It was found that on the application of CuSO_4 , the absorption lags behind transpiration. Further work on this is in hand.

SECTION VIII.—RELATIVE GROWTH RATE OF WATER-HYACINTH AND *PISTIA*.

It is a common field observation that tanks, which are cleared of water-hyacinth were soon filled with another pest, *Pistia stratiotes*. This fact was also reported to us by the district authorities who were in charge of cleaning the tanks. This led us to study the relative growth rate of the two pests.

In two tubs of area 353 sq. in. each 14 *Pistia* plants and 7 water-hyacinth plants were allowed to grow separately. The growth rate was measured in terms of their volumes, and percentage growth rate calculated on the initial value.

No. of days.	Percentage growth rate	
	Water-hyacinth.	<i>Pistia</i> .
1st day	100	100
4th day	20	25
8th day	30	40
12th day	80	64
16th day	100	75
20th day	200	125
24th day	220	200
28th day	260	225
32nd day	290	290
36th day	320	350
40th day	370	550
44th day	480	962
48th day	680	1,150

From the graph (text-fig. 5—not printed) it is seen that water-hyacinth doubles itself on the 16th day while *Pistia* doubles itself on the 13th day. Obviously growth rate of water-hyacinth is more rapid than *Pistia*. Later on the growth curve of *Pistia* rises more than that of water-hyacinth which is due to the production of a large number of plantlets by the mother plants in case of *Pistia*. Within 40 days *Pistia* plants have filled totally an area of 353 sq. inches and have produced 246 plants, while water-hyacinth could not fill the area and produced only 11 plants.

Pistia plants when fully developed do not reach more than six inches in height and perhaps the limited growth on this side is utilised in spreading. So when *Pistia* is allowed to grow separately, it spreads more quickly than water-hyacinth, but in nature water-hyacinth kills the *Pistia* plants by its luxuriant vegetable growth.

SECTION IX.—OTHER WATER WEEDS.

MONOCHORIA.

Of the weeds other than water-hyacinth, *Monochoria hastata*, *Pistia stratiotes* and *Salvinia cucullata* deserve notice. *Monochoria hastata* is a member of the family Pontederiaceae to which the water-hyacinth belongs. It is rather common and as Mr. Peck mentions in his book already referred to, it is sometimes mistaken for water-hyacinth. But as the plant is indigenous, it is not so troublesome nor does it spread so much as its cousin the water-hyacinth. We had the opportunity to study only the germination of seeds which agrees in all essentials with that of water-hyacinth. Text-figure 2 depicts seedlings in various stages of germination and shows the resemblance to the water-hyacinth in a remarkable degree.

Pistia.

(i) *Growth*.—This weed is also very common in ponds and other stretches of water in these parts. It is indigenous but it was ousted from many stretches of water by the water-hyacinth. When, however, the water-hyacinth was cleared, the tanks, etc., were soon filled with this weed. The spreading is so rapid that it caused suspicion in the minds of the executive officers who were engaged in clearing, as to the utility of the operations. We measured the relative rate of spreading of the water-hyacinth and *Pistia*. The details have been given in the previous section. It is found that although *Pistia* spreads more rapidly than the water-hyacinth being a dwarf floating plant, it does not cut off light from the water below so completely as a dense growth of water-hyacinth does.

(ii) *Seeds and germination*.—While experimenting with *Pistia*, it was thought desirable to find out the mode of propagation and perennation in this plant. Although this plant spreads like the water-hyacinth, mostly by vegetative means, it sets seeds quite freely in the cold weather (November and onwards). The seeds are heavier than water and when mature, they are discharged from the capsule and sink under water. Next spring or summer, when favourable conditions appear, the seeds germinate. The first stage of germination consists in the protrusion of a white spongy structure (cotyledon) through the micropyle. As soon as this reaches a certain stage (Text-figure 9—not printed) the seed floats up and later on, the hair-covered leaves come out and the plant establishes itself as a floating organism by producing roots. The germination of the seeds of this species agrees with that described by A. Engler for *P. Turpini*. The interesting point here is the floating of seedlings. This is altogether different from what has been described for the water-hyacinth.

As the seeds are fairly small and when the seedling floats, the testa is almost completely under water and the cotyledonary rim seems to support the seedling in its floating. It was thought that surface-tension might be playing an important part. If the assumption was correct, then kerosene oil or any other substance which would reduce the surface tension would tend to make the seedlings sink. With this idea, when kerosene was applied to tubs containing seedlings and adult plants, not only the seedlings sank, but the adult plants also suffered and ultimately died.

EFFECT OF POISONS ON *Pistia* AND *Salvinia*.

(i) *Kerosene*.—This led us to investigate the effect of kerosene on adult *Pistia* plants and also on *Salvinia* which also grows in close formation on the surface of tanks and pools. Both *Pistia* and *Salvinia* have one common feature, namely, the leaves are covered with hairs. The hairs help the plants in floating up if submerged, as they entangle a comparatively large quantity of air which increases the buoyancy of plants. They also prevent the wilting of the leaf-surfaces.

When *Pistia* or *Salvinia* formations are sprayed with kerosene its first effect is to wet the surface of the leaf and thereby cause the plants to sink under water.

Whatever may be the way in which kerosene works, the effect is that both *Pistia* and *Salvinia* die off if they come under the kerosene spray. The two photographs, one of the control area (Plate III, fig. 1—not printed) and the other of the experimental (Plate III, fig. 2—not printed) show the effect of kerosene on *Salvinia*. It will be seen that in the experimental area *Salvinia* has almost disappeared and only dead plants are floating, although before spraying the formation was as dense as the control area. Three sprays are most effective. The quantity of kerosene is 4 litres on an area of 400 sq. ft.

(ii) *Copper sulphate*.—While experimenting on the effect of copper sulphate on water-hyacinth, that poison was tried on *Pistia* as well. While the water-hyacinth requires 0.018 per cent. *Pistia* requires 0.012 per cent. only for lethal effect. Even 0.006 per cent. kills *Pistia*. Leaves show signs of wilting within 16 hours. In 48 hours roots fall off the plants (Plate III, fig. 4 et. fig. 3—not printed). The rosette of leaves then disintegrates and the plant dies. If the plants are transferred to fresh water after the roots have fallen off, they do not survive.

Salvinia is killed by the same concentrations as *Pistia*. The absorbing organ, which is morphologically a leaf, does not fall off nor do the leaves disintegrate immediately. They merely become black.

It may be mentioned here that the lethal concentration of CuSO_4 is also lethal to fish.

SECTION X.—GENERAL SUMMARY.

WATER-HYACINTH.

The seeds of water-hyacinth remain dormant at least for one season, i.e., from November to June, and retain their viability for several years.

The embryo is fully developed before the capsule bursts.

The dormancy is caused by the hard seed-coat which offers mechanical resistance and prevents the entry of oxygen into the seed. When the seed-coat gets loosened either by alternate wilting and drying or by chemical action, germination is facilitated by the entry of oxygen.

Stages in the germination are described.

The mechanism of the floating of submerged water-hyacinth seedlings already described, is confirmed.

The effect of H-ion concentration on the growth of water-hyacinth has been studied. There is an optimum range (6.0—8.0) of H-ion concentration in which water-hyacinth thrives. Any deviation from this range affects the growth adversely, large alteration resulting in the death of plants. Calcium salts probably antagonise the effect of H-ion concentration, and that is the reason why sometimes plants are not killed by changing the H-ion concentration.

Water-hyacinth is able to resist a considerable degree of drought and survives even when the water content of the soil falls as low as 5.7 per cent of the saturation value. The resistance is due to:—

- (a) change in the osmotic strength of the cells
- (b) decrease in the ratio of the total leaf area to the total root length, and
- (c) presence of mucilage in the leaf-base.

Effect of poisons, esp. CuSO_4 ; were investigated. The lethal dose of CuSO_4 was found to be 0.018 per cent.

Water-hyacinth plants growing in sub-lethal solution tolerate concentrations which are lethal to "uneducated" plants.

Application of CuSO_4 affects (i) roots and makes the absorption lag behind transpiration.

Calcium oxalate crystals escaping from disintegrating leaves antagonise the effect of CuSO_4 . Laboratory experiments lend support to this view. This is perhaps the explanation of failures of spraying experiments on a field scale.

OTHER WEEDS.

Pistia, which succeeds water-hyacinth in cleared tanks, was studied as regards its relative growth rate with water-hyacinth. Although the growth rate of *Pistia* was more or less similar to that of water-hyacinth, the former spreads on water surface more than the latter.

Germination of *Monochoria hastifolia*, a member of Pontederiaceae, was studied, and was found very similar to that of water-hyacinth.

Stages in the germination of *Pistia* seeds, are recorded. Seeds germinate under water and float up. Spraying with kerosene makes them sink.

Effect of CuSO_4 on *Pistia* was investigated. The lethal dose for this plant is much lower (0.006 per cent.) than that for water-hyacinth. On application of CuSO_4 the roots of *Pistia* fall off the plants and then the plants die.

Kerosene spray was tried on *Pistia* and *Salvinia* both of which are killed by it.

RESULTS OF PRACTICAL VALUE.

1. From field observations and experiments in the garden it was seen that the water-hyacinth sets seeds only in the autumn, i.e., in October and November. This fact is of great practical value. It has been the practice so far to search out seedlings during the early rains on account of the fear that the pest left undisturbed may be a source of danger. The weed really becomes a perennial source of danger when it produces and discharges seeds into the mud. As the difficulty of distinguishing seedlings from other weeds is great, the weed may be left undisturbed till the middle of the rains and then cleared as the plants can then be easily located. In consequence of this finding, now the executive officers have been asked to see that the tanks are cleared before the end of September.

2. The seeds lie dormant under water and mud for five years at least and do not germinate without access of oxygen. If the tanks do not dry up the seeds cannot get the necessary oxygen for germination. Thus seeds may be prevented from germinating by flooding tanks. Seeds on tank sides lie buried in mud and when a shower of rain exposes them, they germinate freely, and this process goes on from year to year as more and more seeds get exposed. It has been suggested that quick germination may be effected by ploughing up tank sides and thus free them of the water-hyacinth more quickly. But it is very doubtful if this will be of any practical value.

3. Experiments were carried on the effect of hydrogen-ion concentration. The conclusion drawn from the experiments is of considerable importance. There is an optimum concentration for growth of the plant. Any change to either side of the optimum checks the growth but does not kill the plants completely. If the concentration changes towards the optimum, as it is likely to do in nature the plants grow again. Occasional spraying, therefore, with suitable fluids is of no avail against the pest.

4. Experiments with copper sulphate proved most effective. A very low concentration (0.018 per cent.) proved injurious to the plants, but it was found that even in strong solutions all the plants were not killed. The reason was found to be the antagonism to CuSO_4 of calcium salts liberated by the decaying water-hyacinth plants. This explains why sprays have not been always successful. The lesson from this is that vigilance and mechanical clearing is still necessary even after poisoning the plants.

5. Investigations into the drought resistance of water-hyacinth settled on land showed that the plant has the capacity of producing long roots with the progress of drying of the mud on which it settles. The only effective method to deal with plants settled on the tank sides is to plough them up and expose the roots and thus destroy them.

It is a common experience in these parts that *Pistia* succeeds in most tanks cleared of water-hyacinth. Although it was found that *Pistia* does not cut off light so completely as a thick growth of water-hyacinth does, still a thick growth of *Pistia* is obnoxious.

Experiments both in the garden and the field showed that *Pistia* can be effectively cleared by spraying with kerosene or better with a mixture of kerosene and CuSO_4 . Sprayed with kerosene the plants spread, sink and rot while CuSO_4 (0.06 per cent.) makes the roots fall off, thus killing the plants.

6. The same methods can be used effectively against the Water-fern, *Salvinia*, which forms matted growth in shallow stretches of water in these parts.

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(PLATES NOT PRINTED.)

SECTION XII.—EXPLANATION OF PLATE I

(All the microphotographs in this and subsequent plates have been taken with "Brownie" Camera with the box-camera-adaptor devised by Mr. T. C. N. Singh to whom I am indebted.)

Fig. 1.—A ripe capsule, with perianth covering intact.

Fig. 2.—A ripe capsule dissected out: P=Perianth, covering; C=Capsule; S=Ripe seeds exposed.

Fig. 3.—Median longitudinal section of a ripe seed of water-hyacinth showing the fully developed embryo: R=Radicle; P=Plumule; V.S.=Vascular strand.

Figs. 4 and 5.—Transverse sections through the plumule region.

Fig. 6.—Longitudinal section of a seed through the micropylar region showing the opening of the micropyle and a portion of the tip of the embryo: M=Micropyle; E=Embryo.

Fig. 7.—Photomicrograph of the transverse section of a seed of water-hyacinth: E=Embryo; En=Endosperm; R=Ridges on the testa; L=Remnant of the dried flesh.

Fig. 8.—Water-hyacinth showing two bent spikes (B.S.) with fading flowers immersed in water, ready to discharge ripe seeds in the water from ripe capsules.

Fig. 9.—Water-hyacinth showing two erect spikes (E.S.), with flowers.

Fig. 10.—Portions of two specimen tubs containing water-hyacinth seeds germinated in water.

Fig. 11.—A photomicrograph of a germinating seed, illuminated by the opaque illuminator, showing the radicle growing out from a side: R=Radicle; S=Seed; A=Remnant of the attachment of the seed to the inner wall of the capsule.

EXPLANATION OF PLATE II.

(Germination of seeds in the laboratory.)

Fig. 1.—Earliest stage—showing the tip of the radical just protruding out through the micropyle.

Figs. 2 and 3.—Showing the cotyledon growing out carrying with it the radicle and the plumule.

Fig. 4.—The cotyledon has grown to its maximum limit. The hypocotyl is intercalated. The frill of transitory root-hairs are seen, through which the radicle-tip is protruding out. The first leaf is seen coming out on a side: S=Seed; C=Cotyledon; H=Hypocotyl; R=Root-hairs; R.T.=Radicle tip; F.L.=First leaf.

Fig. 5.—A later stage of fig. 4.

Fig. 6.—A seedling in a later stage from moist soil without any intercalation of the hypocotyl.

Fig. 7.—A photomicrograph showing the frill of root-hairs and the radicle growing out from the centre of the frill: R=Root-hairs; R.T.=Radicle-tip.

EXPLANATION OF PLATE III.

Fig. 1.—*Salvinia cuculate*: Showing luxuriance of vegetation in the control area.

Fig. 2.—*Ibid*: Shows the dead plants floating about in the experimental area sprayed with kerosene. The cleared stretch of water reflects the trees in the background.

Fig. 3.—*Ibid*: Control plants growing in ordinary tap-water.

Fig. 4.—*Ibid*: Experimental plants in CuSO_4 solution, at the end of 48 hours.

APPENDIX XLI-C.

NOTE DATED THE 25TH JANUARY, 1934, BY SECRETARY ON SUBJECT No. 35 (iii).—REPORT ON THE WORK DONE ON THE SCHEME OF RESEARCH ON THE EFFECT OF IONS ON THE GROWTH OF PLANTS BY DR. S. S. BHATNAGAR, DURING THE PERIOD FEBRUARY 1931 TO AUGUST 1933.

A report of the work done by Dr. S. S. Bhatnagar on the scheme of research on the effect of ions on plant growth, during the period February 1931—October 1932, was placed before the Advisory Board at its meeting held in February 1933, in connection with a proposal for the extension of his scheme from the 16th February 1933 to the 31st December 1933, *vide* pages 149-187 of the printed proceedings of the Board. Since then Dr. Bhatnagar applied for a further extension of his scheme up to the 31st May 1934, (which was sanctioned by the Governing Body at its meeting held in November 1933) and in that connection he submitted a full report on the work done by him on the scheme during the period February 1931 to August 1933. This report (Annexure) is now for the consideration of the Advisory Board.

2 The Vice-Chairman to the Council considers that it will be an advantage to have the report examined in the first instance by a Sub-Committee consisting of:—

1. The Vice-Chairman, Imperial Council of Agricultural Research (Chairman) *Ex-officio*.
2. The Agricultural Expert to the Imperial Council of Agricultural Research.
- 3-7. The Directors of Agriculture, Bombay, Bengal, Punjab, Bihar and Orissa and Assam.
8. The Director, Imperial Institute of Agricultural Research, Pusa.
9. Mr. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association, Assam.
10. Prof. J. C. Ghosh, Dacca University.
11. Prof. T. Ekambaram, Madras.
12. Dr. Nazir Ahmad, Director, Technological Laboratory, Matunga, Bombay.
13. Prof. P. K. Parija, Ravenshaw College, Cuttack.

The Secretary, Imperial Council of Agricultural Research (Secretary) *Ex-officio*.

This Sub-Committee will meet at 2-45 P.M. on the 22nd February 1934, in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi, and its report will be placed before the Advisory Board, in due course.

ANNEXURE.

A REPORT OF WORK ON THE "EFFECT OF IONS ON GROWTH OF PLANTS" CARRIED OUT AT THE UNIVERSITY CHEMICAL LABORATORIES, LAHORE, DURING FEBRUARY 1931—AUGUST 1933.

Investigations have been completed on peas, maize, jwar*, beans, barley, moth† and gram. The influence of about fifteen ions including uranium, thorium, manganese, zinc, cerium, copper have been studied. The results of experiments on plant growth in water culture and sand culture, on the germination of seeds and in some cases on their full growth in fields have been recorded. The results definitely establish the preferential activity of thorium, uranium, cerium, manganese and zinc and their accelerating influence on the plant growth, while some of the ions, especially of lead and silver showed an adverse effect. A large number of concentrations have been tried, an attempt is made to determine the most effective concentrations and the toxic limits in every case.

The growth of the plants in the culture solution has been measured by measuring the lengths of the plants and estimating the average total dry matter of the plant after a definite period. In some cases, when the size of the leaf has permitted, the increase in the leaf area has also been measured. Almost in every case the experiments in sand culture were carried out simultaneously with those in water cultures and as far as possible the observations in both these cases have been recorded simultaneously. The germination was studied by noting (1) the period of germination, (2) total dry matter of the plant after a few days of growth and (3) by photographing the roots of the growing plant periodically. It is significant that the seeds of several

* Andropogon Sorghum.

† Phaseolus Aconitifolies.

The vernacular names jwar and moth have been used for these plants in this report.

plants when soaked in dilute solutions of Ur, Th, Zn, Ce and Mn germinated more quickly and showed distinctly improved growth.

The field experiments have been conducted in four cases, viz., peas, maize, jawar and beans. The number of ions investigated in the fields had to be restricted on account of the limited number of plots available. The measurements in field experiments consisted in estimating average dry matter of the plant (stem only), total number of seeds obtained and in certain cases the nitrogen content of the seeds. The field experiments are however still in progress.

* The results of the investigations on each of the above-mentioned plants are described separately. One table for each is given showing details as to the number of plants estimated, various estimations which have been carried out, the effective ions and their influence at different concentrations, and the seasons and periods when the experiments were conducted. The observed changes in the plant growth are given. Reference to the details of experiments described in the previous reports which have been submitted to the Imperial Council are given wherever necessary.

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Experiments.	Seasons.	Ions and their limits of concentrations.	Total No. of plants investigated.	Measurements.
1. Culture solution	Oct. to Decr. 1931.	Thorium 0.1 per cent. to 0.00001 Uranium 0.1 per cent. to 0.00001 Cerium 0.1 per cent. to 0.0001 per cent. Zinc 0.1 per cent. to 0.001 per cent. Manganese 0.1 per cent. to 0.001 per cent. Copper 0.1 per cent. to 0.001 per cent.	180	Lengths and total dry matter.
2. Sand culture	Oct. to Decr. 1931.	Thorium 0.00065 gm. per sq. inch. Uranium 0.00005 gm. Cerium 0.0003 gm. Zinc 0.005 gm. Manganese 0.005 gm. Copper 0.005 gm.	260	Lengths and average total dry matter.
3. Germination.	Jan. to March 1933.	Uranium 0.2 to 0.0001 per cent. Thorium 0.1 to 0.00001 per cent. Copper 0.5 to 0.0001 per cent. Zinc 0.25 to 0.0001 per cent.	1,200	Lengths of stems, period of germination, total dry matter (stem and roots).
4. Field experiments.	Jan. to March 1932.	Uranium Thorium Copper Manganese.	141	Total dry matter, number of seeds.

Culture Solution.

The dry matter of more than 180 plants was estimated for investigating the influence of 6 ions in the culture solution. The composition of the culture solution as mentioned in the previous reports* was used. The increase in the dry matter to an extent of 23.0, 19.4, 97 and 8.0 per cent. was recorded in the presence of Th, Ur, Ce and Mn respectively, while a decrease of 13.2 per cent. in the case of copper sulphate was noted. The most effective concentrations for Th, Ur, Co and Mn were 0.00001 per cent., 0.00001 per cent., 0.0001 and 0.001 per cent. respectively. The average length of the plants and their average total dry matter are shown in Table I. The maximum variation in the individual plant whose means are calculated are shown in the last column. Thorium, uranium, cerium and manganese were also found to be effective in sand culture, the experiments for which were conducted simultaneously.

The following are the results of one set of experiments. The values given below are for average dry matter of the entire plant and the results for the most effective concentration alone are given :—

Thorium nitrate.	Uranium nitrate.	Cerium nitrate.	Manganese.
0.00001 gm.	0.00001 gm.	0.0001 gm.	0.001 gm.
14.2%	9.6%	10.1%	6.1%

* Report dated 2nd January 1933.

TABLE I.
Growth in Culture Solution.
 Season : November—December.

Ions.	Concentrations of salts.	No. of plants.	Length measurements (mean).						Max. variations in lengths.	Average dry weight after 38 days.	Max. variations in dry weights.	Observed change in dry weights.
			0	3rd day.	7th.	19th.	21st.	38th.				
	Per cent.								per cent.	gms.	per cent.	per cent.
Distilled water .	..	8	21.0	34.8	44.2	51.6	52.1	57.3	9.1	11.3	5.2	..
Thorium nitrate	0.00001	7	21.0	42.3	55.3	61.2	62.2	67.0	2.3	13.9	3.8	+23.0
Uranium nitrate	0.00001	9	21.0	40.1	48.9	69.5	60.5	65.7	5.6	13.5	4.9	+19.4
Cerium nitrate .	0.0001	10	21.0	38.3	47.1	55.4	56.8	61.1	3.4	12.4	3.7	+9.7
Zinc nitrate .	0.001	11	21.1	30.5	39.6	46.3	50.1	54.8	8.8	..	..	..
Manganese nitrate	0.001	13	21.1	29.1	38.7	44.2	50.6	58.1	7.1	12.2	2.7	+8.0
Copper nitrate .	0.001	10	21.0	27.6	36.4	41.1	48.7	55.1	5.1	9.8	4.4	-13.2

Field Experiments.

The field experiments were performed for uranium, thorium, cerium, copper, manganese and zinc. The construction of the plots and their arrangement is described in a previous report*. The results of these experiments are summarised in the following table:—

TABLE II.

Salts.	Quantity.	No. of plants.	Increase in dry weight.	Number of seeds.	
				Blank.	Ions.
	gms.		per cent.		
Uranium nitrate	0·0001	60	+9·0	803	857
Thorium nitrate	0·0001	58	+14·4	810	788
Cerium nitrate	0·002	60	+8·2	883	886
Copper nitrate	0·100	60	—14·1	703	783
Manganese nitrate	0·001	60	+6·14	732	614
Zinc nitrate	0·004	56	—7·3	720	640

Germination.

Two series of experiments were conducted (1) by adding the necessary quantities of the salts in the pots and comparing the germination and (2) by soaking seeds in dilute solutions of these salts for about 12 hours before sowing and comparing the germination with those soaked in distilled water.

A large number of concentrations of the salts varying from 0·01 per cent. to 0·00001 per cent. have been tried and the results obtained in the case of most effective ions alone are shown in the table below:—

Salts.	Concentra- tions.	No. of plants.	Increase.	
			Dry weight.	Lengths.
	per cent.		per cent.	per cent.
Uranium nitrate	0·0001	35	+21·5	+4·7
Thorium nitrate	0·00001	35	+18·1	+14·7
Copper sulphate	0·0001	33	—10·2	—7·0
Zinc nitrate	0·0005	30	+20·0	..

A complete list containing details of the experiments on the germination is shown in Tables III to X. The tables include increase in lengths and in total dry matter, max. variations in individual plants, total change recorded and the periods before germination commenced.

TABLE III.
Season: November—December.
Set A (Soaked Seeds).

Uranium Nitrate.

Concentration of the solutions.	Total number of seeds.	Number of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 12th day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	35	32	cms. 8.6	gms. 5.11	per cent. 2.3	per cent. ..	All germinated on 4th day.
0.20 per cent.	35	35	6.1	3.4	4.17	-33.7	A few appeared on 4th day but mainly on the 5th.
0.11 per cent.	35	31	7.3	3.6	5.2	-20.4	A few appeared on 4th day but mainly on the 5th.
0.01 per cent.	35	34	6.6	4.2	4.6	-17.6	All germinated on 4th day.
0.001 per cent.	35	33	8.3	5.8	3.8	+13.7	All germinated on 4th day.
0.0005 per cent.	35	32	8.8	6.1	4.1	+19.6	Some appeared on the 3rd day.
0.0001 per cent.	35	35	9.0	6.2	3.7	+17.7	Some appeared complete on 4th day.

TABLE IV.
Season: November—December.
Set B (Unsoaked Seeds).
5 c. c. solution added to each pot.

Uranium Nitrate.

Concentrations of the solutions added.	Total number of seeds sown.	Number of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 21st day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	30	28	cms. 8.0	gms. 5.32	per cent. 4.1	per cent. ..	All germinated on 5th day.
0.1 per cent.	30	29	7.7	4.78	3.9	-10.2	All germinated on 4th day.
0.001 per cent.	30	27	8.6	5.11	5.0	-3.9	All germinated on 4th day.
0.0001 per cent.	30	30	8.4	5.80	3.6	+9.0	All germinated on 4th day.
0.0005 per cent.	30	29	8.1	5.50	3.9	+3.4	All germinated on 4th day; some appeared on the 5th day.

TABLE V.

*Season: January—February.**Season: January—February.*

Thorium Nitrate.

Concentrations of the solutions.	Total No. of seeds sown.	No. of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 21st day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
			cms.	gms.	per cent.	per cent.	
Distilled water	35	32	9.3	6.61	2.6	..	All appeared on 4th day; complete on 6th.
0.1 per cent.	35	31	7.3	..	..	..	Very delayed; commenced on 4th, complete on 7th day.
0.1 per cent. (Th. chloride).	35	32	8.0	5.2	3.4	-21.2	All germinated between 3rd and 5th day.
0.01 per cent. (Th. nitrate).	35	34	8.3	5.1	4.2	-22.7	All germinated between 3rd and 5th day.
0.0001 per cent.	35	31	10.1	7.1	4.6	+7.2	Distinctly heal—their growth than in control.
0.0005 per cent.	35	35	10.4	7.4	4.1	+12.1	All germinated on 3rd and 4th day.
0.00001 per cent.	35	33	11.3	7.8	3.1	+18.1	All germinated on 3rd and 4th day.

TABLE VI.

Season: January-February.

Set B (Unsoaked Seeds).

5 c. c. solution added to each pot.

Thorium Nitrate.

Concentrations of the solutions.	Total No. of seeds sown.	Number of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 21st day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	35	32	cms. 9.8	gms. 6.21	per cent. 2.6	per cent. ...	All appeared on 4th day; complete on 6th.
0.01 per cent.	35	30	5.3	4.26	5.4	-31.4	Few appeared on 5th day; mostly on 6th and 7th day.
0.001 per cent.	35	33	5.0	4.08	4.2	-34.3	All appeared on 5th and 6th day.
0.001 per cent.	35	31	8.3	5.10	4.6	-17.9	All appeared on 5th and 6th day.
0.0001 per cent.	35	34	8.1	5.21	3.7	-16.0	All appeared on 4th day.

TABLE VII.

Season: March.

Set A (Soaked Seeds).

Zinc Nitrate.

Concentrations of the solutions.	Total No. of seeds sown.	Number of plants whose mean is taken.	Average length on 13th day.	Average dry weight on 23rd day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	30	27	cms. 8.2	gms. 6.04	per cent. 2.7	per cent. ..	All appeared on 4th and 5th day.
0.2 per cent.	30	24	6.4	5.11	3.2	-15.5	All appeared on 4th day; complete on 6th.
0.05 per cent.	30	26	6.6	4.78	4.1	-21.0	All appeared on 4th day; complete on 6th.
0.0001 per cent.	30	28	7.9	6.16	3.7	+20.0	All germinated on 4th and 5th day.
0.0001 per cent.	30	25	8.2	5.14	4.6	-15.0	All germinated on 4th and 5th day.

TABLE VIII.

Season: March.

Set B (Unsoaked Seeds).

5 c. c. solution added to each pot.

Zinc Nitrate₄

Concentrations of the salt added.	Total No. of seeds sown.	Number of plants whose mean is taken.	Average length on 13th day.	Average dry weight on 23rd day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
			cms.	Gms.	per cent.	per cent.	
Distilled water	24	21	9.1	5.01	4.4	..	All germinated on 4th day; few appearing on 5th day.
2.0 per cent.	24	20	6.7	3.8	3.1	-24.0	Mostly appeared on 5th day; complete on 6th day.
1.0 per cent.	24	19	7.1	4.1	2.4	-18.1	Mostly appeared on 5th day; complete on 6th day.
0.1 per cent.	24	21	7.8	4.67	3.3	-8.3	All germinated on 4th and 5th day, a few appearing on 6th.
0.0001 per cent.	24	22	8.8	4.67	3.4	-6.8	All germinated on 4th and 5th day.
0.0001 per cent.	24	20	8.3	5.2	2.1	+4.0	All germinated on 4th and 5th day.

TABLE IX.

Season: January.

Set A (Soaked Seeds).

Copper Sulphate.

Concentrations of salts.	Total No. of seeds sown.	Number of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 21st day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	36	34	cms. 9.2	gms. 6.81	per cent. 3.1	per cent. ..	Germinated on the 4th day.
0.5 per cent.	36	23	7.8	..	..	..	Germinated on the 4th day.
0.1 per cent.	36	29	8.4	..	..	..	All germinated on 4th and 5th day.
0.001 per cent.	36	33	8.7	5.94	4.6	-12.7	All germinated on 4th and 5th day.
0.0001 per cent.	36	32	8.6	5.7	5.1	-16.1	All germinated on 4th and 5th day.

TABLE X.

Season: January.

Set B (Unsoaked Seeds).

Copper Sulphate.

Concentrations of solutions.	Total No. of seeds sown.	Number of plants whose mean is taken.	Average length on 12th day.	Average dry weight on 31st day.	Max. variations in dry weights.	Observed change in dry weights.	Condition of germination.
Distilled water	36	33	cms. 8.8	gms. 6.40	per cent. 3.8	per cent. ..	Germination commenced on 3rd day, complete on 4th day.
0.5 per cent.	36	29	5.31	..	..	..	Very irregular and delayed.
0.5 per cent.	36	31	5.42	..	..	..	Irregular and delayed.
0.1 per cent.	36	39	5.8	4.82	4.2	-25.0	Commenced on 3rd day; completed on 5th day.
0.01 per cent.	36	34	6.4	5.16	5.2	-19.3	Commenced on 3rd day, completed on 5th day.
0.0001 per cent.	36	32	6.28	5.31	4.9	-17.0	Complete germination on 4th day.

MAIZE.

Experiments.	Season.	Ions and their concentrations.	Total No. of plants.	Measurements taken.
1. Culture solution	June—July 1932.	Ur, Th, Cu, Ce, Ag, Pb, Mn from 0.5 per cent. to 0.00001 per cent.	730	Lengths and total dry matter.
2. Field Experiments.	April—July 1932.	Ur, Th, Ce (0.00005 gm. nitrate per sq. ft.).	100	Dry matter of plants and number of seeds.
3. Germination .	April—May 1933.	Thorium 0.1—0.0001 per cent. Uranium 0.1—0.00001 per cent. Cerium 0.1—0.0005 per cent. Zinc 0.1—0.0001 per cent.	800	Lengths of plants and dry matter of the plant after days.

Culture Solution.

About 735 plants were investigated in culture solution. Thorium and uranium nitrates showed an increase of 14.0 per cent. and 11.2 per cent. respectively in the total dry matter of the plant as obtained after 33 days. The concentrations at which these maximum increments were recorded were 0.0001 per cent. and 0.0002 per cent. respectively. Copper, lead and silver at 0.0002 per cent., 0.001 per cent. and 0.0001 per cent. (nitrates) showed depressions of 8.9 per cent., 16.8 per cent. and 22.4 per cent. in the dry matter. Manganese showed no effect. Table XI includes the measurements in total lengths and their dry weights for a period of 33 days. About four different concentrations varying from 0.5 to 0.0001 per cent. were used for every ion and the results for the most effective concentrations are shown in the table below.

TABLE XI.
Maize—Growth in Culture Solution.

Season: June—July.

Ions.	Concentration of the soln.	No. of plants.	Lengths.				Change in total length.	Av. dry weight after 33 days.	Max. variations in dry wts. of plants.	Change observed.	
			3 days.	11 days.	21 days.	33 days.					
	per cent.						per cent.	gms.	per cent.	per cent.	
Blank . . . . .	..	21	6.81	7.7	11.2	16.5	22.6	7.4	17.6	4.3	..
Uranium nitrate	0.0002	19	6.78	10.7	15.6	20.0	24.8	6.3	19.7	3.1	+11.9
Thorium nitrate	0.0001	20	6.86	9.6	13.0	20.8	..	5.3	20.1	2.6	+14.2
Copper sulphate	0.0002	17	6.75	7.9	11.8	17.1	21.7	5.8	15.0	3.7	-14.8
Silver nitrate	0.0001	20	6.83	8.1	10.6	14.4	18.3	6.7	13.6	4.0	-22.7
Lead nitrate	0.001	18	6.8	7.3	10.6	11.5	16.0	5.0	14.5	3.0	-17.6

Field Experiments.

The influence of Ur, Th and Ce was investigated in the fields. Seeds were graded from 0.234 to 0.228 gm. Twenty seeds were sown in each plot at measured distances and at equal depths from the surfaces. The plots were arranged as shown in the diagram below.

1	2	3	4	5	6
	Ur		Blank		
12	11	10	9	8	7
	Blank		Ce		Blank

The plants were watered with 5 litres water in each plot twice every day. An increase of 9.2 per cent. and 7.6 per cent., in the average dry weight of the plants was recorded from the plots containing uranium and thorium nitrate. A slight decrease, 2.4 per cent., was noticed in the plot containing cerium. The increase in the total dry matter on the addition of thorium and uranium was also accompanied by an increase in the nitrogen content of the seeds. The increase in growth of the plants as determined by the increase in their dry weights together with details of field experiments are shown in Table XII.

TABLE XII.

No. of Plot.	No. of seeds sown.	No. of plants at the time of reaping.	Average dry weights.	Total No. of seeds obtained.	Increase in dry weights.
			gms.		per cent.
Uranium	20	18	17.909	310	+9.2
Blank	20	18	16.4	280	..
Thorium	20	14	19.045	226	+7.6
Blank	20	14	17.701	267	..
Cerium	20	19	15.8	297	..
Blank	20	19	16.2	322	-2.4

Germination.

The plants obtained on soaking the seeds in solutions of uranium and thorium nitrates (at 0.0001 per cent.) showed lengthening of roots and an increase in dry matter of the plants as follows:—

Thorium.	Uranium.	Cerium.	Zinc chloride.
22.0 per cent.	19.0 per cent.	0.0005	0.00001
		9.0 per cent.	3.02 per cent.

The details of the measurements for each of these ions are shown in Tables XIII to XVI.

TABLE XIII.

Season—April 1933.

Thorium Nitrate			Soaked seeds.			
Concentration of salt solutions.	No. of seeds sown.	No. of plants whose mean is taken.	Average length of the plant.	Average dry weight of the plant.	Maximum variations in the plants.	Observed change.
			cms.	gms.	per cent.	per cent.
Distilled water .	40	38	11.7	7.2	4.0	-15.1
0.1 per cent. .	40	33	8.2	6.11	6.2	-15.1
0.01 per cent. .	40	35	7.7	6.8	5.8	-5.5
0.005 per cent. .	40	31	12.1	8.06	7.2	+11.9
0.0001 per cent.	40	38	11.9	8.78	4.8	+21.9
0.00005 per cent.	40	40	10.7	7.08	4.65	..
0.00001 per cent.	40	37	12.05	6.2	5.33	+ 4.0

TABLE XIV.

W. Uranium Nitrate.			Soaked seeds.			
Concentration of salt solutions.	No. of seeds sown.	No. of plants whose mean is taken.	Average length of the plant.	Average dry weight of the plant.	Maximum variations in the plants.	Observed change.
			cms.	gms.	per cent.	per cent.
Distilled water .	35	32	12.2	7.91	7.3	..
0.1 per cent. .	35	31	11.1	7.11	6.1	-10.1
0.01 per cent. .	35	30	10.9	7.03	4.3	-11.1
0.005 per cent. .	35	33	12.1	7.58	5.1	-4.1
0.0001 per cent.	35	30	13.1	9.41	2.1	+19.0.
0.00001 per cent.	35	34	12.8	9.1	6.4	+15.0

TABLE XV.

W. Cerium Nitrate.			Soaked seeds.			
Concentration of salt solutions.	No. of seeds sown.	No. of plants whose mean is taken.	Average length of the plant.	Average dry weight of the plant.	Maximum variations in the plants.	Observed change.
			cms.	gms.	per cent.	per cent.
Distilled water .	35	33	10.8	7.1	4.3	..
0.1 per cent. .	35	31	9.4	6.6	4.1	-7.04
0.05 per cent. .	35	31	9.11	7.2	6.2	+2.25
0.01 per cent. .	35	34	10.6	7.00	6.1	-1.4
0.001 per cent. .	35	35	11.4	7.38	4.4	+3.9
0.0005 per cent.	35	33	11.2	7.74	6.9	+9.0

TABLE XVI.

Season—April 1933.

Zinc Nitrate.						Soaked seeds.
Concentration of salt solutions.	No. of seeds sown.	No. of plants whose mean is taken.	Average length of the plant.	Average dry weight of the plant.	Maximum variations in the plants.	Observed change.
Distilled water .	40	38	cms. 11.4	gms. 7.6	per cent. 3.1	per cent. ..
0.1 per cent. .	40	40	11.0	7.4	5.2	-2.6
0.005 per cent.	40	35	11.54	7.82	6.1	+2.9
0.0001 per cent.	40	36	11.9	7.79	4.1	+2.5
0.00001 per cent.	40	37	11.7	7.83	3.4	+3.02

BEANS.

Experiments.	Season.	No. of plants.	Ions and their concentrations.	Measurements.
1. Culture solution	Feb.—April	250	Zinc 0.1 per cent. to 0.0001 per cent. Manganese 0.01 per cent. to 0.0001 per cent. Uranium 0.2 per cent. to 0.00001 per cent. Titanium. 0.1 per cent. to 0.00001 per cent.	Length, dry matter and leaf area.
2. Sand culture .	Do.	116	Thorium 0.00001 gm. per sq. inch Uranium 0.00001 gm. per sq. inch. Zinc 0.0001 gm. per sq. inch. Manganese 0.0001 gm. per sq. inch. Ti 0.0001 gm. per sq. inch.	Length and dry matter.
3. Field experiments.	March—Aug.	180	Th—0.0001 per sq. ft. Ur—0.0001 per sq. ft. Mn—0.0001 per sq. ft.	Dry matter, number of seeds and N content of seeds.
4. Germination .	Aug.—Sept.	787	Th—0.2 gm. to 0.0001 gm. Ur—0.1 gm. to 0.0001 gm. Zn—0.1 gm. to 0.0001 gm. Ti—0.1 gm. to 0.0001 gm.	Photographs of roots, total dry matter, lengths and leaf area.

Culture Solutions.

The influence of Th, Ur, Zn, Mn and Ti was investigated in culture solution and about 50 plants were examined for each. The maximum increase in total dry matter of the plants at concentrations of 0.00001 per cent, 0.0001 per cent, and 0.0001 per cent, of the Th, Ur and Mn was 18 per cent., 21.6 per cent, and 7.6 per cent, respectively. The corresponding increase in leaf area amounted to 9.5 per cent., 5.8 per cent 7.1 per cent. The addition of manganese or titanium did not show any appreciable change though concentrations varying from 0.00001 per cent, to 0.001 per cent, were tried. The addition of titanium chloride above 0.001 per cent, caused the development of yellow spots on the leaves and diminution in leaf area. Table XVII includes details of measurements on lengths, total dry matter and leaf area.

Sand Culture.

Average increase in the total dry matter on the addition of 0.001 per cent gm. Ur and 0.00001 gm. Th, in the pots was 16 per cent, and 13 per cent respectively; a corresponding increase in the leaf area of 4 per cent, and 3.17 per cent, was also measured.

TABLE XVII.

Culture Solution.

Season : February to April.

Ions.	Concen- trations.	No. of plants investi- gated.	Increase in leaf area after 41 days.	Difference in leaf area on account of ions.	Total length after 2½ days.	Change in length.	Dry weights after 41 days.	Change in dry weight.
	per cent.		sq. cm.	per cent.	cms.	per cent.	ms.	per cent.
Distilled water .	...	13	4.23	...	62.3	...	13.4	...
Thorium nitrate	0.00001	11	4.673	9.3	68.6	+10.08	15.81	+18.0
Uranium nitrate	0.00001	13	4.523	5.8	70.3	+12.3	16.3	+21.6
Titanium chlo- ride.	0.0005	12	4.2485	1.6	57.6	-7.52	12.9	-3.2
Zinc chloride .	0.0005	14	4.4255	3.4	60.3	-2.4	13.9	+4.3
Manganese nit- rate.	0.0001	11	4.5833	7.1	66.5	+6.7	14.4	+7.6

Field Experiments.

The field experiments were conducted for thorium nitrate, uranium nitrate and manganese nitrate. An increase of 16.6 per cent, in the average dry matter of the plants in the plot containing thorium nitrate was observed. Number of seeds obtained and the average nitrogen content of the seeds are shown in the table below.

TABLE XVIII.

Ions.	Change observed in the dry matter (av. for plants) in one plot.	No. of seeds obtained.	Average N con- tent of seeds.
	per cent.		
Thorium nitrate	+16.6	968	0.034 gm. per seed.
Uranium nitrate	+4.1	1878	0.032 gm. per seed.
Manganese nitrate	-6.3	593	0.040 gm. per seed.
Blank . . . . .	..	893	0.030 gm. per seed.

Germination.

The experiments on germination were conducted in August and September, 1933. Influence of thorium, uranium, zinc chloride and titanium chloride was investigated. The observations on the leaf area, total dry matter of the plant of the length are shown in Tables XIX to XXII.

TABLE XIX.

Thorium Nitrate.

Concentration of the salts.	No. of seeds sown.	No. of plants whose mean is taken.	Average length on 10th day.	Change in length.	Increase in leaf area after 15 days.	Change in leaf area.	Average dry weight after 15 days.	Change in average dry matter.
			cms.	per cent.	sq. cm.		gms.	per cent.
Distilled water	30	29	13.9	...	2.555	...	7.3	...
0.2 per cent.	30	26	11.8	-15.1	...	...	4.9	-32.9
0.1 per cent.	30	27	11.8	-18.7	...	...	5.8	-20.5
0.008 per cent.	30	30	12.6	-8.6	2.356	-7.8	6.4	-12.8
0.0001 per cent.	30	24	13.1	-5.7	2.639	+3.3	7.9	+8.2

TABLE XX.
Uranium Nitrate.

Concentration of the salts.	No. of seeds sown.	No. of plants whose mean is taken.	Average length on 10th day.		Increase in leaf area after 15 days.		Change in leaf area.		Average Change in dry weight after 15 days.		Max. variations in dry weights.
			oms.	per cent.	sq. cm.	per cent.	gms.	per cent.			
Distilled water	30	25	13.1	..	2.335	..	7.5	..	3.6		
0.1 per cent.	30	27	12.8	-2.29	2.274	-2.6	6.8	-9.3	5.1		
0.05 per cent.	30	30	12.4	-5.3	2.230	-4.0	6.5	-13.3	4.7		
0.0001 per cent.	30	29	13.6	+3.8	2.384	+2.1	7.9	+5.3	2.8		

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TABLE XXI.
Zinc Chloride.

Distilled water	30	26	13.6	..	1.960	..	6.85	..	6.1
0.1 per cent.	30	28	13.0	-4.4	6.10	-10.9	5.6
0.05 per cent.	30	28	13.3	-2.2	2.082	+6.2	7.30	+6.5	4.3
0.001 per cent.	30	29	13.8	..	2.015	+2.8	7.20	+5.1	3.1
0.0001 per cent.	30	26	13.8	..	1.911	..	6.966	+1.7	4.8

TABLE XXII.
Titanium Chloride.

Concentration of the salts.	No. of seeds sown.	No. of plants whose mean is taken.	Average length on 10th day.		Increase in leaf area after 15 days.		Change in leaf area.		Average dry weight after 15 days.		Change in average dry matter.		Max. variation in dry weights.
			cm.	per cent.	sq.	cm.	per cent.	gms.	per cent.	per cent.			
Distilled water	30	26	13.0	..	2.131	..	6.6	..	2.7				
0.1 per cent.	30	27	12.4	-4.6	1.894	-11.1	6.0	-9.0	3.4				
0.05 per cent.	30	29	11.8	-9.2	2.007	-5.8	5.8	-12.1	5.8				
0.001 per cent.	30	30	13.2	..	2.001	-6.1	6.1	-7.5	6.1				
0.0001 per cent.	30	28	12.6	..	1.973	-7.9	6.3	-4.5	5.9				

JWAR.

Experiments.	Season.	No. of plants.	Ions (with concentrations).	Measurements.
1. Culture solution	May to June 1932.	180	Th, Ni, Co, Ur, Ce, Zn, Cu, Mn, Pb, Sr, Ca. 0.0001 per cent.	Lengths only.
2. Sand culture	May to June 1932.	180	Th, Ur, Ce, Ni, Co, Zn, Cu, Mn, Al, Sr, Ca. } 0.0002 gm. per sq. ft. } } 0.0002 gm. per sq. ft. }	Ditto.
3. Field experiments.	March to June 1933.	100 (in 5 plots).	Th, 0.0005 sq. ft. Ur, 0.0005 sq. ft. Mn, 0.001 sq. ft.	Dry matter and nitrogen content of the seeds.
4. Germination	April 1933	960	Th, Ur, Zn, Mn 0.1 per cent. to 0.0001 per cent.	Lengths of the plants, dry matter and photographs showing roots.

Culture Solution.

The growth in culture solution was measured by measuring the total lengths of the plants after definite periods of their growth. An increase in length of 8.7 per cent. and 11.8 per cent. was observed in the bottles containing 0.0001 per cent. thorium or uranium nitrate. The length measurements and the total percentage increase for these ions are shown in Table XXIII.

Increased growth in sand culture was also observed on the addition of thorium, uranium and zinc while copper showed a distinctly depressing effect (Report dated February 1392, pages 12 and 13).

TABLE XXIII.

Season: August—September 1931.

Plant—Jwar in water culture.

Ions.	10th Aug.	15th Aug.	21st Aug.	23rd Aug.	28th Aug.	1st Sept.	15th Sept.	Change in lengths.
Blank	2.32	3.10	3.71	4.75	5.25	7.55	11.94	per cent. ..
Thorium	2.35	3.16	4.00	5.45	6.86	9.32	12.86	+8.7
Uranium	2.75	3.00	4.35	5.95	6.45	9.55	13.35	+11.0
Cerium	2.50	2.85	4.25	5.26	6.51	6.75	12.35	+3.4
Zinc	2.65	2.90	3.75	4.62	5.26	7.65	12.12	+1.58
Copper	2.55	2.75	3.75	4.81	5.4	7.41	11.66	-2.3
Manganese	2.31	2.81	3.58	4.92	5.50	7.40	11.75	-1.6
Nickel	2.30	2.75	3.55	4.40	5.81	7.46	11.85	..
Cobalt	2.25	2.90	3.65	3.95	5.85	7.82	11.93	..
Blank	2.30	2.92	3.75	4.05	5.35	7.42	11.90	..

Field Experiments.

Jwar was sown in plots containing uranium, thorium and manganese. An increase of 4.6 per cent., 7.1 per cent. in the average dry matter of the plants for uranium and thorium was observed while the dry weight in the presence of manganese diminished by about -8.3 per cent. The concentrations of the ions and the average weights of the plants are shown in the table below.

TABLE XXIV.

Ions.	No. of seeds sown.	No. of plants at the time of reaping.	Average dry weights.	Change in average dry weights.		Nitrogen content of seeds.
				gms. per cent.	gm.	
Uranium nitrate . . .	20	13	10.088	+4.6	0.0083	
Blank	20	18	9.71	..	0.0071	
Thorium nitrate . . .	20	1	10.038	+7.1	0.0098	
Blank	20	16	9.304	..	0.0096	
Manganese nitrate . . .	20	17	8.7	-8.3	0.0061	
Blank	20	17	9.9	..	0.0080	

Germination.

The influence of uranium nitrate, thorium nitrate, zinc chloride and manganese nitrate was investigated. Almost 25 to 30 plants were tried for every concentration. The length measurements and the changes in the average dry weights of the plants are shown in the Tables XXV to XXVIII.

TABLE XXV.

Thorium Nitrate.

Concentration of solutions.	Total No. of seeds sown.	No. of plants whose mean is taken.	Average length.	Average dry weight variations in dry wts.		Change obsvd.
				cms.	gms. per cent.	
Distilled water . . .	25	22	4.6	7.801	4.1	..
0.1 per cent.	25	19	3.8	7.238	7.1	-7.2
0.05 per cent.	25	22	4.0	7.0902	2.3	-9.1
0.01 per cent.	25	21	3.7	7.636	4.6	-2.1
0.001 per cent.	25	23	4.0	7.600	3.8	-2.5
0.0001 per cent.	25	22	4.5	7.988	4.0	+2.4

TABLE XXVI.

Uranium Nitrate.

Concentration of solutions.	Total No. of seeds sown.	No. of plants whose mean is taken.	Average length.	Average dry weight on 48th day.	Max. variations in dry wts.	Change obsvd.
			cms.	gms.	per cent.	per cent.
Distilled water .	24	20	5.0	7.310	5.1	..
0.1 per cent. .	24	22	4.1	7.037	4.3	-3.7
0.05 per cent. .	24	18	4.0	7.0737	2.9	-3.2
0.001 per cent. .	24	19	3.8	7.311	3.6	..
0.00001 per cent.	24	21	4.9	7.558	6.1	+3.4

TABLE XXVII.

Zinc Chloride.

Concentration of solutions.	Total No. of seeds sown.	No. of plants whose mean is taken.	Average length.	Average dry weight on 48th day.	Max. variations in dry wts.	Change in dry weights.
			cms.	gms.	per cent.	per cent.
Distilled water .	28	22	4.4	7.101	5.1	..
0.2 per cent. .	28	24	3.1	6.305	6.1	-11.2
0.1 per cent. .	28	26	4.1	6.525	4.0	-8.1
0.001 per cent. .	28	23	4.8	7.227	3.1	+1.7
0.0001 per cent. .	28	21	5.2	7.284	2.9	+2.5

TABLE XXVIII.

Manganese Nitrate.

Concentration of solutions.	Total No. of seeds sown.	No. of plants whose mean is taken.	Average length.	Average dry weight on 48th day.	Max. variations in dry wts.	Change in dry weights.
			cms.	gms.	per cent.	per cent.
Distilled water .	20	18	4.8	8.00	3.6	..
0.1 per cent. .	20	17	4.1	7.392	2.6	-7.6
0.001 per cent. .	20	20	5.1	8.384	3.1	+4.8
0.0001 per cent. .	20	19	5.3	8.311	4.3	+3.9

BARLEY.

Experiments.	Season.	No. of plants.	Ions.	Measurements.
Water culture	Nov. to Decr. 1931.	40	Th, Ur, Ce, Zn, Mn, Ni, Co, Ag, Pb 0.0001 per cent.	Lengths.
Water culture	Oct. to Decr. 1932.	130	Th, Ur, Ce, Zn, Ni, Co, Ag, Pb.	Lengths, total dry matter.
Sand culture	Oct. to Decr. 1932.	50	Th, Ur, Mn.	Dry matter.

Results of a preliminary experiment in culture solution were submitted to the Imperial Council (Report dated February 1932). Length measurements alone were recorded and an increase in length for 0.0001 per cent. Th, Ur and Ce was observed. Depressed growth was noted on the addition of lead even at as low a concentration as 0.0001 per cent. $PbNO_3$. The presence of silver causes a very early decay of the plants.

Another series of experiments were conducted in the same season next year. More than 130 plants were investigated and the lengths as well as the total dry matter of the plants was estimated. Increased growth amounting to 14.0 per cent., 17.4 per cent and 10.2 per cent. (total dry matter) for Ur, Th and Zn respectively were recorded while lead and silver showed depression to an extent of -8.0 per cent. and -13.0 per cent respectively. The concentrations of Ur, Th and Zn in the above solutions were 0.001 per cent., 0.0001 per cent., and 0.0005 per cent., respectively. The results of the experiments in culture solution for the effective ions are shown in Table XXIX.

TABLE XXIX.

*Barley.**Culture Solution.*

Ions.	Concentration.	No. of plants.	Total length after 43 days.	Average dry weight after 42 days.	Change in dry weight.	Max. variations in dry weights.
	per cent.		cms.	gms.	per cent.	per cent.
Control	..	13	28.6	8.321	..	6.0
Uranium	0.001	11	25.3	9.494	+14.1	7.1
Thorium	0.0001	14	39.1	9.789	+17.4	5.3
Zinc	0.0005	14	27.6	9.169	+10.2	4.1
Copper	0.0005	12	31.1	8.52	+2.4	3.2
Iodine	0.0001	13	25.1	8.301	..	5.2
Titanium	0.001	15	33.8	8.030	-3.5	1.8
Lead	0.001	13	27.6	7.656	-8.0	2.6
Silver	0.0001	11	21.1	7.240	-13.0	7.1

The influence of thorium, uranium and manganese was confirmed in pots as well. About 13 plants were sown for each of these ions. 0.001 gm. of uranium nitrate, thorium nitrate and manganese chloride were added and an increase of 8 per cent., 12 per cent. and 5 per cent. for each of them was recorded.

MOTH AND GRAM.

Experiments.	Season.	No. of plants.	Ions investigated.	Measurements.
Moth in water culture.	April to May 1931.	116	Th, Co, Ur, Ce, Na, Zn, Cu, Mn, Al, Sr.	Lengths.
Moth in sand culture.	April to May 1931.	109	Th, Co, Ur, Ce, Na, Zn, Cu, Mn, Al, Sr.	Lengths.
Gram in sand culture.	March to April 1931.	134	Ur, Th, Ce, Cu, Pb, Ag, Mn.	Lengths.

The growth of plants in the above experiments was followed by measuring the increase in their lengths only. The mean of about twelve plants was taken for calculating the average lengths. The results of the experiments for the ions which influenced the growth are shown in the following table. Increase in average total lengths are given. The details of these experiments are mentioned in a previous report (dated February 1932) and the reference to the tables therein is given in the last column.

TABLE XXX.

Experiments.	Thorium 0.0001 per cent.	Uranium 0.0001 per cent.	Cerium 0.0001 per cent.	Copper 0.001 per cent.	Manganese 0.001 per cent.	Zinc 0.01 per cent.	Alum 0.001 per cent.	
Moth in sand culture.	18.1%	...	+8.5	...	+10.6	-14.8	-8.5	Table IV.
Moth in water culture.	23.9	11.8	+17.7	...	+12.4	-18.6	...	Table V.
Gram in sand culture.	14.4	...	+7.7	...	...	+6.1	...	Table I.

SUMMARY OF THE RESULTS.

Peas.

Thorium, uranium and cerium when added in culture solutions as nitrates showed an increase of 23 per cent., 19.4 per cent. and 9.7 per cent. in the average dry weights of the plants at concentrations of 0.0001 per cent., 0.00001 per cent. and 0.0001 per cent., respectively. Copper nitrate at 0.001 per cent. depressed the growth by 13 per cent. Thorium and uranium also showed an increase of 14.4 and 9.0 per cent. in the fields but no definite evidence for improvement in the seeds, either in quality or quantity, was noticed.

When soaked in dilute solutions of the order of 0.00001 per cent., thorium and uranium influenced the process of germination, and the dry weights as well as lengths of the plants were distinctly improved.

Maize.

Thorium and uranium nitrates at 0.0001 per cent. and 0.0002 per cent. increased the average dry weights in culture solutions by 14.2 per cent. and 11.9 per cent., respectively. In fields an increase of 7 per cent. and 9 per cent. and decrease of 2.4 per cent. was noticed, for thorium, uranium and cerium, respectively. Germination

was distinctly improved on soaking the seeds in the salt solutions. The average length as well as the average dry weights showed an increase in the early stages of the plant growth and an increase in dry weights up to 21.9 per cent. for thorium, 19.0 per cent. for uranium, 9.0 per cent. for cerium were measured.

Beans.

Thorium, uranium, titanium and manganese affected the growth. In culture solutions an increase in dry weights of 21 per cent., 16 per cent. and 7 per cent. was measured for uranium, thorium, manganese at concentrations of 0.00001 per cent., 0.00001 per cent., 0.0001 per cent., respectively. Thorium also showed an increase up to 16 per cent. in the dry weights of plants in the fields. Germination was but slightly improved on soaking in thorium nitrate and an increase in the dry weights of 3.2 per cent. at 0.0001 per cent. was noted. At concentrations of 0.0001 per cent. uranium and manganese showed an increase of 5.3 per cent. and 5.1 per cent. while titanium depressed the growth by 4.4 per cent.

Juar.

Influence of 13 ions was investigated in culture solutions. Thorium and uranium nitrates showed an increase of 8.7 per cent. and 11.0 per cent. in lengths in culture solutions, copper and manganese showed slight depression. The effect of uranium, thorium and manganese was tested in fields but no appreciable change was observed in these experiments. Germination was studied on soaking in solutions of varying concentrations from 0.1 to 0.00001 per cent. Usually the salts depressed the subsequent growth but increase in the average dry weights amounting to 2.4, 2.6, 3.4 and 3.9 per cent. were noticed for thorium, zinc, uranium and manganese at 0.0001 per cent. nitrates.

Barley.

Experiments in water culture and in pots were completed. Influence of thorium, uranium, zinc, manganese, nickel, cobalt, silver, lead, copper, titanium, iodine, was investigated. In culture solution uranium, thorium, and zinc proved effective and showed an increase in the average dry weights of 14.1 per cent., 17.4, 10.2 per cent., respectively. Titanium, iodine, lead and silver were injurious at all concentrations tried. Increase in dry weights amounting to 8, 12 and 5 per cent. for uranium, thorium and manganese chloride were also noticed in the sands.

Moth and Gram.

Experiments for moth in water culture and sand culture and for gram in sand have been completed. Influence of thorium, cobalt, uranium, cerium, sodium, zinc, copper, manganese, aluminium and strontium on moth and of uranium, thorium, cerium, copper, lead, silver and manganese improved the growth in all cases while zinc, alum retarded the growth (Table XXX)

APPENDIX XLII.

NOTE DATED THE 23RD FEBRUARY 1934 BY THE SECRETARY ON SUBJECT No. 36. REPORT OF COMMITTEE ON POTATO RESEARCH SCHEMES, FEBRUARY 22ND, 1934.

PRESENT :

Diwan Bahadur Sir T. Vijayaraghavacharya (Chairman).
 Professor S. P. Agharkar.
 Mr. R. G. Allan.
 Dr. W. Burns.
 Mr. B. C. Burt.
 Dr. P. S. Hudson.
 Mr. V. N. Likhite.
 Mr. K. McLean.
 Dr. W. McRae.
 Dr. S. K. Mitra.
 Prof. P. Parija.
 Mr. J. H. Ritchie.
 Mr. H. R. Stewart.
 Rao Bahadur B. Viswanath.

The following schemes for potato research were before the Committee :—

- A. Application from the Government of Bengal for a grant of Rs. 48,950 spread over five years.
- B. Application from the Government of the United Provinces for a grant of Rs. 41,790 spread over five years.
- C. Application from the Government of Punjab for a grant of Rs. 37,760 spread over five years.
- D. Application from the Government of Bihar and Orissa for a grant of Rs. 28,696 spread over three years.
- E. Application from the Government of the Central Provinces for a grant of Rs. 15,246 spread over three years.
- F. Application from the Government of Assam for a grant of Rs. 56,948 spread over five years.

2. Members of the Committee had received copies of translations of some Russian literature on potato-breeding lent by the Imperial Bureau of Plant Genetics (Cambridge) and Dr. Hudson, Deputy Director of the Bureau summarised the present position. Until recently potato breeding work in Europe had been carried out on very limited material and progress had in consequence been limited of late years. He considered that if breeding work in India were confined to material available in India or obtainable from Europe much progress would be made. In 1925, the Russian Soviet Government sent a scientific expedition to South and Central America. (Mexico, Guatemala, Columbia, Peru, Bolivia, Chili and the country down to the Argentine) which brought back 1,000 specimens and made important discoveries. In South America there was found a number of cultivated varieties quite different from those of Europe. There were also wild species of importance collected from the hill sides of the Andes (even up to 15,000 feet) and a wealth of new forms was brought back including fourteen species of cultivated Potatoes and several dozen species of wild Potatoes. Some of these species possess valuable properties, e.g., Frost resistance and resistance to blight (Phytophthora) and suitability to a short day. The chromosome numbers were 24, 36, 48, 60 and 72 whereas European cultivated potatoes have a chromosome number of 48. A number of hybrids were obtained by Russian workers which yielded fertile seed.

He considered that the first step would be to send an expedition to South and Central America before proceeding further. He did not think the requisite material could be obtained from Russia.

3. The Committee, after discussion are of opinion :—

(i) that most of the important problems of potato growing in Northern India could be studied at a single central research station with provincial testing stations and that the question of the most suitable locality should be examined in detail and a preliminary scheme worked out,

(ii) The possibility of an expedition to South and Central America preferably in co-operation with other parts of the Empire should be investigated and the Committee recommended that the High Commissioner for India should be asked to bring the matter before the Executive Council of the Imperial Agricultural Bureaux.

(iii) Dr. Hudson should be requested to ascertain what suitable phytophthora-resistant and other new material could be obtained from the Laboratory of the late Professor Bauer and from the United States of America, Department of Agriculture (Plant-Introduction Bureau).

(iv) An attempt should be made to get some Phytophthora resistant types and hybrids from Russia in exchange for seed etc., supplied from India.

APPENDIX XLII-A.

NOTE, DATED THE 24TH JANUARY, 1934, BY SECRETARY, ON SUBJECT No. 36, PROVINCIAL SCHEMES OF POTATO RESEARCH :—

- A. Application from the Government of Bengal for a grant of Rs. 48,950 spread over five years for a scheme of Potato Research.
- B. Application from the Government of the United Provinces for a grant of Rs. 41,790 spread over five years for a scheme of Potato Research.
- C. Application from the Government of the Punjab for a grant of Rs. 37,750 spread over five years for a scheme of Potato Research.
- D. Application from the Government of Bihar and Orissa for a grant of Rs. 28,696 spread over three years for a scheme of Potato Research.
- E. Application from the Government of the Central Provinces for a grant of Rs. 15,246 spread over three years for a scheme of Potato Research.
- F. Application from the Government of Assam for a grant of Rs. 56,948 spread over five years for a scheme of Potato Research.

At its meeting held in July 1932, the Advisory Board considered a scheme for research work on potatoes submitted by the Government of Madras and did not recommend it for sanction (*vide* printed proceedings, pages 24-25 and 228-233). The scheme was however sanctioned by the Governing Body at its meeting held in October 1932, *vide* extracts enclosed (Annexure I), with a suggestion that other Provinces might be invited to send in schemes for work on potatoes. All provinces other than Madras and the constituent States of Hyderabad, Mysore and Baroda were addressed accordingly and invited to submit schemes for potato research. Six schemes have so far been received *viz.*, from Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces and Assam, and these are for the consideration of the Advisory Board. Details in respect of the duration and cost of each of the schemes, so far as the Council is concerned, are as stated below :—

Bengal.—Rs. 43,450 recurring and Rs. 5,500 non-recurring, or a total of Rs. 48,950 spread over a period of five years, as recommended by the Local Government. Receipts estimated at Rs. 2,000 per annum are expected to be realised from the scheme and these will be credited to the Funds of the Council. The local Government's letter No. 220, dated the 12th January 1934 and extracts from the proceedings of the Bengal Provincial Research Committee relating to the scheme are enclosed along with the scheme (Annexure II).

United Provinces.—Rs. 34,040 recurring and Rs. 7,750 non-recurring or a total of Rs. 41,790 spread over a period of five years (Annexure III).

Punjab.—Rs. 37,260 recurring and Rs. 500 non-recurring, or a total of Rs. 37,750 spread over five years (Annexure IV). Receipts estimated at Rs. 200 per annum are expected to be realised from the scheme and these will be credited to the Funds of the Council.

Bihar and Orissa.—Rs. 21,096 recurring and Rs. 7,600 non-recurring, or a total of Rs. 28,696 spread over a period of three years. Receipts realised from the scheme will be credited to the Funds of the Council. Details in respect of the provision for non-recurring expenditure have been obtained and are also enclosed (Annexure V).

Central Provinces.—Rs. 15,246 spread over a period of three years (Annexure VI).

Assam.—Rs. 50,698 recurring and Rs. 6,250 non-recurring, or a total of Rs. 56,948 spread over a period of five years. A note by the Imperial Mycologist, Pusa, on the basis of which the scheme has finally been drawn up is enclosed with the scheme (Annexure VII).

2. Attention is also invited to the attached copies of translations from Russian (which have been obtained through the kindness of the Imperial Bureau of Plant Genetics for Crops other than Herbage) (Annexure VIII), *viz.* :—

(i) "Vegetative Mutation in the potato", by T. O. Asseyeva.

(ii) "A contribution to the question of the origin of the potato", by Juzepczak and Bukasov, S.M.

3. The Vice-Chairman to the Council considers that these schemes may appropriately be examined in the first instance by a Committee consisting of the under-mentioned gentlemen :—

- (i) The Vice-Chairman, Imperial Council of Agricultural Research (Chairman—*ex-officio*).
 - (ii) The Agricultural Expert, Imperial Council of Agricultural Research.
 - (iii) The Director of Agriculture, Bombay.
 - (iv) The Director of Agriculture, Bengal.
 - (v) The Director of Agriculture, United Provinces.
 - (vi) The Director of Agriculture, Punjab.
 - (vii) The Director of Agriculture, Bihar and Orissa.
 - (viii) The Director of Agriculture, Central Provinces.
 - (ix) The Director of Agriculture, Assam.
 - (x) The Director, Imperial Institute of Agricultural Research, Pusa.
 - (xi) Dr. F. J. F. Shaw, Imperial Economic Botanist, Imperial Institute of Agricultural Research, Pusa.
 - (xii) Dr. P. S. Hudson, Deputy Director, Imperial Bureau of Plant Genetics (for Crops other than Herbage).
 - (xiii) Rao Bahadur B. Viswanath, Government Agricultural Chemist, Madras.
 - (xiv) Professor P. K. Parija, Ravenshaw College, Cuttack.
- The Secretary, Imperial Council of Agricultural Research—Secretary—*ex-officio*.

This Committee will meet on Friday, the 23rd February 1934, at 2-45 p.m. in the Conference Room, First Floor, South Block, Imperial Secretariat Buildings, New Delhi, and its report will be placed before the Advisory Board in due course.

ANNEXURE I.

EXTRACTS FROM THE PROCEEDINGS OF THE MEETINGS OF THE GOVERNING BODY OF THE
IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH HELD ON THE 6TH AND 7TH OCTOBER
1932.

47. Application from the Government of Madras for a grant for research work on potatoes.

Mr. Carpenter said that the Advisory Board did not recommend the scheme as it was thought to be a purely provincial one. If the Governing Body considered it necessary, it might be referred back to the Advisory Board. Sir Jogendra Singh pointed out the importance of research work on potatoes and the possibility of quick results and favoured the scheme being sanctioned straightaway. Maulvi Abdul Hamid said that the scheme did not cover other provinces and wanted a co-ordinated scheme. The Vice-Chairman suggested that the scheme might be referred back to the Advisory Board to prepare an all-India scheme. On being put to the vote, the scheme was sanctioned and a suggestion was made that other Provinces might be invited to send in schemes for work on potatoes.

ANNEXURE II.

LETTER FROM THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT,
No. 220, DATED THE 12TH JANUARY 1934.

I am directed by the Government of Bengal (Ministry of Agriculture) to forward for consideration at the next meeting of the Advisory Board of the Imperial Council of Agricultural Research, a scheme for research on potatoes in Bengal, as revised and approved by the Provincial Agricultural Research Committee, together with an extract from the minutes of the meeting of the Committee. I am to say that the local Government recommend the scheme subject to the following modifications :—

- (1) that the scale of pay of the Research Officer be fixed at Rs. 225—30/2—235 on the analogy of the revised scales of pay decided by this Government for some of the provincial services; and
- (2) that the pay of the peons be fixed at Rs. 15 (rupees fifteen) each a month which is admissible in the district of Darjeeling in which the scheme will be operated.

A further communication will be made in regard to the question of provision by this Government of the cost of quarters of the research officer and the overseer, as recommended by the Provincial Committee.

* * * * *

EXTRACT FROM THE MINUTES OF THE SEVENTH MEETING OF THE BENGAL PROVINCIAL
AGRICULTURAL RESEARCH COMMITTEE HELD ON 7TH DECEMBER 1933.

* * * * *

2. *Scheme for potato breeding in Bengal by the Bengal Agricultural Department.*—
Dr. Agharkar raised the point that the scheme seemed to be one of importing and multiplication of tubers, and not pure plant breeding. He was assured that potatoes would be raised from the seed, and the scheme was essentially one of plant breeding and hybridization.

Dr. Ghosh referring to the item under cost of buildings, suggested that, as the Imperial Research Council would not meet the cost of residential buildings, the cost of the quarters for the Assistant would have to be met by the local Government, and this should be mentioned in the note. It was agreed to incorporate this in the note.

Mr. Fawcus objected to the prominence given to Nepal, and proposed that the seed should be distributed to cultivators in Darjeeling and in Sikkim. There would be no possibility of controlling the potatoes in Nepal, and at the same time encouragement should be given to the people of this province. It was pointed out that it was entirely a question of supply; Darjeeling district being unable to meet the demand which was mainly met from Nepal. It was agreed that it should be stated in the note that the seed would be distributed to neighbouring cultivators without making any specific mention of Nepal.

Dr. Mukharji raised the question of supervision and was informed that the Research officer would be directly under the Economic Botanist, Bengal.

The scheme was then approved.

SCHEME FOR POTATO RESEARCH IN BENGAL.

The area under potatoes in Bengal is estimated to be 85,500 acres, a large percentage of this acreage being planted with imported sets. In the Hooghly, Howrah and Burdwan districts, Patna, Darjeeling or Nainital seed potatoes are generally planted: Northern Bengal imports both Darjeeling and Shillong seed.

Potatoes grown from sets stored on the plains rapidly deteriorate into the marble-like "Silbilati" of Rangpur district, which although much relished as a curry potato by the consumer, gives no return to the producer owing to the poor yield. This potato is being rapidly ousted by the imported potato and any attempt to breed types

suitable for continued production on the plains would be a waste of money. The fact that seed potatoes must be raised in a temperate climate is recognised through the world.

Whilst allowance must be made for the yielding capacity of a particular variety, the relative average yields of potatoes grown on the Bengal plains indicate that this applies to India :—

	Mds.
Darjeeling	135
Nainital	80
Shillong	54
Local plains	65

Nainital and Shillong seed potatoes are grown at an altitude of 6,000 ft. or under—Darjeeling at altitudes above 8,000 ft.

2. Of the potatoes used for seed, the names Nainital and Shillong indicate their origin. The Patna potato is a product of Nepal, which may or may not have been grown for one or more cold weather on the plains. The Darjeeling potato also comes from Nepal and Sikkim: only a few thousand maunds are grown in the Darjeeling district. Of late years "Phytophthora infestans" has been very prevalent in crops planted to this variety. Opinion is divided as to whether this disease is carried in the tuber but, whether in the tuber or in the soil which attaches to the tuber, the disease reaches the plains with serious consequences. Phytophthora can be controlled by spraying and clean cultivation, but the Department of Agriculture has no control over the grower in Nepal. Cleaning stations on the frontier might prove efficacious, but would add considerably to the cost to the plains cultivator which is already very high.

An attempt to meet the problem is being made by the department. So called "resistant" varieties are being tested on land provided by the Forest Department in the Darjeeling district and should any prove high yielders and show immunity to the disease they will be sold to growers in the neighbouring hills.

Potatoes which show resistance to disease in Britain will not necessarily show the same resistance in India where the lack of care in cultivation and the consequent jungle in the fields makes for ideal disease breeding conditions. It is, therefore, necessary that breeding work should be commenced on a station in the Darjeeling district with a view to producing disease resistant heavy yielding varieties. Such a station will not only benefit Bengal, but Bihar and the United Provinces as well. The station will be located at an elevation above 7,000 ft. Lower elevations are not suitable for the summer crop which provides the plains with seed potatoes. The Bengal Government will provide 12 acres of land, but cannot meet other non-recurring or recurring expenditure except staff quarters. It is proposed that, of the 12 acres, one acre will accommodate roads, buildings, etc., two acres will be utilised as a breeding area, and 9 acres as a multiplication area. The latter will be cropped on a three-year rotation—Green manure—potatoes—barley, and at present prices the receipts are expected to be Rs. 2,000 per annum.

The actual cost of the scheme will, therefore, be Rs. 41,710 less Rs. 10,000= Rs. 31,710.

	1st year.	2nd year.	3rd year.	4th year.	5th year.
	Rs.	Rs.	Rs.	Rs.	Rs.
<i>Recurring—</i>					
1. Research Officer— (Rs. 212-8-0—20— 292-8-0.)	2,550	2,790	3,030	3,270	3,510
2. Overseer (Rs. 50)	600	600	600	600	600
3. Peons (2) at Rs. 13 each.	312	312	312	312	312
4. Contingencies . . .	3,500	3,500	3,500	3,500	3,500
5. Travelling allowance . .	1,200	1,200	1,200	1,200	1,200
Total .	8,162	8,402	8,642	8,882	9,122
			43,210		

	Rs.	Rs.
<i>Non-recurring—</i>		
*Research officer's quarters	1,000	
*Overseer's quarters	500	
Peons and coolies' quarters	500	
Godown and office	1,000	
Fencing	500	
	3,500	
Apparatus and implementa	3,000	
Furniture	200	
Typewriter	300	
	3,500	
		7,000

*The cost of quarters will be met by the local Government. So cost to be met by the Imperial Council of Agricultural Research will be Rs. 5,500.

KENNETH McLEAN,
Director of Agriculture, Bengal (Offg.).

The 16th October 1933.

ANNEXURE III.

AN APPLICATION FROM THE UNITED PROVINCES GOVERNMENT TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A TOTAL GRANT OF Rs. 41,790 (Rs. 7,750 NON-RECURRING AND Rs. 34,040 RECURRING SPREAD OVER FIVE YEARS) FOR RESEARCH WORK ON POTATOES IN THE UNITED PROVINCES (AS MODIFIED IN ACCORDANCE WITH RESOLUTION No. 2 OF THE UNITED PROVINCES AGRICULTURAL RESEARCH COMMITTEE PASSED ON APRIL 24, 1933).

Introduction.

This scheme is based on a suggestion of the Imperial Council of Agricultural Research and is intended to form a link in the chain of similar schemes for other parts of India.

The area under potato in the United Provinces has increased from 50,000 to over 150,000 acres within recent years, which is the largest acreage among all other provinces. The potato is cultivated in all the districts both in the plains and the hills. The statement below shows that there is a steady increase of the acreage under this crop and in 1929-30 it stood at 300 per cent. of the normal, as estimated on the average of five years (1901—1905) :

Statement.

<i>Year.</i>	<i>Acres.</i>
1921-22	78,322
1926-27	94,819
1927-28	119,955
1928-29	129,487
1929-30	153,483

There is an extensive cultivation of potato in the hills up to an altitude of 8,500 ft. It is grown usually in small patches on the terraced slopes of the hill sides and in the narrow valleys and also as the catch crop in new fruit plantations. With the opening of the motor roads and better means of communication more and more area is every year brought under this crop.

Though at present the principal use of the crop is as a vegetable, there appears to be ample scope for its industrial use later if the yield and quality of the crop can be improved. The loss alone in ruined potatoes which at present takes a large toll of

the total yield in the absence of adequate storage or the establishment of an effective seed supply from the hills is enormous and if avoided or reduced as the outcome of this scheme might provide surpluses which could be used to prepare dextrine Farina and like industrial products.

Cultivation in the plains.—In the plains the potato is grown in winter. It is planted, in October and harvested in February-March.

At certain places in small areas two crops are taken during one season. They are known as the Katwa and Gola. Only the hill varieties are grown as these subsidiary crops. In the district of Farrukhabad where a very intensive cultivation is practised potato forms one of the principal crops. The usual rotation for this district is :

Potato	. . . . .	October to March
Tobacco	. . . . .	March to June
Maize	. . . . .	July to September

followed by potato again next year. When two crops of potato are taken then the rotation is :

Potato (Gola)	. . . . .	September to December
Potato (Katwa)	. . . . .	January to March
Tobacco	. . . . .	March to June
Fallow or maize	. . . . .	July to September

followed by potato again next year.

In the hills the main crop of potatoes is grown as rainy season or kharif crop. It is planted in May-June and harvested in September-October. The valley tracts where irrigation facilities exist it grows as the zaid or the summer crop. In such places it is sown in February-March and dug in June-July, before the rains.

The main crop of the hills is exported to the plains during October-January. There are two distributing centres for them, Dehra Dun serving the Western Garhwal, and Haldwani serving the districts of Naini Tal and Kumaun. In Dehra Dun the large size tubers reach the market earlier, while as the season advances, the size becomes smaller. In the Haldwani market no such difference in the size can be noticed. The seed dealers from Meerut and Farrukhabad go to Dehra Dun in December to buy them for seed purposes. They are sown cut and hence are generally known as katwa. Since they are sown very late, they get the growth period of only about two and a half months. The tubers therefore remain small and immature. The whole produce is stored as seeds. For immediate marketing they have no value, as they are harvested at a time when the main crop is already glutting the market. They are dug when the temperature is fairly high and the potato moth is severe, hence they become very badly infected and in the store the major part rots away. Only a small fraction is saved. Naturally they sell at a very high price (Rs. 20—Rs. 30 a maund) next year. They are sown in September in small areas mostly in the neighbourhood of big towns and are dug in December-January at a time when the supply from the hills decreases, and therefore they find a ready market and fetch a good price.

The katwa is thus the crop of the seedsmen.

Varieties.—The varieties of potato are very few in number. They are phulwa, kabra and Patna grown in the plains Naini Tal and long-keeper in the Kumaun hills and kharra and safeda or Quetta in the Garhwal.

The plain varieties are generally known as deshi while the hill ones as pahari. There were formerly several other kinds of deshi potatoes, e.g., lalwa, jalandhari, Madrasi, etc., but they have now gone out of cultivation owing mainly to their bad keeping qualities and ravages of the potato moth. Of the deshi varieties phulwa is the most predominant at present. It is preferred by the cultivators on account of its better keeping quality and prolific habit. But its table qualities are poor. The phulwa and kabra are largely grown in the western districts. The Patna seeds find market in the eastern districts.

Diseases.—As compared to European countries, there are a very few fungus diseases of the growing crops in the plains. Mention may be made of the rhizoctonia which a few years ago was causing good deal of damage both in the fields and the stores. But it has almost disappeared now. To the very high temperature of the soil in the summer months combined with the graminaceous crop (maize) which follows potato and which does not act as a suitable host for the potato parasites, may be ascribed the cause of the absence of the majority of fungus diseases. In the hills, however,

the late blight is some times reported and also the ring disease of bacterial origin in localized areas.

But although fungus pests are not so common, yet there is in the growing crop a very extensive prevalence of degeneration diseases, the "crinckle" and the "mosaic". All the deshi varieties are affected with it, and it is mostly due to them that they have degenerated so badly.

The Paharis are remarkably free from the degeneration diseases.

Besides the virus diseases of the growing crop there is a serious pest of the stored potatoes, the potato moth, which brings on its trail the soft and dry rots. These pests cause enormous damage in the stores.

WHAT THE GOVERNMENT OF THE UNITED PROVINCES HAVE DONE.

Recognizing the importance of the crop, the United Provinces Government opened a small 10 acres Potato Research Farm at Farrukhabad in 1925-26 primarily to study the disease problems and generally to find out means to improve the condition of the crop. This farm, however, had to be closed down chiefly on account of financial stringency. Besides the capital expenditure involved in the purchase of land, erecting buildings, construction of tube-well, etc., that on the running of the farm and various potato experiments was—

	Ra.
1925-26	2,138
1926-27	3,218
1927-28	3,011
1928-29	2,774
1929-30	3,046
1930-31	2,758
1931-32	1,642

Problems investigated.

1.—*Storage rot*—Prior to opening of the farm the Plant Pathologist investigated the causes of the summer rot. They were the potato moth, a fungus (*Fusarium solani*) and bacteria (Hutchinson's type 2). The cold storage was found by experiment to be the best means of saving the potatoes from deteriorating in the store. But the method proved too expensive for universal adoption.

With the opening of the farm and construction therein of a storage godown various experiments were carried out for stopping the summer rot, e.g., (1) storing in underground chambers, (2) use of various chemicals, (3) fumigation, including that with petrol which was one time strongly recommended by the Bombay Department of Agriculture, (4) storage in charcoal, etc., etc. But all these experiments proved ineffective to stop the rot completely.

An easy method was, however, discovered of controlling the potato moth in the stores and with its control storage rot was considerably reduced. To safeguard against fresh infection by the moth the potato is now universally stored in sand in the plains. The caterpillars come out from the already infected tubers and pupate in this covering sand. The control consists in sieving this sand within the first month and burning off all the collected pupae. As the number of the moth is greatly reduced in this way, subsequent infection to the sound tubers is minimized. And this method combined with sorting out of all damaged tubers in the stored heap greatly reduces the storage rot.

The field infection can be reduced if the potatoes are dug earlier by the middle of February when the temperature is still unfavourable for the moth. Cultivation of early and mid early varieties therefore is advantageous.

Again, as the moth hides in cracks and crevices in the godowns it is very necessary to destroy them beforehand. Liberal use of kerosene is useful for the purpose. Mixing kerosene with the mud used for plastering the floor and walls is very effective. The roof should have a ceiling of thick cloth.

The soft and dry rot organisms effect their entrance mostly through the moth injury. They are carried from year to year in the sand in which the previous seasons stock was stored. Hence it is necessary to change the sand every year.

This it has been investigated that the storage rot can be considerably reduced by (1) digging the potatoes early and covering them immediately with sand. There

is a popular belief that the potatoes should be allowed to sweat for a number of days before storing. But covering the tubers with sand, as soon as they were dry enough to be freed from the adhering soil, had no deleterious effect, provided the sand covering was not too thick, (2) changing the sand every year, (3) sieving the sand once or twice during the first month, twice later on in the season, (4) sorting out all damaged tubers in the store, (5) before storing, plastering the walls and floor of the godowns with mud mixed with kerosene and spraying kerosene in the ceiling.

II—Virus diseases.—The most common type of the virus diseases prevalent in the plains is the "crinckle". It is, however, almost always associated with mosaic. Investigations have been made of the cause of the rapid spread of these diseases, their effect on the yield, effect of different manures on their incidence and methods of their eradication. These diseases were successfully kept under check by using larger size tubers for seeds (the small potatoes are usually the produce of diseased plants) and careful roguing of diseased plants in the fields. The most convenient time for roguing is when the first earthing is done.

It has been noted before that in the hills the potato remains remarkably free from the virus diseases. Such seeds give rise to healthy crops in the plains.

III—Improvement of the crop. (a) By selection.—For any selection work for the improvement of the crop a very large number of varieties should be readily available. But unfortunately there are only a few in these Provinces. A number of English varieties was, therefore, imported. As the season for potato cultivation in the hills agrees with that of England, they were grown at the first instance in the hills and then in the plains in the second year. Two of these English varieties, namely a flowering kind of the type "up to date" and the other belonging to the type "katti glover" gave good results. The Italian varieties obtained from Bombay proved unsuitable.

These English varieties, however, underwent rapid deterioration in the summer heat. They had thus to be taken back again to the hills. In this way their vigour has been re-established.

This work, continued for three years, has conclusively proved that the seeds drawn from the hills give much better results and their vitality remains unimpaired. The potato requires a rest period of at least three months before it can be used for seed. Therefore in the hills they should be grown as the first crop in the valley tracts. The following scheme of supply of seeds of these English varieties for the plains has been introduced.

The scheme consists of raising two crops in suitable localities in the hills, thus :

First crop.—To be sown in February-March and harvested in June-July. The seeds should be exported to the plains after three months namely in October, for ready sowing. The "ware" can be utilized for local consumption or immediately exported to the plains.

Second crop.—In line with the existing practices, it should be planted in May-June and harvested in September-October. The seeds from this crop should be utilized for the first crop.

This scheme was communicated to the Governments of Assam and Madras, along with the seeds of the two acclimatized varieties. These seeds have also been supplied to the Government of Bombay. Those of the indigenous hill varieties were supplied to the Governments of Bihar and North-West Frontier Provinces for trials in their experimental farms.

Based on these recommendations some of the influential potato growers of Kumaun have formed into an association who are examining the possibility of developing the seed trade in the hills on these lines.

(b) By hybridization.—Crosses were successfully made between one of the selected English varieties and the Phulwa in order to see if the good qualities of the former could be combined with the hardiness and prolific habit of the latter. Good healthy berries were obtained, but the seed failed to germinate, probably due to unsuitable climatic condition in the plains where this work was carried out. Further careful study of this problem is essential for improving the indigenous varieties.

IV—Improvement of the methods of crop production. Grading.—It is mentioned before that in order to reduce moth infection it is necessary to cover the potatoes immediately in sand. This is practicable if the tubers are sorted out into different grades as soon as they are dug. The ordinary method of hand sorting is a laborious and slow process. A simple and inexpensive potato sorter has been devised with which the harvested crop can be graded very quickly at one operation into three grades, the ware, the seed and the chat. With this sorter three men can grade more than 100

maunds of potatoes in a day of ten hours as against 45 maunds by hand sorting. This sorter is now gradually coming into use in Farrukhabad.

Harvesting.—Kudali-forks have been introduced for breaking the ridges prior to digging with khurpies. With them harvesting becomes much quicker and the amount of damaged tubers greatly reduced. This simple implement is much more effective in heavy soils and when the field gets dry and the ridges hard.

V—Miscellaneous.—Preliminary investigations have also been made of the most economical size of seed tubers, the distance and time of planting, the effect of different kinds of manures, the comparative merit of the mature and immature seeds and raising potato as a catch crop for sugarcane fields. After repeated trials a standard of manure has been established for the farm lands in the plains.

LINE OF FURTHER RESEARCH.

(A) Investigations carried out so far indicate that the potato crop can be readily improved if the supply of seeds from the hills can be established. By this means the problem of storage of seeds in the plains in summer as also the question of mosaic control will be eliminated. But before this is possible it is necessary to examine a large number of varieties imported from different parts of India and foreign countries and grow them in a suitable locality in the hills. After a preliminary selection both by the "tuber unit" and "hill selection" methods at this research station the promising varieties will be experimented upon in the foot-hill and the plains and further selection made there by "mass selection" method. The best among these will then be introduced in the hills for large scale cultivation. Such a variety can then be tried in the research farms in the plains in other provinces. In this way seeds of a large number of good varieties, of proved merit, will be available within a short time to the potato growers, not only in the United Provinces but also in other provinces.

It will be necessary for this work to open one small research station in the foot-hills and a higher level growing station at about 7,000 ft. Suitable land for this purpose will be placed at the disposal of the scheme by the United Provinces Government or it may be leased from landowners for a period of time.

The trials in the plains will be carried out in the Cawnpore Research Farm and possibly if needs demand by re-institution of the farm at Farrukhabad. Arrangements will also have to be made for systematic plot trials on the high altitude area on selected zamindari holdings under special control of an assistant.

(B) Since the deshi varieties have got certain desirable characters, improvement of the crop is also possible by hybridization of these with foreign stock. By this cross-breeding numerous varieties of potatoes are now available in European countries and America. Mention may be made of the recently evolved Wart-immune varieties, the Arrans of Scotland, the Burbanks and Rurals of America.

This work will be carried out in the proposed research station in the hills.

(C) This system of importation of seeds from colder regions will, no doubt, eliminate the problem of storage in the plains, but its introduction will necessitate a thorough investigation of this problem so far as it will affect the conditions in the hills. The seeds for the main crop of the plains can only be obtained from the first crop of the hills grown as the Zaid in the valley tracts. They will necessarily have to be stored for three months from July-September. Experiments carried out at Jeolkote (Naini Tal) farm indicated that the low-lying valleys were unsuitable for storing on account of the moist heat of these places during the monsoon. It was therefore recommended that the seeds should be carried up and stored in higher altitude where temperature was colder. But this question requires further investigation.

The experimental work will be controlled by a body consisting of—

The Director of Agriculture.

The Deputy Director of Agriculture, Rohilkhand and Kumaun Circle.

The Economic Botanist (Cawnpore).

The Plant Pathologist.

The services of the Agricultural Chemist to Government will be available for investigating chemical problems arising out of the work, as, for instance, the analysis of the soils, manures, starch content, and food value of the varieties, etc. This body will be responsible for proper functioning of the scheme and will be in a position to guide the workers and to identify inefficiency and slackness. The second, third, and fourth officers above mentioned will however actually participate in the work involved.

the first named by work in the foot-hill stage and the other two in investigation work at Cawnpore.

The Government of the United Provinces has spent nearly Rs. 50,000 on the investigation of the lines of improvement of the potato crop. Satisfactory progress was made in this work, but as the outcome of financial stringency, expenditure has had to be seriously curtailed. At the same time they realize the growing economic importance of the crop, and hence this demand is made on the generosity of the Imperial Council of Agricultural Research to assist in the provision of the necessary funds for this work. If this scheme is sanctioned it will not only benefit the United Provinces, but will prove equally useful to all other provinces who will be able to obtain good seeds for their potato crop.

The Government of the United Provinces will contribute 44 per cent. of the non-recurring expenses and 46 per cent. of the recurring costs, as shown in the schedule attached, apart from such direct services as may be rendered by the expert staff.

ENCLOSURE I.

The cost of establishing a potato research station in the Kamaun hills.

	Rs.	Rs.
<i>Non-recurring.</i>		
To be provided by the United Provinces Government—		
Land, suitable areas of hill land, 10 acres approximately value	1,000	
Laboratory, residences of staff on foot-hill station and of fieldmen at high level station, farm building and shed to be erected by the United Provinces Government	5,000	
		6,000
To be provided by the Imperial Council of Agricultural Research—		
Grading and levelling	3,500	
Temporary seed store	1,500	
Implements	250	
Fencing	1,500	
Laboratory instrument, i.e., barometer, recording thermographs, hygrometer, microscope glass apparatus, etc.	1,000	
		7,750
Total		13,750

ENCLOSURE II.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total five years.	Remarks.
Recurring :	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1. Pay of officers—							
Plant Breeder with thorough knowledge of horticulture on Rs. 200—25—400	2,400	2,700	3,000	3,300	3,600	15,000	Requested Council.
One member, S. A. S., at Cawnpore Research Station	1,320	1,320	1,320	1,320	1,320	6,600	Provided by United Provinces Government.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total five years.	Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
2. Pay of establishment—							
One Field Assistant on Hill Research Centre, Rs. 40—4—60	480	528	576	624	672	2,880	Requested from Council.
One mali on Rs. 25	300	300	300	300	300	1,500	Ditto.
One peon on Rs. 12	144	144	144	144	144	720	Ditto.
One Field Assistant operating in the high altitude area, Rs. 40—4—60.	480	528	576	624	672	2,880	Provided by United Provinces Government.
One peon ploughman on Rs. 14	168	168	168	168	168	840	Requested from Council.
3. Allowances—							
Travelling allowance	500	500	500	500	500	2,500	Ditto.
Hill allowance—officer	400	400	400	400	400	2,000	Ditto.
Hill allowance—establishment. {	240	240	240	240	240	1,200	Ditto.
180	180	180	180	180	180	900	Provided by United Provinces Government.
4. Supplies—							
Rent of high level land	300	300	300	300	300	1,500	Requested from Council.
Cost of importation of potato stock	500	100	100	100	100	900	Ditto.
Experiments at Cawnpore	1,000	1,000	1,000	1,000	1,000	5,000	Provided by United Provinces Government.
Working costs, cultivation, etc., of foot-hill station	1,200	1,200	1,200	1,200	1,200	6,000	Ditto.
Working costs, cultivation, etc., of high altitude area	1,000	1,000	1,000	1,000	1,000	5,000	Ditto.
Manures and fertilizers	300	300	300	300	300	1,500	Requested from Council.
Freight and cartage	50	50	50	50	50	250	Ditto.
Sundries, including books and periodicals	100	100	100	100	100	500	Ditto.
Miscellaneous foot-hill station contingencies	200	200	200	200	200	1,000	Ditto.
Annual laboratory equipment	150	150	150	150	150	750	Ditto.
Storage experiments	200	200	200	200	200	1,000	Ditto.
Contingencies in work on private farm area	400	400	400	400	400	2,000	Provided by United Provinces Government.
Total (Recurring)	12,012	12,006	12,404	12,800	13,196	62,420	
Share of United Provinces Government	5,580	5,628	5,676	5,724	5,772	28,380	
Share of Imperial Council of Agricultural Research	6,432	6,380	6,728	7,076	7,424	34,040	

N.B.—The rates of pay proposed here are on the basis of conditions in the plains. Hill allowance has been added for the period of stay in the hills.

ENCLOSURE III.

Abstract.

	Non-Recurring	Recurring	Total.
	Rs.	Rs.	Rs.
United Provinces Government	6,000	28,380	34,380
Imperial Council of Agricultural Research	7,750	34,040	41,790
Total	13,750	62,420	76,170

The share of the United Provinces Government is about 45 per cent.

ANNEXURE IV.

A FIVE YEARS' SCHEME OF RESEARCH ON THE POTATO CROP IN THE PUNJAB.

The potato crop is grown in many parts of India and is important in several of the provinces. In the Punjab the total area under this crop may not be large when viewed in comparison with the areas under such crops as wheat or gram, but potatoes are very intensively grown in certain localities in the hills where their success or failure means everything to the small hill cultivator.

2. Work on the improvement of the potato crop was first started by the Agricultural Department in 1909, following a report to the effect that this crop, which had previously been the mainstay of the farming community in the Simla Hills, had practically ceased to give a profitable return. Investigations then made showed that the local varieties of potatoes had been raised year after year from tubers originally introduced some 40 years before, that no selection had been carried out and that, as a result, the varieties had deteriorated to such an extent as to make their cultivation unprofitable. Tubers of some 26 Scotch varieties of potatoes were imported into the Simla Hills by the Department in 1909-10 and in a few years certain varieties, such as the Factor, King Edward VII, Scot, Admiral and Talisman showed that they did well under the conditions which exist in these hills. Eventually, as a result of prolonged trials, two varieties, the Factor and the Talisman, proved to be the best of all the varieties introduced. They produced yields far in excess of those obtained from the old local varieties. In more recent years some further English and Scotch varieties were imported and placed on trial in these hills. Of them the variety Kerr's Pink has been giving very high yields for some years and holds out considerable promise of success in the hills as well as in the plains. The variety Ally is also promising and shows signs of competing favourably with the best of the varieties introduced earlier.

3. Whilst work on the testing of imported varieties has been in progress, investigations have also been carried out on a small scale in connection with the improvement of the potato crop by selection and breeding. Comparatively little has been done, however, in this connection and it is proposed now to expand the research work on this crop if additional facilities can be provided. The climate, soil and other conditions are favourable for the work and the results obtained would be likely to be applicable to a large part of the potato growing areas in India.

4. *Problems to be studied—*

- (1) A detailed study of the existing varieties as regards their suitability for employment in breeding work.
- (2) Considerable difficulty has been experienced in obtaining a good setting of berries and seeds in the preliminary breeding work which has been carried out. This is thought to be due to pollen being non-viable and stigmas non-receptive at the usual time of pollination. Preliminary work has indicated that good setting may be obtained by certain methods of artificial pollination, but his work requires to be followed up and a technique developed with a view to breeding new varieties.
- (3) Difficulty has been experienced in raising seedlings satisfactorily. A study of the factors affecting their growth is required for the production of suitable new varieties.

- (4) The introduction and testing of further new varieties from outside.
- (5) The crossing of different varieties in order to combine desirable characters.
- (6) A study of the problem of the supply of seed tubers for crops raised at different seasons of the year.

5. In the Punjab plains two crops of potatoes are raised annually:—(1) the autumn crop which is planted in September and harvested in January; (2) the spring crop which is sown in February and harvested in April and May. In the hills ordinarily one crop is raised. It is planted in April and harvested in September-October. Potato tubers require a period of rest after harvesting before they are fit for planting, and the crop harvested in the hills in October provides the necessary seed for the crop planted in the plains in February. There is, however, great difficulty in obtaining seed for the autumn sown crop in the plains. Owing to climatic conditions very heavy losses occur in the storage of potato tubers in the plains during the summer months. Losses as high as 60 to 70 per cent. of the potatoes stored from harvesting time in April till sowing time in September are common, and hence the rates charged for seed tubers for this crop are very high. In practice a large proportion of the seed required for the autumn sown crop is imported at considerable expense from such places as Patna and Farukhabad. Possibilities appear to exist of utilising the crop harvested in June in certain localities in the low hills of the Kangra Valley for the sowings in the plains in September. These possibilities require to be thoroughly explored for, if they prove to be successful, they offer a solution to a problem of great importance to potato growers in the Punjab plains as well as in the adjoining territories.

6. *Facilities required.*—To carry out the scheme of breeding and acclimatization proposed, facilities are required in the hills at an altitude of 5,000 to 6,000 ft. Facilities are also needed for testing in the plains the value of the results obtained in the hills. For the former the Agricultural Department possesses no facilities at present, but for the latter ample facilities are available at several experimental and other farms which the Department possesses in the plains. In the present scheme, it is proposed that the Imperial Council of Agricultural Research should finance part of the expenditure connected with the breeding investigations in the hills. It is considered that an area of about 5 acres of land will be required. The other requirements, equipment, etc., are shown in the attached statement

It is proposed that the work should be carried out by a Botanist under the guidance of a senior officer in the Botanical Section at Lyallpur, who already has many years' experience of work on potatoes and who has carried out most of the work, which has been done so far on this crop. At present the only whole-time staff provided for work on the potato crop consists of one Potato Supervisor drawing Rs. 55 per mensem. His services will be made available by Government for the purpose of this scheme, and it is proposed that, in addition to his pay, Government should meet the recurring charges in connection with the rent of the necessary land and buildings in the hills and should credit annually to the Imperial Council of Agricultural Research a sum equal to the income credited into the treasury from this land. The amount is estimated to be about Rs. 200 per annum. Government would also meet the non-recurring expenditure connected with fencing the land. Government's contributions would, therefore, be—

	Rs.
Non-recurring	200
Recurring	1,410 per annum.
Total	7,250 spread over five years.

In addition, Government would provide the land, buildings, labour and all other costs involved in trials connected with potato research on the farms selected for the purpose in the plains.

The total cost of the scheme, according to the attached statement, is estimated to be—

	Rs.
Non-recurring	700
Recurring over a period of five years	43,310
Total	44,010

Deducting the contributions of the Punjab Government the Imperial Council of Agricultural Research is requested to finance this scheme over a period of five years to the following extent :—

Non-recurring	Rs. 500
Recurring	36,260
Total	<u>36,760</u>

EXPENDITURE.

Non-recurring.

One pair of hill bullocks	Rs. 200
Implements and other equipments	300
Fencing	200
Total	<u>700</u>

Recurring.

	1st year.	2nd year.	3rd year.	4th year.	5th year.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs
Staff—						
(Botanist for potatoes on Rs. 250—25—350 (less 15 per cent.)	2,550	2,850	3,150	3,450	3,750	15,750
1 Agricultural Assistant on Rs. 100—10—140 (less 15 per cent.).	1,020	1,140	1,260	1,380	1,500	6,300
1 Potato Supervisor on Rs. 35—2—55.	660	660	660	660	660	3,300
1 Plant Observer on Rs. 20—1—24.	240	252	264	276	288	1,320
1 Laboratory Attendant on Rs. 20—1—24.	240	252	264	276	288	1,320
1 Peon on Rs. 14 . . .	168	168	168	168	168	840
3 Beldars on Rs. 15 each . . .	540	540	540	540	540	2,700
1 Chowkidar on Rs. 13 . . .	156	156	156	156	156	780
Casual labour	300	300	300	300	300	1,500
Feeding stuffs	250	250	250	250	250	1,250
Seeds and manures	300	300	300	300	300	1,500
Contingencies	400	400	400	400	400	2,000
Travelling allowance	400	400	400	400	400	2,000
Rent of land	250	250	250	250	250	1,250
Rent of buildings	300	300	300	300	300	1,500
TOTAL	7,774	8,218	8,662	9,106	9,550	43,310

ANNEXURE V.

A SCHEME OF RESEARCH ON THE STORAGE OF SEED POTATOES IN BIHAR AND ORISSA.

Bihar and Orissa has nearly 60,000 acres under potatoes and the crop from this area is valued at over rupees two crores. It is essentially the small main crop and its cultivation enables him to meet his liabilities to a considerable extent. The grower is also the stockist.

Over 100,000 maunds of seed potatoes valued at Rs. 12 to Rs. 15 lakhs are exported every year for planting in Bengal, East United Provinces, parts of Central India and the Punjab. Owing to the high percentage of losses that occur in storage under village conditions from harvest to planting the price of seed potatoes in October-November is four to five times of that at the harvest time in March. Investigations which will lead to practical measures capable of being adopted by the villagers for the reduction of these losses, if not their complete elimination, will automatically bring down the price of seed potatoes at planting time. This will be to the advantage of the potato cultivators in those provinces to which the seed is usually exported. Cold storage method of preserving seed potatoes or methods involving large initial expenditure are beyond the reach of the ordinary cultivator. Simple inexpensive methods which will minimise losses are required if the stockist is to be benefitted. The Department of Agriculture in Bihar and Orissa carried out work on these lines some years ago and devised the sand storage method to reduce losses from insect attack. It is now carrying out work, with the help and advice of the Imperial Institute of Agricultural Research, Pusa, on other methods of storing seed potatoes especially the charcoal dust method. This work however is on a small scale and in order to get results quickly it is necessary to pursue the matter on a more extensive scale. That the object of these investigations is of more than provincial importance cannot be denied and it is on these grounds that the scheme is being submitted to the Imperial Council for a small grant for supplementing the small scale efforts of the Department.

Another problem that is purely of extra provincial importance is the loss that occurs in the transport of the seed due to faulty packing. It is felt that suitable and inexpensive containers will go a long way to reduce this loss and it is necessary therefore to tackle this aspect of the problem also.

While the Department gratefully acknowledges the help of the Imperial Institute of Agricultural Research in dealing with the problem on a small scale it is essential that there should be a whole time man with necessary laboratory facilities on the spot to study the subject in all its bearings in order to achieve results of value. As the problems to be solved mainly centre round the prevention of disease, only a plant pathologist can successfully deal with these and provision has accordingly been made in the scheme.

It is proposed to carry out these investigations over a period of 3 years in the first instance. It ought to be possible to get some results at the end of this period. Further extension of the scheme will rest on the merits of the case.

Investigations on the varietal, cultural and manurial problems of the crop being of local importance only, it is not proposed to ask any help from the Imperial Council of Agricultural Research for this work. These form a part of the normal routine of the Department and as such will be continued.

The work will be carried out at the Patna Experimental Farm as the storage of seed potatoes during the rains is mainly confined to South Bihar. Necessary Laboratory and office accommodation exists at this farm and will be made available to the scheme. Provision has been made for the purchase of seed potatoes at harvest time. Receipts from the sale of these at planting time will therefore be credited to the Imperial Council of Agricultural Research. On financial grounds it is not possible for the local Government to contribute anything more than making available the necessary accommodation.

Financial.

	Rs.
A. Non-recurring:—	
Laboratory equipment	5,000
Office equipment	2,000
Storage equipment, Kacha sheds, etc.	2,000
Total	7,600

B. Recurring :—**1. Staff—**

One Plant Pathologist @ Rs. 200—10—220.

One Laboratory Assistant @ Rs. 60—4—68.

One Clerk @ Rs. 40—2—44.

Two peons @ Rs. 10 each.

2. Travelling allowance @ Rs. 500 per annum.**3. Laboratory and Office contingencies @ Rs. 1,500 per annum.****4. Purchase of seed potatoes @ Rs. 1,000 per annum.***Details of 3 years expenditure.*

	1st year. Rs.	2nd year. Rs.	3rd year. Rs.
1. Staff	3,840	4,032	4,224
2. Travelling allowance	500	500	500
3. Laboratory and office contingencies	1,500	1,500	1,500
4. Purchase of potatoes	1,000	1,000	1,000
Total	6,840	7,032	7,224
Total for 3 years Rs. 21,096			

Details of non-recurring expenditure.

	Rs.
1. Two Microscopes and accessories	1,500
2. Incubator and other apparatus	1,000
3. Glassware	750
4. Chemicals, etc.	750
5. Laboratory furniture and fittings	1,000
	5,000

Office equipment.

1. Typewriter	350
2. Furniture	250
	600

Storage equipment.

1. Cost of putting up Katcha huts for storage of seed	1,800
2. Trays, Bamboo Racks and other appliances	200
	2,000

ANNEXURE VI.**SCHEME FOR POTATO RESEARCH.**

The chief problem in connection with potato cultivation in the Central Provinces and Berar is that of storage and there can be no doubt that much larger areas would be grown if the cultivator could store his own seed or get it from local sources instead

of having to import it from outside the province every year. The heavy freight charges, on the seed and its heavy cost are deterrent factors in the expansion of the crop.

One of the results of the depressed agricultural conditions of recent years is the interest taken by growers in money crops and garden cultivation. The area under fruit and sugarcane has increased and the cultivator is no longer content to grow only the staple crop of the tract, *e.g.*, rice, wheat or cotton but is turning to the more remunerative intensively cultivated crops like potatoes, sugarcane, oranges, mangoes, etc.

The question of a seed supply for the potato grower becomes therefore a very pressing one.

Disease is of greater importance in potato cultivation than in most other crops. Root parasites in the form of sclerotia-producing-fungi and species of *Fusarium* as well as virus diseases take a heavy toll and make potato growing a difficult and sometimes unremunerative business while as soon as it is harvested, it becomes subject to bacterial rot and other forms of disease which renders it unfit either for food or for sowing.

A survey of the many diseases of the potato in the Central Provinces and Berar is therefore called for and if this is to be done satisfactorily, it will be necessary to increase the staff of the Mycological Department as the present staff cannot be spared for the duration of the investigation which is expected to last for three years.

The scheme, therefore, is to obtain through the Imperial Council of Agricultural Research a highly qualified assistant to undertake the work of investigating the diseases of potatoes for a minimum period of three years. The cost is estimated as follows :—

	First year.	Second year.	Third year.	Total.
	Rs.	Rs.	Rs.	Rs.
Pay of Assistant at Rs. 200—25—250 per mensem, Provincial Agricultural Service, Class II.	2,400	2,700	3,000	8,100
Pay of Chaprasi at Rs. 11 per mensem	132	132	132	396
Travelling Allowance	750	750	750	2,250
Agricultural experiments, etc.	1,500	1,500	1,500	4,500
Total	4,782	5,082	5,382	15,246

To explain these items in greater detail : As the post will last for three years only, it will be necessary to offer a higher salary in order to obtain the services of a qualified Mycologist. He will be required to do a considerable amount of touring as potato cultivation is carried on in three totally different tracts—the Hills, the Plateau and the Plains—and conditions vary in each. The item of Rs. 1,500 under "experiments" is meant to cover the cost of seed, etc., for storage experiments in the three tracts.

These experiments will be carried out on the Government farms and demonstration plots in the potato growing tracts and no grant is being asked for cultivation expenses as the department will meet these in the ordinary course of its demonstration work.

The investigation will be directed by the Mycologist to Government who will also place the necessary laboratory accommodation and other facilities at the disposal of the investigator.

The problems of storage are already being tackled on a small scale on the Experimental Farm, Chhindwara, and also at the Government Garden, Pachmarhi, but the experiments need to be extended to get speedy results.

ANNEXURE VII.

POTATO RESEARCH SCHEME FOR ASSAM.

There is hardly any need to emphasise the importance which the potato crop is rapidly assuming all over India, as well as the necessity for improving the varieties. In the Provinces of Bengal and Assam it has become one of the most important winter crops and its cultivation is rapidly extending, owing to the fall in the price of jute it has become an important money crop for the small cultivators. As pointed out by Mr. B. C. Burt, the Agricultural Expert to the Council of Research, in his note on the scheme for Madras, the potato crop is essentially the small man's crop and its extension should be encouraged. On account of the moist heat during the summer and rains in the plains it is extremely difficult to preserve seeds for the next year's planting and most of the seeds in the plains have to be imported from the hills.

2. The work done so far by the different Departments of Agriculture to improve the seeds and to maintain the standard has been comparatively meagre. The crop deserves much more attention from the Departments than has been given hitherto.

3. Potato was originally introduced in the Khasi and Jaintia Hills more than a century ago but owing to the same seeds being grown year after year the crop rapidly degenerated. The Government of Assam started the Upper Shillong farm as early as 1897 mainly with the object of improving the potato crop which continues to be the principal crop of the farm, and as a result mainly of the efforts of the Department, continues to be the chief money crop in the plateau of Khasi and Jaintia Hills. The annual value of the crop raised in Khasi and Jaintia Hills, of which over fifty per cent. is exported (mostly for seed), is estimated in a normal year at about rupees twenty lakhs. This is perhaps one of the few experimental stations specialising in potato experiments and admirably suited for the purpose. There are at present 30 acres under this crop at the farm and apart from the cost of land and buildings the Local Government is spending about Rs. 9,000 per annum for the improvement of this crop, besides maintaining a demonstration staff.

The method of cultivation is very similar to that in the Nilgiris. Practically all the potatoes of the Khasi and Jaintia Hills are now grown from seeds originally obtained from the Upper Shillong farm. Until a few years ago the demand for seeds from this farm was confined mainly to Khasi Hills and the Province of Assam. Seeds from the farm are, however, now exported not only to different parts of Assam and Bengal but almost all over India and the demand is constantly increasing, e.g., seeds from this farm have been sent to various places in United Provinces, Rajputana, Central Provinces and to different parts of Bengal, Bihar and Orissa. The increased demand for improved seeds has brought in its train the problems of more systematic selection, experiments, and of the maintenance of the standard of the seeds, which are of All-India importance.

4. The problems which require thorough investigation may be stated briefly as follows:—

The experiments of the Upper Shillong farm were so far confined to the renewal of seeds from Great Britain to prevent deterioration and to carry out selection to maintain the improvement. On the whole the experience gained has shown that such renewal is necessary to prevent the degeneration of seeds. Further, some varieties have been found to stand out and retain their superiority for a long period. It is desirable to make experiments to find out definitely how long the best varieties can continue their high yields and under what conditions.

5. The main crop in Khasi and Jaintia Hills is grown during the summer but instead of storing their seeds during the rains and winter the cultivators plant a second crop in August which is harvested in November and December and planted in February for the main crop. Some experiments were conducted to see how far storage in the summer could replace winter planting. On the whole, under the conditions obtaining in the farm, storing appears to be preferable to winter planting but this requires larger storage accommodation. It is necessary to find out the comparative costs carefully and also to test the best method of storage.

6. The size of tubers planted, determines the cost of seed per acre which is the main deterrent to the extension of the potato cultivation. The usual practice is to keep the smallest tubers for seeds as a large area can thus be covered, but whether this is economical in the long run or whether cut sets can be used with advantage for the same purpose remains to be worked out.

7. *Phytophthora infestans* which invariably attacks the crops in Khasi and Jaintia Hills and occasionally in the plains is proving a serious menace to the cultivation of potatoes. Some improvement has been effected by clean cultivation and rotation but much remains yet to be done. It is necessary to carry out experiments to discover comparatively immune types. There are several other Fungus diseases attacking the seeds, particularly during storage, which require further investigation regarding the best method of control. This can perhaps be best worked out on the spot.

8. Considerable loss occurs during the despatch of potato seeds from the Hills owing to the defective methods of packing and storage. This is one of the principal causes of high prices of seed potatoes in the plains. It is proposed to investigate and devise more suitable methods.

Funds are now required to carry out experiments on the following lines :—

- (1) Variety trials.
- (2) Hill selection of potatoes—
 - (a) to improve the quality and (b) to develop the resistive varieties against *Phytophthora*.
- (3) Investigation into *Phytophthora* disease—
 - (a) Morphological and Physiological conditions of the diseased plants.
 - (b) Optimum moisture, temperature, humidity, for the spread of the disease.
 - (c) Control of *Phytophthora* by spraying and dusting of different chemicals.
 - (d) The effect of rotation and green manuring.
- (4) Storage of potatoes above and under ground.
- (5) Manurial experiments of potatoes with cowdung, Ammophos, Sodium Nitrate, Superphosphate, Sulphate of Potash in single and different combinations.
- (6) Prevention of attack by white ants and cut worms.

All the above experiments will be carried out at the Upper Shillong farm. The results obtained will be applicable to many parts of India. The Local Government will be responsible for providing land, accommodation and general supervision as well as labour for ordinary cultivation. A statement is enclosed herewith showing the expenditure for which the Local Government will be responsible. Assistance is now sought for a small subordinate staff, which it is necessary to employ as well as for the additional equipment. A small room can be made available for conversion into a temporary laboratory.

9. As the farm is situated only 5 miles away from my headquarters the work will be carried out under my personal supervision acting on the advice of the Economic Botanist. It is also hoped that the help of Pusa will be available for Mycological Investigations and advising generally on this branch of the work. It will be possible to accommodate one of the Assistants and the Fieldman on the farm but there are no quarters where the other Assistant can be housed. It will be hardly worth-while to build a quarter for such a short period. He can, however, come up to the farm from Shillong for which a conveyance allowance has been provided. A statement of expenditure for five years is enclosed herewith. The scheme consists of two parts :—Selection and Cultural, and Mycological. These can be worked independently of each other and I have, therefore, submitted separate estimates for these two schemes. An alternative scheme for a complete Mycological staff is also enclosed in case substantial help from Pusa is not available.

10. The Mycological Assistant will also be able to help in the investigations of the disease of orange trees in the Fruit Research scheme. The citrus experiments station will be situated less than 40 miles away.

J. N. CHAKRAVARTY,
Offg. Director of Agriculture, Assam.

TO BE PROVIDED BY THE COUNCIL OF RESEARCH.

I. SELECTION EXPERIMENTS.

Details.	1st year.		2nd year.		3rd year.		4th year.		5th year.		Total.		
	Non-recurring.	Recurring.	Non-recurring.	Recurring.	Non-recurring.	Recurring.	Non-recurring.	Recurring.	Non-recurring.	Recurring.	Non-recurring.	Recurring.	
	1	2	3	4	5	6	7	8	9	10	11	12	13
ESTABLISHMENT.													
Botanical Assistant—Rs. 80-90—100—4—140—6—200.	Rs. ..	Rs. 960	Rs. ..	Rs. 1,080	Rs. ..	Rs. 1,200	Rs. ..	Rs. 1,248	Rs. ..	Rs. 1,296	Rs. ..	Rs. 5,784	
Fieldman—Rs. 20—25—30—4/2—50.	Rs. ..	Rs. 240	Rs. ..	Rs. 300	Rs. ..	Rs. 360	Rs. ..	Rs. 360	Rs. ..	Rs. 408	Rs. ..	Rs. 1,668	
Peon—Rs. 14—1/4—17—1/4—19.	Rs. ..	Rs. 168	Rs. ..	Rs. 168	Rs. ..	Rs. 168	Rs. ..	Rs. 180	Rs. ..	Rs. 180	Rs. ..	Rs. 864	
Travelling allowance	Rs. ..	Rs. 400	Rs. ..	Rs. 400	Rs. ..	Rs. 400	Rs. ..	Rs. 400	Rs. ..	Rs. 400	Rs. ..	Rs. 2,000	
CONTINGENCIES.													
Godown for underground storage.	Rs. 1,500	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. ..	Rs. 1,500	Rs. ..	
Seeds, plants, manures, etc.	Rs. ..	Rs. 1,000	Rs. ..	Rs. 1,000	Rs. ..	Rs. 1,000	Rs. ..	Rs. 1,000	Rs. ..	Rs. 1,000	Rs. ..	Rs. 5,000	
Labour	Rs. ..	Rs. 360	Rs. ..	Rs. 360	Rs. ..	Rs. 360	Rs. ..	Rs. 360	Rs. ..	Rs. 360	Rs. ..	Rs. 1,800	
Miscellaneous Contingencies	Rs. ..	Rs. 250	Rs. ..	Rs. 250	Rs. ..	Rs. 250	Rs. ..	Rs. 250	Rs. ..	Rs. 250	Rs. ..	Rs. 1,250	
Packing and transport, etc.	Rs. ..	Rs. 500	Rs. ..	Rs. 500	Rs. ..	Rs. 500	Rs. ..	Rs. 500	Rs. ..	Rs. 500	Rs. ..	Rs. 2,500	
Total	Rs. 1,500	Rs. 3,878	Rs. ..	Rs. 4,058	Rs. ..	Rs. 4,238	Rs. ..	Rs. 4,298	Rs. ..	Rs. 4,394	Rs. 1,500	Rs. 20,866	
												Total 22,366.	

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TO BE PROVIDED BY THE COUNCIL OF RESEARCH.

II.—MYCOLOGICAL EXPERIMENTS.

Details.	1st year.		2nd year.		3rd year.		4th year.		5th year.		Total.		
	Non-recur-ring.	Recur-ring.	Non-recur-ring.	Recur-ring.	Non-recur-ring.	Recur-ring.	Non-recur-ring.	Recur-ring.	Non-recur-ring.	Recur-ring.	Non-recur-ring.	Recur-ring.	
	1	2	3	4	5	6	7	8	9	10	11	12	13
ESTABLISHMENT.		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Mycologist on Rs. 250—260—20—320.	..	3,000	..	3,120	..	3,360	..	3,600	..	3,840	..	16,920	
Laboratory Assistant—Rs. 50—2½—100.	..	600	..	630	..	660	..	690	..	720	..	3,800	
One peon at Rs. 14—½—17—½—19.	..	168	..	168	..	168	..	180	..	180	..	864	
Laboratory servant—Rs. 15—½—20.	..	180	..	180	..	192	..	192	..	204	..	948	
Conveyance allowance for Mycologist at Rs. 30 per mensem.	..	360	..	360	..	360	..	360	..	360	..	1,800	
Travelling allowance . . . . .	..	1,000	..	500	..	500	..	500	..	500	..	3,000	
NEW WORKS.													
CONTINGENCIES.													
Instruments and appliances	4,000	..	..	..	..	..	..	..	..	..	..	4,000	..
Conversion of a room into a laboratory.	750	..	..	..	..	..	..	..	..	..	..	750	..
Chemicals, etc. . . . .	..	350	..	350	..	350	..	350	..	350	..	1,750	
Miscellaneous contingencies (Office expenditure and miscellaneous).	..	250	..	250	..	250	..	250	..	250	..	1,250	
Total .	4,750	8,908	..	8,558	..	8,840	..	6,122	..	6,404	4,750	29,832	

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NOTE BY THE IMPERIAL MYCOLOGIST, PUSA.

The help that can be given by the Imperial Mycologist consists in advice to and discussion with the officer in charge of the scheme on questions he may offer for consideration, in the provision of literature on the diseases of potatoes and of experimental field-work in other countries for perusal, in the identification of potato disease causing fungi that may be sent to his laboratory and to a limited extent in working out specific items with regard to the physiology of these fungi.

If a study of the diseases of potatoes is to be made in Assam, as must be done to make the scheme workable, adequate provision for staff and experiment must be made.

As all experiments will have to be carried out at the Upper Shillong Farm, I presume, the Assistant Mycologist's laboratory will be there. He will have to be on the farm or in his laboratory every day and his living at a distance of five miles will be a handicap to him. A conveyance allowance of Rs. 15 per month seems insufficient adequately to overcome this handicap. It depends, of course, on rates for conveyance which will probably be somewhat high in a headquarters station like Shillong.

In paragraph 10, it is implied that the mycological assistant will be able to help in the investigation of the diseases of orange trees, at a Citrus Research Station forty miles away. The requirements of this duty should be more clearly defined. As citrus is a permanent crop and potatoes are grown in two seasons each year it is going to be difficult adequately to deal with the diseases of both crops. So it is a matter for consideration whether it will not be better in the long run to confine his responsibility to intensive work on potato diseases.

A laboratory Assistant ought to be provided in the first scheme, if it goes through, because cultures will have to be kept going and observations recorded both in the laboratory and in the field when the mycological assistant is away on tour as he may be pretty frequently.

The provision for laboratory equipment, viz., Rs. 1,500 in two years non-recurring and Rs. 250 per annum recurring is not sufficient. The list of equipment in the potato scheme includes three microscopes presumably to be used by Botanical and Mycological posts of the scheme. For the high power microscope Rs. 450 is inadequate. It will cost Rs. 560. One dozen beakers, two dozen reagent bottles and half a dozen flasks are quite inadequate. Rs. 3,600 non-recurring and Rs. 350 recurring are required. A list of equipment is enclosed. Some of the items may be used by the Botanist also and it is known that some spraying apparatus is already in the Upper Shillong Farm. The miscellaneous grant should also be Rs. 350. These sums are about the minimum required adequately to carry out the investigation. Some touring will have to be done in the potato growing tracts and provision ought to be made for travelling allowance.

APPARATUS.

Name of articles.	Quantities.	Price.		
		Rs.	A.	P.
1. Leitz microscope with stand No. DT. 28/92 and optical equipment No. 6	564	8	0
2. Dissecting microscope	60	0	0
3. Autoclave, Pressure sterilizer, vertical type, made of cast aluminum size—Diameter 10½", Depth 14" and capacity 21 lbs. (Central Scientific Co., U. S. A.)	200	0	0
4. Hot air sterilizer	200	0	0
5. Hearson's incubator, Hot	385	0	0
6. Capsules for incubator	30	0	0
7. Stokes water still	150	0	0
8. Balance—Physical	60	0	0
9. Becker's sons gramme weight 100 grms. pieces down to 1 milligram	17	8	0
10. Zeiss Aplanatic folding magnifier × 10	2 at Rs. 20	40	0	0

APPARATUS—*contd.*

Name of articles.	Quantities.	Price.
		Rs. A. P.
11. 'Ubel' Headland Portable Spraying apparatus with double barrel Ram Pump, complete with accessories and spare parts (The United Brass Foundry and Engineers, Ltd., Empress Foundry, Cornbrook, Manchester, England) price with freight £37 . . . . .	..	500 0 0
12. Holder Harriden Pneumatic Sprayer 10-gallon with wheel carrier. (Holder Harriden Co., 35/37, Noble Street, London, E. C. 2)—£21 . . . . .	..	290 0 0
13. Dust gun for sulphur dusting . . . . .	..	75 0 0
14. Mortar and Pestle 4" (Porcelain)	1	1 0 0
15. Baskets iron wire without joints 6" × 6" × 6"	6	9 0 0
16. Forceps steel nickel plated with roughened blunt point 4"	3	4 8 0
17. " " " " " fine	3	3 12 0
18. Scalpel metal handle (medium)	4	4 0 0
19. " ebony handle large	4	6 0 0
20. " " medium	4	5 4 0
21. " " small	4	4 12 0
22. Scissors 4"	1	1 0 0
23. " blunt	2	2 0 0
24. " fine	2	2 0 0
25. Needle holder of metal nickel plated	4	3 0 0
26. Platinum needle holder 10" long with screw cap	2	3 0 0
27. Plain white wood box to hold slides 3" × 1" 6 dozen slides	2	12 0 0
28. Razors Hollow ground keen edge	6	15 0 0
29. Cushion strop	1	2 0 0
30. Razor hone 5½ × 2"	1	2 8 0
31. Keen cutter oil	1	2 4 0
32. Screw driver 4"	1	0 13 0
33. Clasp pruning knives with stag handle	2	4 0 0
34. Iron tripod	3	1 8 0
35. Retort Stand	2	4 0 0
36. Wooden filtering stand	2	6 0 0
37. Asbestos wire gauge 4" × 4"	6	2 0 0
38. Asbestos sheet 1 sq. ft.	4	6 0 0
39. Primus Stoves No. 2	2	16 0 0
40. Spatula horn	3	1 8 0
41. Rubber cork, assorted size	12	10 0 0
42. Velvet cork, assorted size	1 gross	5 0 0
43. Vascula	2	16 0 0
44. Rubber tubing, assorted size . . . . .	..	20 0 0
45. Brush bottles	4	2 0 0
46. Brush Test tubes	12	1 0 0
47. Brush Camel hair	12	5 0 0

GLASS APPARATUS.

Name of articles.	Quantities.	Price.
		Rs. A. P.
48. Glass specimens Jars with ground flange 10"×4"	12	72 0 0
49. Glass Jars for storing tubes 9"×5½"	6	12 0 0
50. Glass basins with bell covers without knob fitting outside 9"×2"	12 pairs	42 0 0
51. Petri dishes 3" diameter	6 doz.	48 0 0
52. " " 4" "	6 "	72 0 0
53. Medicine bottles for culture	1 gross	20 0 0
54. Flasks, boiling, flat bottom, 250 cc.	2 doz.	10 4 0
55. " " " " 500 "	2 "	16 4 0
56. " " " " 1,000 "	2 "	33 10 0
57. " " " " 1,500 "	½ "	12 0 0
58. " Erlenmayer, 250 cc.	6 "	30 0 0
59. " " " 500 "	1 "	8 0 0
60. Beakers with spout 50 "	1 "	3 9 0
61. " " " 250 "	1 "	5 8 0
62. " " " 500 "	1 "	9 0 0
63. " " " 1,000 "	1 "	14 0 0
64. " " " 1,500 "	½ "	9 0 0
65. Flasks, measuring with stopper 250 cc.	1 No.	1 8 0
66. " " " 500 "	1 "	1 14 0
67. Filter Funnel glass with stop cock, cup form 100	2 Nos.	6 0 0
68. Graduated cylinders with spout 50 cc.	2 "	1 0 0
69. " " " " 100 "	2 "	1 5 3
70. " " " " 250 "	2 "	2 4 0
71. " " " " 500 "	2 "	3 0 0
72. Pipettes 1 cc.	2 "	1 8 0
73. " 5 "	4 "	1 8 0
74. " 10 "	4 "	2 0 0
75. " 25 "	2 "	1 8 0
76. " graduated 5 cc.	2 "	1 0 0
77. " " 10 "	2 "	1 0 0
78. Test tubes, rimless, 6"×3/4"	4 gross	24 0 0
79. Roux Potato tubes, 8"×1"	3 doz.	15 0 0
80. Microscope slides 3"×1"	6 gross	20 0 0
81. " cover glass No. 1, 3/4" diameter	2 oz.	9 0 0
82. " " " No. 2, " "	2 "	9 0 0
83. Desiccators, glass, 8"	2 Nos.	18 0 0
84. " " 6"	2 "	8 0 0
85. Schusters drop bottles, stoppered, 50 cc.	2 "	0 10 0
86. Drop bottles with groove, 50 cc.	6 "	1 12 0
87. Drop bottles with solid rod, ground stopper cap 2 oz.	6 "	7 8 0

GLASS APPARATUS—*contd.*

Name of articles.	Quantities.	Price. Rs. A. P.
88. Reagent bottles n.m. with ground stopper, 250 cc.	1 doz.	8 0 0
89. " " " " " " 500 "	1/2 "	6 14 0
90. " " " " " " 750 "	1/2 "	9 0 0
91. " " " " " " 1,500 "	1/2 "	14 0 0
92. " " " " " " 2,000 "	1/2 "	20 0 0
93. Bottles winchester 2 1/2 litre cap	1/2 "	4 8 0
94. " aspirator 4	1 No.	4 8 0
95. " " 5	1 "	5 8 0
96. " " 10	1 "	10 12 0
97. Canada Balsam bottle	1 "	1 12 0
98. Cedar wood oil bottle	1 "	2 0 0
99. Bottles, w. m. ground flat stopper, 250 cc.	3 Nos.	4 8 0
100. " " " " " " 500 "	6 "	7 2 0
101. " " " " " " 1,000 "	6 "	13 8 0
102. " " " " " " 2,000 "	4 "	15 0 0
103. " extra wide mouth 500 cc.	6 "	9 0 0
104. " " " " " " 1,000 "	6 "	35 0 0
105. Bell jars with knob and without flange 5" x 10"	8 "	32 0 0
106. " " " " " " 6" x 12"	8 "	40 0 0
107. " " " " " " 8" x 18"	3 "	24 0 0
108. Specimen tubes with cork, 3" x 1"	2 doz.	3 8 0
109. " " " " " " 4" x 3/4"	2 "	3 0 0
110. " " " " " " 3" x 1/2"	2 "	3 0 0
111. Glass tubing, assorted size	10 lbs.	8 12 0
112. Spirit lamp, 200 cc.	4 Nos.	4 0 0
113. Nickrome wire for platinum needle	..	1 0 0
114. Thermometer, 200°c.	2 Nos.	4 0 0
115. " 100°c.	3 "	5 10 0
116. " 0-50°c.	3 "	12 0 0

CHEMICALS.

		3,632 9 3
Acid Acetic	1/2 lb.	0 13 0
" Carbolic	1 "	1 0 0
" Hydrochloric	1 "	1 6 0
" Lactic	1/2 "	1 11 0
" Nitric	1 "	0 14 0
" Sulphuric	1 "	1 4 0
Agar-Agar shreds	4 lbs.	32 0 0
Alcohol, absolute	1 lb.	11 12 0
Canada Balsam.	2 ozs.	3 0 0
Calcium Chloride	4 lbs.	4 0 0
" Nitrate	1/2 lb.	0 11 0
Copper Carbonate	2 lbs.	5 2 0
" Sulphate Merck	1 lb.	1 6 0
" " Commercial	1/2 cwt.	4 6 0
Form aldehyde 40 per cent. Merck	2 lbs.	2 12 0
" 40 per cent. Commercial	12 "	10 8 0

CHEMICALS—contd.

Name of articles.	Quantities.	Price.		
		Rs.	A.	P.
Glycerine, pure	½ lb.	0	6	0
Magnesium sulphate	1 „	0	14	0
Potassium Permanganate	2 lbs.	1	14	0
Ammonium Hydrate	1 lb.	1	2	0
Glucose, pure powder	2 lbs.	8	0	0
Mercury Bichloride, Merck	2 „	9	0	0
Peptone Dry (from meat)	½ lb.	5	0	0
Potassium Bichromate E. P. Cryst	¼ „	0	14	0
„ Phosphate KH_2PO_4 E. P. Dry	1 „	2	14	0
„ „ K_2PO_4 „	1 „	2	14	0
„ Iodide E. P. Cryst	4 ozs.	2	12	0
„ Nitrate pure	2 lbs.	2	4	0
Saccharose, E. P.	1 lb.	3	10	0
Cane Sugar	2 lbs.	0	8	0
Sodium Hydroxide	2 „	3	10	0
Starch	1 lbs.	2	6	0
Xylol	1 „	1	10	0
Rectified Spirit	1 drum	5	0	0
Asparagin	½ lb.	15	4	0
Quick lime	1 cwt.	5	4	0
Cerasan	10 lbs.	25	0	0
Sulphur	1 cwt.	5	4	0
Washing Soda	24 lbs.	3	0	0
Filter paper in sheet	2 qrs.	9	12	0
Drying paper	1 ream	25	0	0
Brown wrapping paper	1 „	6	0	0
Cork borer set, with handle for each borer in a set of six	1 set	3	8	0
Cotton wool non-absorbent	24 lbs.	9	12	0
„ absorbent	4 „	2	12	0
Cotton blue	10 gms.	1	6	0
Fuchsin Acid	5 „	0	6	0
„ Basic	5 „	0	10	0
Gentian Violet Basic	5 „	0	8	0
Iodine P. B. Merck	1 oz.	1	10	0
Light green	5 gms.	0	8	0
Litmus blue book	6 books	3	0	0
„ red book	6 „	3	0	0
„ powder red	1 oz.	1	12	0
„ „ blue	1 „	1	12	0
Orange G.	5 gms.	0	6	0
Safranin, pure	5 „	1	10	0
Cedar wood oil	10 „	0	10	0

ANNEXURE VIII.

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Asseyeva, T. O.

633.491 :575.247.

Vegetative mutation in the potato* Proc. U.S.S.R. Congr. Plant and Animal-Breed., 1930 :2 : 141-54.

This paper represents an attempt to make a systematic investigation of the variability of the vegetative mutations in one definite botanical species—namely, in our usual Potato *Solanum tuberosum*. The entire examination is not nearly accomplished. However, as a result of 4 years' work (1925-1928) I have succeeded in gathering a collection of vegetative mutants, containing about 140 different forms and also in showing a series of interesting regularities in their character and structure.

I have already published the results of the investigations of 1925 and 1926. This paper represents a further development and extension of this work.

I. THE PERICLINAL-CHIMERICAL STRUCTURE OF THE VEGETATIVE MUTANTS OF THE POTATO.

The method of the removal of the eyes.

In the work published 1927 I have explained the results of the investigation on eleven vegetative potato mutants as well as the method which helped to reveal their periclinal-chimerical structure. This method may be described shortly as follows.

The tubers of the investigated mutant are cut in half about two months before the planting, then all the eyes on one half of each tuber are removed 1-2 mm. deep, the other half remains untouched as a control. In the spring these and the alternate halves are planted separately on two neighbouring furrows in the field. The halves with the untouched eyes develop into plants which repeat the normal characters of the parent-mutant, whereas the halves with removed eyes develop in a considerable number of cases (25-50) per cent. into plants unlike this mutant, but similar to the normal form from which it originated. So, for instance, if we subject to such an operation the blue-tubered variety "Chugunca"—the vegetative mutant of the white-tubered "Institut de Beauvais"—then the control halves with the untouched eyes will again give blue-tubered plants, whereas the halves with the removed eyes will develop into plants with white tubers, absolutely analogous with "Institut de Beauvais".

This is to be explained by the fact that vegetative mutations affect, in the large majority of cases, the epidermal complex of tissues only, all the inner cell layers remaining normal. Consequently, the vegetative mutants have the structure of periclinal chimeras. In these cases, when the outer tissues are removed, the new buds develop from deeper lying cell layers, which are unaffected by the mutation process and give rise to plants which consist entirely of normal, unchanged tissues.

The method of the removal of the eyes was applied by me in 1927 and 1928 for the investigation of other recently found vegetative mutants and all these mutants proved to be of periclinal-chimerical structure, with the exception of a very small number of cases to which I will refer later on.

Three types of periclinal-chimerical mutants.

I have already pointed out in my previous work that, as a result of mutations of the tuber colour, plants are obtained having almost always variegated tubers. This occurs because of the fact that in the potato tubers the cells containing the anthocyanin pigment are located in the inner layers of the periderm, which is formed partly of the epidermis, partly of the sub-epidermis and these two layers can have a different complex of colour factors in chimeric mutants. In those cases when the epidermis only mutates (*vid.* Fig. 1, M. I) the colour is changed almost all over the surface of the tuber and only small patches preserve the normal primary colour, scattered irregularly or confined to the "eyebrows". In the case when only the sub-epidermis is mutating (Fig. 1, M. II) the distribution of the colours is quite the reverse. When both layers are mutating (Fig. 1, M. I & II), then the colour of the tuber is changed all over its surface, and only occasionally can be found small spots corresponding to the normal, unaltered colour, their appearance being caused by the influence of the third layer of the cone of the growing point.

*The work will be published as a whole in the Bulletin of Applied Botany.

The colour of the stems in the three mutants described, M. I, M. II and M. I+II, has also characteristic peculiarities. A quite close correlation can be observed between the colour intensity of the tubers and of the stems of the potato, which fact is to be explained, probably, by the pleiotropic influence of the gene. On the other hand, the cells in the potato stems containing pigment belong chiefly to the sub-epidermal layer. Therefore, in mutations connected with loss or gain of the tuber colour, the stem colour also changes correspondingly, but only in those cases when the sub-epidermal layer is affected, i.e., in M. II or M. I+II; in cases when only the epidermis is mutating (M. I) the stem colour remains almost unaltered and the correlation between the stem and the tuber colour is disturbed (Vid. Fig. I) Similar changes are displayed in the colour of the sprouts, which also depends almost entirely on the sub-epidermal layer.

In my material there are at the present time 45 mutations of tuber colour; in 37 of these cases the epidermis mutated, in 2 cases the sub-epidermis and in 6 cases both these layers. There is reason to presume that the mutants of the two latter groups arise not independently, but from corresponding epidermal mutants by means of a corresponding transgrouping of tissues in the case of growth as a result of certain irregularities in the mechanism of development.

Under the influence of the removal of the eyes the epidermal mutants are transformed into normal unaltered forms; the sub-epidermal mutants partly return also to the normal types and partly are transformed in dichlamyds. As for the latter the method of removal of eyes up to now has been applied only on 4 mutants which have had presumably a dichlamydeous structure, but no outer change has resulted. It is possible, however, that the investigated mutants have been in fact no dichlamyds, but polichamyds.

The genetic behaviour of the periclinal-chimeric mutants.

Before we start to discuss the behaviour of different types of periclinal-chimerical mutants of the tuber colour in self-fertilization and crosses, it is necessary to say a few words about the genetical nature of this colour in general.

The colours of tubers of the European potato varieties may be divided into three principal categories:—the violet-blue, the red and the white one. According to Salaman* the red colour of tubers depends on the factors D and R and is displayed only when both of them, i.e., when the combination DR is present; the violet-blue colour depends on the factor P and is manifested only in the presence of D and R, i.e., in the combination PDR. A white colour of tubers corresponds to all the remaining combinations. My investigations brought me to the conclusion that the presence or the absence of the factor P always influences the colour of the sprouts; in the first case they are blue-violet, in the second red-violet. Besides the factors of the general colour of tubers a factor of the colour of eyes, A, is also to be pointed out, which is displayed only in the presence of D and is connected with R. The combination DA gives white tubers with red eyes, the combination DRA and PDRA gives correspondingly red or violet tubers with dark coloured eyes; if A is absent the eyes are light or not coloured at all. The said is illustrated by the scheme given in Fig. 2.

The large outer circles in this diagram represent the tubers, the small inner circles the eyes, and the side projections correspond to the sprouts. The cross-chequing represents the blue-violet colour, the ordinary oblique represents the red colour (the red-violet in sprouts), and the clear spaces correspond to the white colour.

The given formulæ, however, do not always explain the complicated cases of segregation observed on the potato. Probably they are correct in the main, but at the same time not sufficiently complete and require supplementing. But the very fact of the dominance of the violet colour over the red, of the red over the white and of the coloured eyes over the uncoloured ones can be considered as definitely established.

Let us now turn to the picture of segregation given by our vegetative mutants with periclinal-chimeric structure. As we know the sexual cells of the plant are formed of the sub-epidermal layer, therefore a transmission of the mutating character through the seeds must take place only in the case when this layer is affected by the mutation process, i.e., only in M. II and M. I+M. II; whereas the epidermal mutant M. I must lead to segregation analogous to the normal initial form. All these expectations come true in reality.

*Salaman J. Genet, 1910: No. 1.

As table 1 shows the numerical relations found in the segregation of epidermal coloured tuber mutants (M. I) coincide completely with the segregation of the corresponding normal white-tubered varieties (N); in other words, the mutating character is not transmitted through the seeds. And though seedlings with coloured tubers occur in the subsequent generations of those mutants, they occur almost in the same quantity among the descendants of normal varieties too, and this fact is completely explained by the combination of the different factors of colour of the paternal and of the maternal plant.

The dichlamydeous mutant (Institut de Beauvais, M. I+II), on the contrary, gives a picture of segregation differing clearly from the normal. The transmission of the mutating character through the seeds is indubitable in this case.

I am working at the present time on a method of artificial transformation of epidermal mutants into dichlamyds by means of certain injuries of the growing points in the young shoots. It would be possible to approach the problem of the factorial character of mutations through an analysis of the sexual descendants of those dichlamyds. A quite certain method is not yet found. However, the attempt was successful in two cases, a proof that in principle the solution of this problem is possible.

II. THE CHARACTER, THE DIRECTION AND THE LIMITS OF CHANGEABILITY IN VEGETATIVE POTATO MUTATIONS.

The vegetative mutations in the potato affect the tubers as well as the aerial organs altering their colour, shape and structure.

Certain peculiarities in the mutations of the tuber colour have already been pointed out above. Here we will confine ourselves to the group of epidermal mutants and take into consideration the direction of the mutation processes. Of the 37 recorded cases the mutation led 17 times to a loss of the dominating character (the violet colour mutated into red or white, the red one mutated into white) and 20 times it led to its gain (the white colour mutated into violet or red, the red one mutated into violet). In other words, the relative frequency of positive and negative vegetative mutations is on the whole equal in this case. Besides this we come to the conclusion that different varieties, even of the same colour tubers, have a very different inclination to mutations caused certainly by different liability of the genotypes.

Mutations of the stem colour were always connected in my material with the mutation of the tuber colour and occurred only in M. II and M. I+II, as was mentioned above.

Of the mutations in the colour of flowers the change of the violet and blue-violet colour into white and of the white one into blue is to be noted. The shape of corollas mutated from the normal wheel-like shape into the starlike (vid. Fig. 3). The fasciation of the flower-stalks and of the panicles is also to be considered.

Especially rich and diverse are the mutations of the leaf. Leaves of some mutants, which deviate mostly from the norm, are represented in Fig. 4.

Extremely feeble changes of leaf shape and leaf structure are met with too, but they are transmitted constantly in the vegetative reproduction and must therefore be related to mutations and not to simple modification. The "Kudriash's" (wildings) of the potato must also be reckoned, probably to the mutations, those peculiarly transformed plants differing from normal ones by their large numbers of stems, feeble dissection of the leaf (Fig. 4, j), absence of blooming and small size of tubers. The "Kudriash's" are found everywhere and in a large quantity. The peasant's sowing of "Imperator" and of "Early Rose", the two most propagated varieties in U. S. S. R. contain on the average 10 to 15 per cent. of the "Kudriash's". The "Kudriash" transmits its characters constantly in reproduction by tubers, but we have succeeded in causing a return to the normal form in a very limited number of cases (about 1 per cent.) applying the method of the removal of the eyes. This leads to the presumption that the "Kudriash's" are also periclinal-chimerical mutants, but further investigations are necessary if we wish to reach absolute certainty.

III. VEGETATIVE CHANGES OF AN UNEXPLAINED NATURE.

When investigating the vegetative variability, I came across a small group of varieties, their tuber colour being of an extremely peculiar variability. The phenomena observed on them have much in common with the above-described mutations, but at the same time differ from them by such peculiar characters, that it is more correct to single them out into an independent group.

All the varieties belonging to this group have white tubers with large violet or red patches, which always correspond to the eyes; the latter are dark-coloured. This "large-spotted" colour generally remains constant in the vegetative reproduction, but sometimes almost entirely white separate tubers appear on some of the plants, the colour of these tubers being reduced to very small and sparse speckles and the eyes without any colour. These tubers, when planted separately, transmit their colour to the subsequent vegetative generations and so start a new "small-speckled" race. This race remaining constant in general in vegetative reproduction, returns from time to time to the initial "large-spotted" race.

Three groups of seedlings are obtained on self-fertilization of the large spotted race and in its crosses with the variety Furstenkrone (ddRr): large-spotted, white with coloured eyes and entirely white-tubered (vid. Table II). Besides these groups, seedlings are obtained in crosses with the variety Alme (Ddrr) which have continuously coloured tubers and light eyes as well as seedlings of a peculiar kind of colour, which can be called "hidden-spotted". This latter type of colour can be regarded as obtained by a layer of continuous colour covering up the large spotted; large spots corresponding to the eyes stand out on the general coloured background; the colour of the eyes is dark (vid. Fig. 5). I have described the same type of spots in the two selectional varieties Kanaler and Gen. Nodzu.

The removal of the eyes in the large-spotted varieties and in their large spotted seedlings leads to a transformation of their colour into a small-speckled one (vid. Fig. 5) and this change is transmitted in the subsequent vegetative generations. The small-speckled race is not affected by the removal of the eyes, whereas the removal of the eyes in hidden-spotted varieties and seedlings leads to an entirely new type of colour, never before observed in the vegetative or in the generative generation of large-spotted races. This new kind of colour, which we will call "spectacles-spotted" can be regarded as a negative representation of the large-spotted colour. In this case the general background of the tuber is coloured, and around the eyes are large sharply outlined white spots. The eyes themselves are light coloured (vid. Fig. 5).

The cause of all these peculiar phenomena is as yet entirely unexplained. Supposing that the change of colour under the influence of the removal of the eyes is caused by the manifestation of the internal component (of the small-speckled race) out of the periclinal-chimeric mutant (of the large-spotted race), then we have to admit that the seedlings of the large-spotted varieties as well consist of 25-50 per cent. of periclinal chimeras. But such a phenomenon has never been met before in the genetic literature, and its explanation from the point of view of autogenesis would involve great difficulties.

On the other hand, if we deny that the investigated plants show the periclinal-chimeric character, i.e., that they consist of two genotypically different components, then we are forced to acknowledge that the removal of eyes in this case cause a real change, a real transformation of one character into another, and not simply manifests a form which already existed before. The fact too, that the new character is transmitted to the subsequent vegetative generations speaks for a deeper change than a simple phenotypical one.

Certain peculiarities of the colour in the described spotted varieties distinguish them sharply from all the remaining European types, and bring them at the same time near to the South American native varieties. In the latter the "spectacles-spotted" and the hidden-spotted colours are met with extremely often, and frequently these types of colours change from one into another in vegetative reproduction. The removal of eyes made on one of these varieties, "the Uruguayian", transformed the hidden-spotted race into a "spectacles-spotted" one but did not bring about any noticeable change in the latter.

The crosses of a "spectacles-spotted" South American variety with the variety "Alma" (Ddrr) led to a division into the same five types of colour, as in the analogous crosses of the European large-spotted varieties (vi. Table II). The same five types were also obtained in the crosses of this variety with "Furstenkrone" (ddRr). In both cases not a single "spectacles-spotted" seedling occurred. On the other hand, in self-fertilization of the "spectacles-spotted" varieties we get a large number of "spectacle-spotted" seedlings and not a single large-spotted one (Table II). The material which is at our disposal is as yet too limited to make an explanation of all those mutual relations possible. But there is no doubt that the group of the European large-spotted varieties is very similar and related to the South American varieties.

(ENCLOSURE)

Additions to the translation under the figures :—

To Fig. 1 :—

The black coloured spaces in the figure correspond to the mutationally changed colour of tubers and stems.

To Fig. 5 :—

The arrow shows the direction of the variation.

To Table I :—

v = violet

r = red

p = pink

w = white

x = coloured eyes.

To Table II :—

The colours are :—

large-spotted

hidden-spotted

spectacles-spotted

continuous

white.

(The words are sometimes shortened.)

x = coloured eyes.

Table I.—The segregation of the Tuber Colour in Self-Fertilization and in Crosses in Normal Varieties and in their periclinal-Chimeric Mutants.

Name of the variety.	Colour of tubers.	Self-fertilization.			Crosses with the variety Furste.krone (ddRr).			Crosses with the variety Alma (Ddir).		
		No. of families.	General No. of seedlings.	Numerical relations when n=16.	No. of families.	General No. of seedlings.	Numerical relations when n=16.	No. of families.	General No. of seedlings.	Numerical relations when n=16.
Switez-N . . .	White (sprouts red-violet).	2	124	16:02	2	252	16:0w.	..	..	..
Switez-M. 1 . .	Red with white patches	3	285	16:0w.	1	81	16:0w.	1	85	4:9cr.: 11:10w.
Beauty of Habrar N.	White (sprouts red-violet).	..	..	..	..	..	..	1	19	3:37r.: 12:63w.
Beauty of Habrar M.I.	Pink with white tubers	..	..	..	4	162	16:0w.	3	37	3:03r.: 12:97w.
Sinetsvetka-N .	White (sprouts blue-violet).	3	143	16:0w.	1	18	16:0w.	3	108	3:56v.: 1:48p. 10 × 96w.
Sinetsvetka-M. 1	Violet-blue with patches.	7	379	16:0w.	1	37	16:0w.	8	240	3:41v.: 1:33p: II. 26w.
Institut de Beauvais N.	White with pink eyes	..	..	..	4	161	—: 4:57 r × : 1:09 px. 8:39w 1,3:w: 8:59w.	6	250	4:61p × : 2:18w × : 9:21w.
Institut de Beauvais M. I.	Violet-blue with white patches.	6	242	—: 4:56 r × : 1:65p × : 2:05 w × : 7:74w.	5	233	3:23p × : 3:84w × : 8:93w.
Institut de Beauvais M. 1 II.	Violet blue	2	98	4:57v × : 1:63r : 0:49p × : × 1:1:14w × : 8:17w.

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Table II.—The segregation of the Tuber Colour in Self-Fertilization and in Crosses in Varieties with Different Types of Spots.

The Investigated variety.		Self-fertilization.			Crosses with the variety Furter.krore (ddRr).			Crosses with the variety Alma (Ddrr).			
Name.	Tuber colour.	No. of families.	General No. of seedlings.	Numerical relations when n = 16.	No. of families.	General No. of seedlings.	Numerical relations when n = 16.	No. of families.	General No. of seedlings.	Numerical relations when n = 16.	
European Varieties.	Bcvinia .	Large-spotted .	2	18	large sp. × white × white. 3-55 1-78 10-67	8	185	large sp. × white × white. 6-92 0-86 8-22	5	16	conti- h-sp × l-sp × n-xous w × w. 1-33 : 3-72 : 2-62 : 0-83 : 7-45.
	Torpuil .	Large-spotted .	..	..	..	6	325	6-99 0-59 8-42		49	2-62 : 6-86 : 2-28 : 0-65 : 3-59.
	DiVarnon .	Large-spotted .	..	..	.. ..	..	..	..	3	37	3-89 : 5-63 : 2-16 : 0-43 : 3-89.
	Kanzler .	hidden—	..	..	..	..	..	..	1	35	2-75 : 2-29 : 7-31 : — 3-65.
South American Varieties.	SA 303 .	Spectacles-spect- ted.	2	50	conti- hid.l. nous spect-spr t × colour × w w. 7-68 : 4-48 : 1-28 : 0-96 : 1-80.	2	98	conti- sp. × l-sp. × nous w × w. 2-29 : 4-89 : 3-27 : 1-47 : 4-08.	1	23	3-40 : 2-76 : 2-48 : 1-40 : 4-87.
	Uruguayan .	Hidden-spect- ted	1	56	4-86 : 0-57 : 4-37 : 1-43 : 4-57.

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Translation

of

"A CONTRIBUTION TO THE QUESTION OF THE ORIGIN OF THE POTATO".

by

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A lot has been written about the origin of the potato, but the problem is not yet solved. Even in the question about its native country there are the greatest differences in literature; some of the authors regarding Chile, the others Peru and Bolivia as the place of its origin. Still less clear is the other part of the question which is the discovery of the wild growing initial form of the potato. A careful investigation of the species, in which several authors thought they saw an original form, led to the recognition of the fact that they were very distinct from the cultivated forms united under the name *S. tuberosum* L. It is true that many authors and travellers tell us about wild growing potatoes in several countries indistinguishable from the cultivated potato, but we lack in such cases two conditions: (1) a botanical investigation of the form found, (2) a guarantee that specimens reverted to the wild state have not been mistaken for wild growing potatoes.

This state of the question justifies the new work begun by the authors. As materials for this work there serve not only the entire literature on the subject, but also the vast collections of wild growing and cultivated *Solanum's* which the authors have collected on the expedition of the U. S. S. R. Institute for Applied Botany and New Cultures, in Central and Southern America (by Bukasov were made collections in Mexico, Guatemala and Colombia and by Juzepczuk those in Peru, Bolivia and Chile), and finally the personal observations of the authors on the spot. The work is not yet finished, but even what has been done up to now discloses a great number of very important facts; therefore a short account of the results attained may be of interest.

It must be said first of all, that the inquiry as to whence the potato was imported to Europe, has no direct relation to the problem of its origin; at the time of the discovery of America this culture was so widespread there that the place of export represented only an insignificant part in the area of the native potato culture. The contradictions too in this problem force us to look out for new ways, an exact botanic study of all the native kinds cultivated now in several American countries and a comparison between them and the European sorts would play a decisive role in such investigations.

As to the other point—the search for the wild growing progenitor of the potato,—two mistakes have been made: (1) not all existing tuberous species of *Solanum* have been explored, (2) the choice of the explored ones has been merely accidental. Recently it has been made clear that the tuberous species of the genus *Solanum*, subsection *Hyperbasarthrum* of the section *Tuberarium*, are very numerous in all the countries of Central and Southern America: according to Wight there are a hundred of them known now. It is true that not all of them are of the same interest, many being botanically greatly differentiated from "*Solanum tuberosum*". Unfortunately the greater number of the varieties of this subsection have not been sufficiently investigated as yet to be brought into a system; but some natural groups can be already differentiated (the works of Wittmack, Bitter and Rydberg). Further investigations must add to these groups some new ones and provoke a further systematic division of

the known groups, this is specially important for the group *Tuberosa*. Here is a summary of the groups noted:—

1. *Juglandifolia*.—Plants with woody climbing stalk; their tuber bearing is doubtful. Here belongs the whole species *S. juglandifolium* Dun, which we meet in Central America, Colombia and Ecuador. Side by side with it we can put provisionally the yellow-flowered *S. ochranthum* (Colombia, Peru Ecuador) and *S. lycopersicoides* (Peru).
2. *Oxycarapa*.—Plants with grass-like stalk and egg-like or conical fruits. Their tuber bearing is not always proved. Here belong the species: *S. Oxycorpum* (Mexico), *longiconicum* (Costa Rica), *S. man-torranthum* (Panama) *S. Colombianum* (Colombia, Venezuela), *S. dolichocarpum* (Venezuela) *S. Circaefolium* (Bolivia).
3. *Bulbocastana*.—Plants with more or less round fruits; tuberous. Here belong also two Mexican species: *S. bulbocastanum* and *S. morelliformis*.
4. *Pinnatisecta*.—Plants with star-like corolla and pinnate leaves; tuberous. They are to be divided into two groups: Central American (*S. polyadenium* Greem. *S. pinnatisectum* Dun.—, *S. Jamesii* Torr. and *S. cardiophyllum* Lindl.) and Southern American *S. Commersonii* Dun. (Uruguay, Argentina); near to this: *S. Tenue* sendt., *S. acroleucum* Bitt., *S. Calvecan*, Bitt., and so on.
5. *Tuberosa*.—Plants with mostly pinna to leaves with more or less evident articulation in the midst of the peduncle and with a pentagonal corolla; tuberous. This group has many species and prevails from Mexico to the South of Chile (in Southern America more towards the western part). Not only *S. tuberosum* L. but also the Mexican species *S. Jamisum* Lindl., *S. verrucosum* schlecht., *S. stoloniferum* Schlecht. and the South American *S. Maglia* Schlecht. (Chile) and others belong here.
6. *Etuberosa*.—Near to *Tuberosa*; differ in the articulation of the flower stalk, the tuberousness of the species belonging here is doubtful. A whole series of species in Chile belong here; *S. fernandezianum* Phil., *S. etuberosum* Lindl., *S. Pearcei* Phil. and so on.
7. *Acaulia*.—Have an undeveloped stalk, and indistinct articulation in the upper part of the flower stalk; tuberous. Here belongs *S. acaule* Bitt. (Peru, Bolivia, North-West Argentina).

It is evident that when we search for the progenitor of the cultivated potato, we mean seriously only the species of the group *Tuberosa*. But such a search is a difficult task, because there are a large number of such species and the morphological resemblance between the wild growing and cultivated forms is of no decisive importance. For instance there exist in Mexico some wild growing forms, which are very near to the potato but must be omitted because it is not likely that Mexico is the native country of the potato. (There are indications that the potato was unknown in Mexico at the time of its discovery by Europeans). All this compels us to look out for new methods for the solution of the problem.

We indicate the "differential method" suggested by N. Vavilov, which leads to the establishment of geographical centres, embracing the varietal riches and diversity of a cultivated plant. For the potato these centres are; the Peru Bolivian plateau and the Southern Chile (especially the island Chile with the adjoining islands). Indeed, the material collected by the expedition of the U. S. S. R. Institute for Applied Botany in Mexico disclosed a great poverty and Uniformity; the Colombian sorts are more various. But only in Peru, especially in the South and in the mountainous regions of Bolivia, the sorts of the potato are of extraordinary variety. The expedition of Juzepczuk found in the surroundings of Cuzoo (Southern Peru) alone, 150 different sorts of the potato; and Cevallos Tovar (1914) found in Bolivia 134. It must be noted that these "sorts" do not always correspond to what the European growers call a sort, being often composite types which can be further distinguished from one another.

Moving in the southern direction, we find in the north of Chile a rapid falling off in the number of the cultivated potato sorts which increases afterwards and culminates on the island of Chiloe. Canas Pinochet (1911) cites for Chile only two sorts for the province, Atacama 5 for Coquimbo 10 for Aconcagua 6 for Maule 17 for Arauco and finally some 140 for Chiloe. This method (1) supports the theory of the Peruvian, Bolivian or Chilian origin of the potato and (2) shows a possibility of its origin from several predecessors in every centre. That the choice of these regions as centres where the potato has originated is correct some other facts and considerations also prove, e.g., vestiges of a very ancient civilization and agriculture and the existence of many other original cultivated plants in these countries.

The Peru Bolivian Plateau had been populated by a people already extinct at the time of the discovery of America. They left behind them great monuments, of the so-called "magalithic" civilization and which gave to mankind in addition to the potato the cultures of *Chenopodium guinea Oxalis tuberosa Ullucus tuberosus Tropaeolum tuberosum*. The "mapuches" too of Southern Chile were responsible for some very interesting cultivated plants as for example the new extinct bread grain *Bromus* and the oil plant *Mecia gatiya*. It is true that the majority of the original cultivated plants were afterwards supplanted by cultures which the Inca's and the European imported; but there are no proofs that the same applies to the potato. It is of interest to remark that the Peru Bolivian plateau and Southern Chile represent ideal places for potato culture because of their climate and also because the potato is here almost entirely free from diseases.

We return now to the question of the progenitor of the potato. It is interesting to note that the areas of such wild growing species as *Solanum utile* Klotzsch., *S. Commersonianum*, *S. tuberosum* Lindl., *S. Maglia* Schlecht., which up to now used to draw the greatest attention of the investigators in search of the initial form of the potato and which have been subjected to numerous experiments, lie beyond the limits of the above mentioned regions and can have no direct bearing on our problem. Instead, a whole series of other forms, growing within the limits of the above established regions, insufficiently known upto for instance, *S. immitte* Dun., (Peru) *S. multiinterruptum* Bitt. (Bolivia) the almost unknown *S. chillioense* and many more among them some species found in Peru by S. W. Juzepczuk. All of them are very near to the cultivated potato. It is of interest that several of them are weeds.

That in time one of these forms might be recognized as the progenitor of the potato is evidently very unlikely. Already the abundance of these wild growing forms and the fact too, that many of them were and are now used as food by the native population, make it improbable that only a single form has been introduced into cultivation by primitive man. On the contrary the majority of these forms evidently appeared to him eatable, since he had learned early to remove their bitter taste. Juzepczuk was told that the Indians of the district Puno still prepare from the wild growing potatoes a special product "chuno".

The point of view developed here as to the origin of the potato from many wild growing forms, finds a proof in the botanical investigation of the native southern-American potatoes of the *Solanum tuberosum* up to now regarded as one species. This botanical study shews that the so-called "*Solanum tuberosum*", must be conceived as a collective species. To distinguish one from another of the forms many characteristics are of importance, thus for instance: the appearance of the plant, its habit of growth, the branching of the stalk; the size of the leaves, their form; the hairiness of the stalks the leaves the flower stalk and many other characteristics of the stem, leaf and flower.

All the characteristics which are employed to distinguish the varieties are of the same order as those used to distinguish and to describe the wild growing species of this subsection. Supposing that the various and well distinguished cultivated sorts of Bolivian potato were found in the wild state and not under cultivation, the systematist would without doubt regard them as a series of independent, although very allied species. We can even say that the various cultivated forms of the collective species *S. tuberosum* differ from one another by sharper and more distinct characters than from certain of the wild growing tuberiferous species and more than these wild growing species differ from one another.

The establishment of this fact must lead to a reform of the systematics of the section *Tubarium*. It seems to us that it is not right and even harmful to use different standards for the wild growing and for the cultivated plants.

In our case it would seem logical to subdivide the collective *S. tuberosum* into a series of species corresponding in their value to the wild growing species. The necessity of such a method appears specially clear in connection with what has been said about the "domestication" of several wild growing forms in the ancient area of the potato culture, not excluding of course the possibility of their hybridization afterwards. As the cultivated potato appears a conglomerate of heterogeneous forms, so it seems to us, that the problem of its origin can be solved when divided in partial questions about the origin of every single form.

That the *S. tuberosum* is a collective species is proved by the cytological examination of our material by Ryojn. He found besides the forms which have the common number 48 chromosomes, also many forms with the deviating number 24 and 36. They should be singled out in the first place, being morphologically very distinct from the sorts cultivated in Europe which we could call *S. tuberosum sensu stricto*. We give here the description of 7 of them in Latin. Only one of them *S. Rybinii* Juz et buk was found in Colombia, all the others in Peru and Bolivia these being the

countries which we marked as centres where the potato originated. Two of them, *S. tenuiflamentum* and *S. Juzepczukii*, are widespread in both those countries; the others are more localized. So for instance *S. goniocalyz* is cultivated only in Central Peru, *S. Shanburi* *S. Phuro* only in Bolivia. There are also differences between these forms in relation to the climatic condition of their cultivation and to the methods of their use. So must be singled out the species which are cultivated for the preparation of the "chuns" and it is to be expected that it is just such researches that will lead us to the discovery of a great number of original and primitive species some of them indistinguishable from the wild growing forms.

The description of the new species in latin (pp. 603-06).

The majority of the forms described shows the number of chromosomes as 24 and only *S. tenuiflamentum* and *S. Juzepczukii* have 36. Coming now to the forms with the normal number of chromosomes (48) we find that the region of their cultivation is larger—extending from Mexico to Southern Chile. In Europe only these forms have been known up to now. When we compare the European species with the Central and Southern American, we notice that they differ by many characters, although less than the native sorts differ from the forms with 24 and 36 chromosomes. There is reason to suppose that the Chilian types are very near to the European; the proof of this supposition would at last solve the question, whence the potato was imported to Europe. Certain types of potatoes with 48 chromosomes can be differentiated as belonging to certain definite regions and are characterized as strictly peculiar to Bolivia, South Peru, Central Peru, Colombia and finally to Central America, Mexico and Guatemala. The studies of the forms of these regions made by Bukasov are not yet finished; a short description of them follows:—

Bolivian group.—Represented by native varieties Huari-salla and chiar-imilla.
Huari-salla.—Tuber long bent red and yellow-leaves 4-paired. Flower stalk 19-25 mm., articulation in upper quarter. Corolla light lilac, filaments short and broad; anthers 6.5-7.5 mm. Style wide, stigma small.

Chiar-imilla.—Tuber round, flecked blue-white at eyes, leaves 5 paired. Flower stalk 16-25 mm. articulation 4 mm. under flower, calyx regular 8-11 mm. Corolla blue, anthers 7-7.7 m.m., stigma big, conical.

Southern Peru group.—Short articulation to flower stalk. Calyx short processes. Leaves 4 to 5 pairs.

Central Peru group.—The outstanding type. Leaves very divided, 6-8 pairs, corolla 3-4 petioles. Flower stalk long, articulation 7-13 below flower, and corolla, dark violet, large anthers, long style small stigma.

Group Colombian.—Bogetan—4-5 pairs leaves with large petioles. West Colombian. 6 paired leaves.

Mexico and Central America.—Low forms, small leaves.

The further investigation of the 48 chromosome potatoes will add many corrections to this scheme.

Also to the described forms of 24 and 35 chromosomes will be added a description of some new ones.

A careful study of both types is the next task. Only after becoming well acquainted with the botanical characteristics of the cultivated potatoes shall we be enabled to solve the question of its origin. Also the exploration of the wild growing forms must be continued; but only comparing them with completely investigated cultivated forms, not only comparing them with completely not with the botanically vague, "Solarum tubercum" as it has been done up to now can we hope to find a solution for the problem.

Addition.

After this paper was written in the summer 1929 the authors made a further study of some more of the new forms, whose position was mentioned above as being doubtful. There are 4 of them: 3 with 36, the last with 24 chromosomes. A short characteristic of them is given here in latin.

As to the potatoes with 48 chromosomes, it proved to be true that the majority of the potato varieties now cultivated in Europe belong to the Chilian type; they seem all to belong to the polymorphic species, *S. tuberosum* L. *Sensu strictiore*. All the remaining native forms with 48 chromosomes, from Bolivia, Peru, Colombia and Central America constitute another polymorphic species (evidently of a different origin), which can be characterized shortly as follows (p. 609).