

the agricultural needs and condition of each district of the country; and I think that there should be a *permanent agency* for the purpose in each Province, and that in such agency the assistance of an agricultural chemist would be advantageous.

I conclude the chapter by recommending (1) the spread of General and Agricultural Education; (2) the establishment of an organised system of Agricultural Enquiry; (3) the active prosecution and encouragement of positive measures, such as the supply of water, wood, &c., which have already been found to be beneficial.

RECOMMENDATIONS.

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CHAPTER III.

CHAPTER III.

CULTIVATING CLASSES.

CULTIVATING CLASSES.

It is pointed out that certain "castes" and "races" of the people of India show more agricultural ability than others, and that the differences between them as cultivators are in great measure to be referred to the caste or race distinctions existing between them. It is very certain that if the prejudices attaching to caste and race could be broken down, considerable improvement in agriculture would result. Instances are next given which show indications of a change slowly going on. Thus, the prejudices against the cultivation of indigo and of the potato have, to a great extent, disappeared; also the cases of Nagpur, Poona and Amritsar are mentioned as showing that the prejudice against the use of night-soil as manure for crops is giving way. Improvement in coffee cultivation and in the manufacture of indigo, as the outcome of the example of English planters, is also distinctly traceable. The people, it is pointed out, will lose those caste prejudices which retard improvement in agriculture, partly through the spontaneous adoption by them of the more profitable practices, and partly from the force of circumstances which make living harder and oblige more attention to be paid to cultivation. In the weakening of caste prejudice Education is a most important factor, and Government by spreading it will help to break down the caste distinctions which prevent progress in agriculture.

I therefore advocate the spread of General and Agricultural Education.

RECOMMENDATION.

CHAPTER IV.

CLIMATE.

CHAPTER IV.

CLIMATE.

WITH the aid of the "Rainfall Map" included in the Report the great variations of climatic conditions throughout India are illustrated, and their bearing is shown upon the crops grown, the agricultural systems pursued, the cattle, and even the people themselves. The close connection of famine with the rainfall is also set forth. It is pointed out that while it is to only a limited extent that climatic differences can be modified, yet that something can be done by increasing the means of irrigation in dry tracts, and by the creation of "reserves" of wood and fodder in districts where these are scarce. The influence of vegetation, and especially of trees, in improving climate is discussed; the real value consisting in the lowering of temperature, the production of a more gentle rainfall, the increase in the number of rainy days, the holding-up of the soil, the obtaining of a cooler earth-surface, and the retention of moisture by the soil.

It is maintained that such work must fall to the lot of Government, and that the people can be expected to do but little to aid it. Encouragement is, however, given to tree-planting by individuals, and this should be prosecuted more vigorously. It is further insisted that in order to get definite knowledge as to where provision of irrigation and "reserves" of wood and fodder can be made, careful enquiry must be set on foot by Agricultural Departments.

RECOMMENDATIONS.

I recommend, accordingly, (1) the extension of irrigation to dry tracts; (2) the creation of "reserves" of wood and fodder (called "Fuel and Fodder Reserves"); (3) the planting of trees along canal banks and railway lines; (4) the further encouragement of Arboriculture; (5) organised enquiry by Agricultural Departments with the view of finding out where the foregoing measures can be adopted.

CHAPTER V.

CHAPTER V.

SOIL.

SOIL.

THE principal geological types of soil which occur in India are illustrated by the help of the "Geological Map" accompanying the Report, and the presence or absence of particular kinds of soil are indicated. The neglect, in the past, of any regular scientific study of Indian soils is referred to, and the important question is next dealt with--whether or not the soil of India is becoming exhausted under the present systems of cultivation. It is admitted that there is want of positive evidence in support of exhaustion, but instances are given from Settlement Reports and from the Famine Commission's Report, of a process of deterioration

going on, and it is argued that under existing conditions of export of grain, oil-seeds, and manures, and the burning of cattle-dung for fuel, there must be a gradual deterioration of the soil. The wheat-yield of India is compared with that of other countries, and Sir James Caird's estimate of the crop-increase needed to provide against famine is alluded to, and the deduction is drawn that to supply this amount, not a *deterioration* but an *increased productiveness* of the soil is required, and that this can only be brought about by increasing the manure supply. The soils of India are then considered in respect of the different constituents which they contain, each ingredient being taken in turn. It is shown how important is the relation of water to soil, that organic matter (*humus*) and nitrogen are generally deficient in Indian soils, and that lime, potash and phosphoric acid are, as a rule, present in sufficiency. Several chemical questions of great importance are dealt with, such as the supply to plant life of nitrogen from atmospheric sources, the amount of nitrogen contained in the rainfall of India, the nature, occurrence and possible removal of saline deposits in soil, &c. The reclamation of land, whether it be ravine land, land infested with weeds, or land rendered sterile by the presence of salts (*usar* land), is dealt with, and instances are given of the various experiments which have been tried in different places. Throughout the chapter it is shown that the application of chemistry to the solution of the various agricultural problems connected with the soil is very necessary, and it is urged that future investigation should be pursued with its assistance.

In conclusion, it is pointed out that the work of soil improvement must devolve mainly upon Government, as in very few cases will the people have the means to take such measures in hand.

I recommend in connection with the improvement of the soil, (1) the increase of the supply of water to dry tracts; (2) the increase of the manure supply; (3) the setting on foot of enquiry to ascertain where such improvements are needed; (4) the continuation of experimental research aided by chemical science.

RECOMMENDATIONS.

CHAPTER VI.

WATER.

CHAPTER VI.

WATER.

It is indicated, at the outset, that while water in one form or another is indispensable in Indian agriculture, the amount and the method of supply will vary very greatly in different parts of India. In some parts rainfall is sufficient, in others artificial irrigation will be a necessity, in others, again, it may be a useful supplement. The nature of "protected" and "precarious" tracts is pointed out. The main types of water supply are summarised and then examined *in extenso*. Special points are noted, such as the benefits and the evils attending the introduction of canals, the comparison (where it is possible to make it) between cultivation by canal irrigation and by well irrigation, the differences in chemical composition between canal water and well water, &c. Embanking and drainage of land are spoken of, and instances are given of parts which stand in need of further irrigation. The great work done by Government in extending canals is favourably reviewed, and direction is turned to the necessity of Government undertaking all works of a major character, while minor ones may be carried out by the people. The possibility of Government constructing wells on a large scale is discussed, and improvements are suggested in the management of canal watercourses and tanks, and in the repair of the latter. The chapter goes on to treat fully of the system of advances known as *taccavi*; principally for purposes of well digging, and it is shown how greatly this is capable of further development, and of being made more popular and useful. It is maintained that the Agricultural Department should pay particular attention to this subject, and that a certain share of the administration should be vested in the Department. Suggestions are made as to improvements in the working of the system. Lastly, the necessity of a thorough "agricultural analysis" of each district of the country is insisted on with the view of ascertaining the local requirements in the way of water supply.

RECOMMENDATIONS.

I recommend (1) the further extension of canals and other means of irrigation to tracts where they are required; (2) the more energetic working and popularising of the system of *taccavi* advances for well digging and similar purposes; (3) the giving of a share in the administration of *taccavi* advances to Agricultural Departments; (4) the institution by Agricultural Departments of organised enquiry to ascertain the irrigation requirements of each district.

CHAPTER VII.

CHAPTER VII.

MANURE.

MANURE.

THE importance of manure in Indian agricultural systems is illustrated by extracts from various Reports, and the interdependence of water and manure is shown in the existence of the finest cultivation where both water and manure are available. Instances are given to show that the cultivator is not ignorant of the value of manure, but will, for certain crops, spend considerable sums of money upon it. The different sources of manurial supply are then examined, the ordinary cattle-manure being the most important, and, speaking generally, the only one available. Its composition is set out in analytical tables, and a comparison is instituted between it and ordinary farmyard manure, as met with in England, the result being to show that the value of Indian cattle-manure is often underrated, and that when it is burnt (as is so often the case) very serious loss is incurred. As the outcome of an enquiry in which I specially interested myself, I state the conclusion I came to, *viz.*, that the best cultivators do not burn cattle-manure for fuel except from necessity, that is, because they have nothing else to burn as fuel. The connection between the supply of firewood and that of manure is hence a very close one. Other sources of manurial supply are then dealt with in succession, *e.g.*, ashes of cattle-manure, sheep-folding, green-manuring, silt, soil-mixing, oil-seed refuse, nitre, lime, bones, &c., and various analyses of different materials so used are given in the Appendix. Special questions, such as the system of seed-bed cultivation known as *rāb*, the use and export of bones, and the likelihood of artificial manures being used in India, are treated in detail. Attention is then drawn to two points in which the cultivator does not take full advantage of the facilities he possesses (1) the non-utilization by him of night-soil for agricultural purposes; (2) the imperfect conservation of cattle-manure and the loss of the urine. In this connection instances are given of the highly beneficial results that have attended the use of night-soil, and analyses are given showing the value of cattle urine and the advantages to be gained by preserving it by the aid of litter. Incidentally, questions of town and village sanitation are touched upon, and throughout the chapter there are frequent references to investigations which could not be carried on without the aid of agricultural chemistry. In conclusion, it is maintained that water and manure constitute the cultivator's chief wants, and that the supply of manure must go hand in hand with that of water, and must, like the latter, be taken up by Government, otherwise the soil will not be able to provide for the increasing millions of the people. It is further held that, as cattle-manure is the only really available manurial source, it is incumbent on Government to provide supplies of firewood ("Fuel and Fodder Reserves") so that the cattle-manure need not be burnt, but may be set free for use on the land, and the fertility of the latter be thereby kept up.

Lastly, I set forth the duty of Agricultural Departments to make organised enquiry as to the manurial requirements of every district, to continue experimental research at Government Farms, and to spread agricultural education so as to teach better practices and remove prejudices.

RECOMMENDATIONS.

I recommend (1) the creation of supplies of fuel ("Fuel and Fodder Reserves"); (2) the establishment of a system of agricultural enquiry; (3) the spread of agricultural education; (4) the continuation of experimental work at Government Farms; (5) the employment of an agricultural chemist.

CHAPTER VIII.

WOOD.

CHAPTER VIII.

WOOD.

THIS chapter deals principally with the administration of the Forest Department and the extension of its work in a more agricultural direction than has been the case in the past. The early policy of the Department is first considered, and the reasons are given for its success having been gauged by financial results. But it is pointed out that, as population has increased and cultivation has been brought nearer to the borders of the forests, it has become necessary to extend the benefits of forests, so that they may more directly serve the interests of agriculture. In consequence of this, at the instance, first of Sir Dietrich Brandis, and then by successive representations of the Famine Commissioners and of the Government of India, a certain impulse has been given to the supply of wood for agricultural purposes. But it is urged in this chapter that there is a great deal more that ought to be done, and that the greatest need is that which was set out in the previous chapter, *viz.*, the supply of wood to take the place of cattle-manure as fuel. This is again put forward as a matter which Government should see to in their own interests, alike for the maintenance and increase of the soil's productiveness, as well as in order to keep up the Land Revenue of the country. The different classes of forests are then examined, and the uses which they might best serve are discussed, also the measures which should be taken to obtain those ends. Special points, such as the natural reproduction of timber trees, the guarding against forest fires, the exclusion of grazing, and the inadequacy of the forest staff, are alluded to separately. The wider adaptation of "reserved forests" situated near cultivation to the purposes of that cultivation is insisted on, and also the necessity of creating fresh supplies of wood. The difficulties of obtaining land for these new creations are admitted, but it is shown that there is still a quantity of land that could be so utilised, and suggestions are made for the acquirement of land, by purchase if necessary; the outlines of a scheme are also set forth for the working of the new "reserves" by a system of

annual licences for the removal of wood, etc., for agricultural uses. These views are supported by the quoted opinions of several authorities, and more especially by a recent Resolution of the Madras Government upon the subject. Cases are also cited where such "reserves" have been created, and have achieved much good. It is maintained that the success of such a scheme must not depend alone upon financial considerations, but should be considered from the point of view of the needs of the people and the demands of the principal industry of the country, viz., agriculture. Extension of the establishment of plantations along canal banks and railway lines is also urged, and the further encouragement of arboriculture. Lastly, the opinion is expressed that a proportion of the yearly revenue obtained by the Forest Department should be expended in the extension of the work of the Department in an agricultural direction.

I recommend (1) the creation of "reserves" of wood, fuel, &c., for agricultural purposes ("Fuel and Fodder Reserves"); (2) the increase of plantations along canal banks and railway lines; (3) the further encouragement of arboriculture; (4) the prosecution of agricultural enquiry for ascertaining the needs of the different cultivating districts in the matter of wood supply; (5) the setting aside yearly of a portion of the revenue derived by the Forest Department, and its employment in the extension of "reserves" to meet agricultural wants.

RECOMMEN-
TIONS.

CHAPTER IX.

GRASS.

THE different kinds of grazing areas available for the use of the cattle belonging to cultivators are referred to, and attention is drawn to the inclusion of large and valuable grazing areas amid the forests. It is maintained in this chapter that the provision of grazing in forests is a desirable and legitimate object, and one which will much benefit agriculture, whilst in times of drought it may be invaluable in keeping the cattle of the country alive. Nevertheless, it is not regarded as an absolute necessity in ordinary times, and, therefore, should only be carried on under such restrictions as would cause it not to interfere with the other ends which a forest or "reserve" should serve. These various restrictions and the necessity for their imposition are then considered. The question of the utilisation of "village wastes" is next gone into, also the provision of grazing along canal banks and in other plantations. The best way of utilising the grass in forests and "reserves," and the possibility of grass-growing and the supply of pasturage becoming a part of the cultivator's system on his own holding are discussed. In the second part of the chapter the system of Grass Farms and the utilisation of uncultivated grass

CHAPTER IX.

GRASS.

lands (*rukhs*) belonging to Government are explained, and, while their benefits are recognised and their extension urged, suggestions are also made for their improvement. The methods of hay-making and silage-making as conducted at Government Grass and Experimental Farms are examined, also the relative costs compared with the cost in England. The prospects of the development of silage-making in India are treated of and the desirability is urged of making further enquiries at Experimental Farms. Lastly, a change is advocated in the Commissariat Department, whereby the services of men of experience and ability may be retained in the management of Grass Farms, and the formation of a special Forage Branch of the Commissariat is suggested.

RECOMMENDATIONS.

I recommend (1) the creation of more "Fuel and Fodder Reserves" to supply grass and grazing; (2) the extension of the system of Grass Farms, and their management by a special Forage Branch of the Commissariat; (3) the carrying out of enquiry at Government Experimental Farms on the making of silage.

CHAPTER X.

CHAPTER X.

FODDER-CROPS
AND HEDGES.

FODDER-CROPS AND HEDGES.

THE advantages of growing fodder-crops are set forth and exemplified in the better condition of the cattle in many parts where the system is practised. The principal crops used as fodder-crops are mentioned, and, in particular, the utilisation of prickly pear. The scope for extension of the growing of fodder-crops is also shown. (It is pointed out that but little is known as to the relative values of different Indian fodders,) and that such an investigation calls for the association of an agricultural chemist. The useful ends served by hedges round fields are explained, and the materials generally used for fencing are named.

RECOMMENDATIONS.

I recommend (1) the extension, wherever practicable, of the systems of growing fodder-crops and of enclosing fields by hedges; (2) the employment of an agricultural chemist in investigating, among other matters, the relative values of different fodders.

CHAPTER XI.

CHAPTER XI.

LIVE STOCK AND DAIRYING.

LIVE STOCK AND
DAIRYING.

It is indicated at the opening of this chapter that, since the differences between the cattle of different districts are largely due to conditions of climate, improvement of cattle is only possible within limits. After speaking of their food and the excellence of the cattle in certain districts, it is shown that, as a rule, little or no attention is paid to their breeding and selection. The Hindu system of breeding from Brahmani bulls is referred to, and the harm is pointed out which is likely to follow from a recent legal decision given in the North-West Provinces as to ownership in these bulls. The breeding of good stud bulls at Government Cattle Farms, and the distribution of them to villages, are advocated, and should form part of the duty of Agricultural Departments. Further, I point out that Experimental Farms and Court of Wards' Estates might well be made centres for locating stud bulls for the improvement of the cattle of the district. Accounts are next given of the Hissar and Bhadgaon Cattle Farms, and mention is made of the influence which they, and notably the former, have exercised on the cattle of the country. The evils attending frequent changes in the superintendence of Government Cattle Farms are pointed out, as they were in the case of Grass Farms (Chapter IX). Mention is made of the use of buffaloes as plough cattle; and of the giving of advances (*taccavi*) for purchase of cattle.

In the second section of the chapter dairying is the main subject, and the special features of the yield and quality of milk from cows and buffaloes are treated of. The efforts made to extend dairy farming in India are detailed in connection with the visit of Mr. Howman, and the subsequent steps taken by Mr. Ozanne in Poona and Bombay. The unsatisfactory conditions of the milk supply to towns and to troops, as well as to Government institutions, are referred to, and the establishment of Dairy Farms is advocated wherever troops are quartered or large institutions are situated. It is pointed out that there is considerable work for an agricultural chemist to do in the investigation of points connected with dairy farming.

A brief reference is made to the operations of the Horse-breeding Department, and to attempts made to improve sheep and goats.

The last part of the chapter is taken up with the consideration of Cattle Diseases, the ravages which they cause, and the steps which have been here and there taken to cope with epidemics. Special mention is made of the establishment of an Imperial Bacteriological Laboratory at Poona.

I recommend (1) the continuance and extension of Cattle Farms, and the distribution from them of stud bulls to villages; (2) the making Experimental Farms and Court of Wards' Estates centres for the location of stud bulls; (3) the establish-

RECOMMENDA-
TIONS.

ment of Dairy Farms for the supply of milk to troops and Government institutions; (4) the appointment of an Agricultural Chemist to investigate matters connected with dairy farming; (5) the prosecution of enquiry into cattle diseases and the means of preventing epidemics.

CHAPTER XII.

CHAPTER XII.

IMPLEMENTS.

IMPLEMENTS.

THE possibility of effecting improvement in the implements of the cultivators is reviewed, and the opinion is expressed that there is but little scope for improvement, and that any advance must be the outcome of a study of native requirements. The success of the Beheea sugar-mill is instanced as a case in point. The question of the use of the native wooden plough, as against that of the iron one, is fully gone into, the several objections to iron ploughs being discussed, and the circumstances under which they might be usefully employed. The chapter then deals with the introduction and possible extension of the iron sugar-mill, the shallow evaporating-pan, and other devices for improving the out-turn of sugar. The possible use of introduced threshing machines, winnowers, chaff-cutters, pumps, and other implements is considered, and the need of more exhaustive trials of implements at Experimental Farms is urged. It is added that in these trials skilled experts, such as engineers, chemists, &c., should be associated, according as the enquiry calls for it, and that Experimental Farms should be centres for distributing implements the merits of which have been satisfactorily proved.

RECOMMENDATIONS.

I recommend (1) the exhaustive trial of new implements at Government Experimental Farms; (2) the association of "experts" in such enquiries; (3) the distribution of approved implements from Experimental Farms.

CHAPTER XIII.

CHAPTER XIII.

CROPS AND CULTIVATION.

CROPS AND CULTIVATION.

IN this chapter no attempt is made to describe the kinds of crops grown, or the methods of cultivation employed, but points only are discussed in which it seems possible to effect improvement. The general excellence of the cultivation is indicated, and the changes, more especially in wheat-growing, which have been brought about by an export trade, are mentioned. Fallowing and rotation are next taken, and instances are given to show that the native cultivator is not ignorant of either practice. The system of "mixed-cropping" is also explained, but it is pointed out that little is known or practised in regard to selection or change of seed, although some Government Experimental Farms have already done good work in growing and distributing pure and selected seed. It is then shown that improvements can be effected by the introduction of new crops, and of new varieties of existing crops, as also in the extended cultivation of certain profitable crops, such as wheat and sugar-cane. It is further demonstrated that by the transference of method from one part to another, improvements in cultivation may be carried out; this is exemplified in the case of sugar-cane, and even in that of a crop so widely cultivated as rice. Reference is made, in conclusion, to the need that exists for getting more knowledge as to the diseases and injuries to which crops are liable, and the best means of preventing them.

I recommend (1) the continuation of experimental enquiry at Government Farms, in reference to new crops and methods of cultivation; (2) the growing of good seed at Government Farms, and its distribution from them; (3) the study of the diseases and injuries of crops; (4) agricultural enquiry into existing modes of cultivation.

RECOMMENDATIONS.

CHAPTER XIV.

CHAPTER XIV.

AGRICULTURAL
INDUSTRIES AND
EXPORTS.

AGRICULTURAL INDUSTRIES AND EXPORTS.

THIS chapter deals with certain special crops which undergo a process of manufacture in the country before being sent out of it, or with which particular considerations regarding export are bound up. Such crops are sugar-cane, cotton, indigo, tea, coffee, tobacco, flax, jute, silk, wheat, and linseed. These crops are successively treated in view of the improvements which it is possible to effect either in their cultivation, their manufacture, or in the export trade. It is first shown that the yield of sugar from sugar-cane depends upon points in the cultivation, in the expression of the juice and in its refining, none of which are fully understood. Next, the deterioration of Indian cotton is alluded to, and a brief account is given of the efforts that have been made to improve its quality. Indigo is treated at some length, and the general want of knowledge, both as to its cultivation and the manufacture of the dye, is commented on. Reference is made to the need of chemical investigation into problems affecting the manufacture, and to the unsatisfactory conditions which often attend the cultivation. Similarly, chemical problems in the manufacture of tea are pointed out. The cultivation of coffee is next taken, then that of tobacco, and the native method of curing tobacco is described. After a brief mention of flax and jute, allusion is made to the efforts, so far unsuccessful, to eradicate the disease in silkworms known as *pebrine*. The important matter of the cleaning of wheat is dealt with at length, and by the help of analyses which I made of samples taken off the cultivators' own threshing-floors, or from stores in their houses, it is shown that the fault attributed to Indian wheat, that it is "dirty," does not rest with the cultivator, but is that of the trade, and more particularly the London Corn Trade, who do not want "clean" wheat. The efforts made to improve the trade in this respect, and their failure, are described. The applicability of the "elevator" system to India is also discussed. Lastly, the conditions of the linseed trade are explained, and are illustrated by analyses of a number of samples of seed collected for me in the Central Provinces.

RECOMMEN-
DATIONS.

I recommend (1) agricultural enquiry to ascertain the best methods of cultivation and manufacture of crops such as sugar-cane, indigo, tea, coffee, tobacco, &c.; (2) the employment of chemical science in the investigation of problems affecting these industries, and more especially that of an agricultural chemist in connection with the sugar industry; (3) the making it a penal offence to adulterate wheat, or to trade in adulterated wheat.

CHAPTER XV.

CHAPTER XV.

ECONOMICAL AND POLITICAL CONDITIONS.

ECONOMICAL
AND POLITICAL
CONDITIONS.

By the insertion of this chapter I wish to recognize the existence of a number of conditions of an economical or political nature which have an important bearing upon the improvement of agriculture, but into the details of which I do not enter. Under this head I mention pressure of population, relative ease or difficulty of living by agriculture, varying systems of land tenure, smallness of holdings, paucity of capital, indebtedness of the cultivating classes, export trade, extension of railways, &c. My reasons for not discussing these several points are given, the only ones mentioned at any length being the smallness of holdings, the indebtedness of cultivators, and the lack of enterprise sometimes found among the people, more especially under easy circumstances of living.

CHAPTER XVI.

CHAPTER XVI.

PRACTICAL ENQUIRY.

PRACTICAL
ENQUIRY

AFTER having sketched out in the previous chapters the principal ways in which I think that improvement of agriculture may be effected, I proceed to consider in those that follow, the agency by which the improvements are to be carried out. A brief review of the recommendations already given points to the conclusion that the main advance will be made by a practical enquiry into native agriculture, with a view to ascertaining (1) the requirements of each district in respect of water, wood, manure, and other facilities; (2) the best native methods of cultivation, in order to transfer them to other districts where they are not practised. A number of opinions in support of this view are quoted, and it is then pointed out that, up to the present, enquiry has been limited to the collection of Land Revenue statistics, and that there has been no organisation for enquiry into agricultural methods with a view to agricultural improvement. A large field for enquiry is then sketched out, and the necessity of an agency of an expert nature is urged. The opinions of the Famine Commissioners, the Government of India and Provincial Governments, on this point are quoted. The existing agency is reviewed, and more particularly the position occupied by the Director of the Department of Land Records and Agriculture in a Province. The lack of technical knowledge in the Department is brought out, and it is suggested that this want could best be supplied by associating with the Director of the Department in any Province a certain number of agricultural experts to be engaged on purely agricultural work. It is then discussed whether these experts should be Europeans or

Natives, and the conclusion is come to that, on the whole, the selection of Natives trained in India would be best, provision being made for the giving of a high-class agricultural education in the country itself.

RECOMMENDATIONS.

I recommend (1) the organisation of enquiry into agricultural conditions and practices; (2) the association with the Director of an Agricultural Department of one or more assistants who are experts in agriculture; (3) the selection of these assistants from Natives of India trained in the country itself; (4) the provision of a high-class agricultural education in India.

CHAPTER XVII.

SCIENTIFIC ENQUIRY.

CHAPTER XVII.

SCIENTIFIC ENQUIRY.

THE close connection of science with practice in any scheme of agricultural improvement is, at the outset, put forward, and the necessity is shown that practical enquiry should be scientific in its methods. The relation of chemistry to agriculture is then pointed out, and reference is made to the expressed opinions and renewed applications of the Government of India on the desirability of having an Agricultural Chemist for India. The scope of work for an agricultural chemist is then sketched out, and the principal duties of the office are defined as being the acting as "referee" or adviser to Government in chemico-agricultural matters, and the direction and maintenance of the continuity of enquiry. Among other duties are those of assisting in the development of agricultural education and the preparation of suitable text-books. The necessary qualifications to be possessed by the holder of such an appointment, and the conditions essential to his successful tenure of it, are defined. The existence of a suitable laboratory, and the co-operation of an assistant chemist (to take actual charge of the laboratory and to give instruction in agricultural chemistry) are regarded as essential. The relations, respective duties and salaries of the two officers proposed are discussed, and it is recommended that neither of them be allowed to undertake private work for separate remuneration. It is urged that not only an agricultural chemist, but also other scientific men, such as a botanist, an entomologist, and an agricultural engineer, should be associated with the Agricultural Department for the purpose of conducting enquiry and research. The chapter closes by dealing generally with the position of scientific men in India, the encouragement of scientific research, and, in particular, the appointment of Chemical Examiners.

RECOMMENDATIONS.

I recommend (1) the appointment of an agricultural chemist as adviser to Government in chemico-agricultural matters, and for the direction of experimental enquiry; (2) the appointment of an assistant chemist; (3) the attachment to the Agricultural Department of other scientific officers, such as a botanist, an entomologist, and an agricultural engineer,

CHAPTER XVIII.

CHAPTER
XVIII.

EXPERIMENTAL FARMS.

EXPERIMENTAL
FARMS.

• THE causes that have led in India, as well as in other countries, to the establishment of Experimental Farms as separate institutions are first described. The past work of such Farms in India is reviewed, and the expenditure upon them is regarded as not having been excessive, and their continuance is advocated. The chapter then proceeds to deal at length with the work which ought to be done at Experimental Farms, and to lay down the lines for the successful carrying out of experimental enquiry. The various conditions, such as suitability of soil, size of farm, situation, supervision, plan of experiment, recording of results, &c., are discussed, and are illustrated by examples drawn from existing Experimental Farms both in India and in England. It is then maintained that in the case of such Farms the financial test ought not to be the one that determines success. The employment of Experimental Farms as centres for seed distribution, the location of stud bulls, and, at times, for cattle-breeding, is recommended. The establishment of another class of Farms, *viz.*, Demonstration Farms, to show the result of what has experimentally been found useful, is advocated, and mention is made of farms belonging to private individuals where experiment is more or less carried on. The remainder of the chapter is occupied with a review of the work in progress at each of the Experimental Farms which I visited during my tour, my general comments on each Farm being given at the same time.

I recommend (1) the continuance of agricultural enquiry at Experimental Farms; (2) the distribution of seed and the location of stud bulls at Experimental Farms; (3) the establishment of Demonstration Farms.

RECOMMENDA-
TIONS.

CHAPTER XIX.

CHAPTER XIX.

AGRICULTURAL EDUCATION.

AGRICULTURAL
EDUCATION.

THE influence which general education first, and then, more specially, agricultural education, exert upon the improvement of agriculture is, at the opening, explained. It is then shown that the tendency of education in the past has been too much in a literary, and not sufficiently in an agricultural, direction. The suggestions now given are with the intention of remedying the past defect, and of directing attention to, rather than diverting it from, the cultivation of the land. The intention is, in brief, to give a more agricultural turn to education. The different grades of educational institutions, from Universities and Colleges down to Primary Schools, are then taken in order, and the line of agri-

cultural education at each is briefly sketched out. As regards Universities, it is maintained that they should recognize the importance of agricultural science by making it an optional subject in the final course for a degree in science. It is not considered advisable, at present, to have special Agricultural Colleges, but rather to utilise existing institutions and to make agriculture one branch of the instruction provided. The importance of combining at Colleges practical work with theoretical instruction is set forth, and the establishment of Demonstration Farms, and of areas on which the students can themselves work, is advocated. Agricultural Classes in connection with High Schools are well spoken of, and the association with them of Illustration Farms is considered desirable. In Middle Schools it is held that the elements of physical science should be taught, that agriculture should be introduced by means of text-books, and that illustration *plots* rather than *farms* should be attached to the schools. In Primary Schools a beginning might be made by the introduction of "readers" and of "object lessons" on familiar agricultural topics. Lastly, the importance is inculcated of providing at Normal Schools sound training in agriculture for those who are to become the teachers of others. The paucity of text-books on agriculture, and the urgent need for many more of them, are commented on, the relation of the "scientific adviser" to agricultural education is discussed, and it is contended that more inducements to study agriculture should be given, and that the claims of men who have studied it should be freely recognized for appointments in the Revenue and cognate Departments. The chapter concludes with a brief review of the agricultural training given at different Colleges, Agricultural Classes, and other institutions which I visited, including the Forest School at Dehra Dun.

RECOMMENDATIONS.

I recommend (1) the spread of general education; (2) the extended introduction of agricultural education into the general educational system; (3) the preparation of agricultural text-books, suitable to the different parts of the country; (4) the recognition of the claims of passed students in agriculture to appointments in the Land Revenue and cognate Departments.

CHAPTER XX.

CHAPTER XX.

AGRICULTURAL DEPARTMENTS.

AGRICULTURAL DEPARTMENTS.

THE concluding chapter of the Report deals with some points in the working of Agricultural Departments, which have not already been fully treated. The first is the training of junior Civilians in agriculture. There commendations of the Famine Commissioners on this subject are discussed, and while it is maintained that it will be impossible to get civilian Directors of Agriculture who will at the same time be practised agriculturists, it is urged that much good may be done by giving at the open competitive and final examinations in England more

weight to proficiency in natural science. It is then suggested that junior Civilians, or at least a proportion of them, should, on arrival in India, be drafted into provincial Departments of Land Records and Agriculture, there to learn something about the country, the people, the crops, and the agricultural conditions generally, and that at their departmental examinations they should be required to show an acquaintance with these subjects. It is held that Directors of Agriculture should be chosen from the men who have shown a liking for natural science, and who have distinguished themselves subsequently by their knowledge of agricultural matters. The position of the Director of Agriculture is reviewed, and it is urged that it should be invested with some administrative power, and that the Director should form a part of the Revenue Administration. The giving to the Agricultural Department of a share in the administration of Government advances (*taccavi*) for well digging is again advocated. The necessity that Directors of Agriculture should tour in their districts is insisted upon, and is made applicable in a special way to the Secretary of the Imperial Department of Agriculture. The useful purposes which occasional Conferences on agricultural questions can serve are also exemplified. The classification of the work of Agricultural Departments is then referred to, and the main heads are briefly noted. Among them the importance of "analysis of districts" and the desirability of making a digest of the Land Records are put forward. Agricultural Shows are treated at some length, and suggestions are made for their improvement, as also for the better conduct of trials of implements.

In conclusion, the future policy of Agricultural Departments is discussed, and the two great needs—a competent organization, and the expenditure of more money upon agricultural improvement—are put prominently forward. Lastly, uniformity of purpose and continuity of policy in the work of Imperial and Provincial Agricultural Departments are strongly urged.

I recommend (1) the giving of more weight to natural science in the open competitive and final examinations for the Civil Service; (2) the drafting of a certain proportion of junior Civilians into the Department of Land Records and Agriculture on their arrival in India; (3) the selection of Agricultural Directors from those who have distinguished themselves in natural science, and subsequently by their agricultural knowledge; (4) the giving of some administrative powers to Agricultural Directors, and, especially, that a share of the administration of Government advances (*taccavi*) be entrusted to Agricultural Departments; (5) the granting of more money to be expended by Agricultural Departments in the work of agricultural improvement.

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