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REPORT

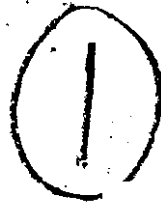
BY

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OFFICIATING FIRST ASSISTANT, FORT BLAIR,

ON SPECIAL DUTY,

On the Production & Manufacture of Sugar



CERTAIN DISTRICTS OF BENGAL AND THE NORTH-WEST PROVINCES.

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REPORT

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On the Production & Manufacture of Sugar

IN

CERTAIN DISTRICTS OF BENGAL & THE NORTH-WEST PROVINCES.

INTRODUCTORY REMARKS.

FOR purposes of more ready reference it has been deemed desirable to divide the subject treated of into its four separate and distinct stages, which may be concisely thus described—

Division
of the
subject.

I.—THE GROWTH OF THE SUGARCANE.

II.—THE EXPRESSION OF THE CANE JUICE.

III.—THE PREPARATION OF RAW SUGARS.

IV.—THE REFINING PROCESSES.

2. With respect to the last, however, it may be as well at once premised that no "refining," in the true sense of the term, is really practised in India, except in the case of the few existing European establishments for this purpose; where only is the raw sugar really "refined" by being freed from all admixture of the uncrystallizable syrup it contains, and where the removal of the inherent impurities and of the colouring and other uncrystallizable substances is attained by the use of deep strainers of animal charcoal, and by various other processes which will be later more fully explained and described in the Fourth Chapter of this Report.

No true refining by
Natives.

3. It has been deemed best to adopt the divisions above indicated also, although, perhaps, technically incorrect, in order to distinguish the more clearly between the work of the Native agriculturist, who but prepares the raw sugar in the cruder forms of "rab" or "goor," and there relinquishes all further effort at its improvement, and that of the Native and European sugar-makers respectively, who here step in, and, with various processes, to be hereinafter detailed, attempt, in the first case, merely a partial refinement in ridding these raw products of much of their molasses, without any further actual modification of structure, and, in the last, the production of the pure sugar from which all admixture of uncrystallized syrup has been eliminated, leaving it thoroughly purified from, and rid of, the colour and all other removeable defects (tending to deteriorate from its purity and value) by the more advanced methods of treatment now known to science.

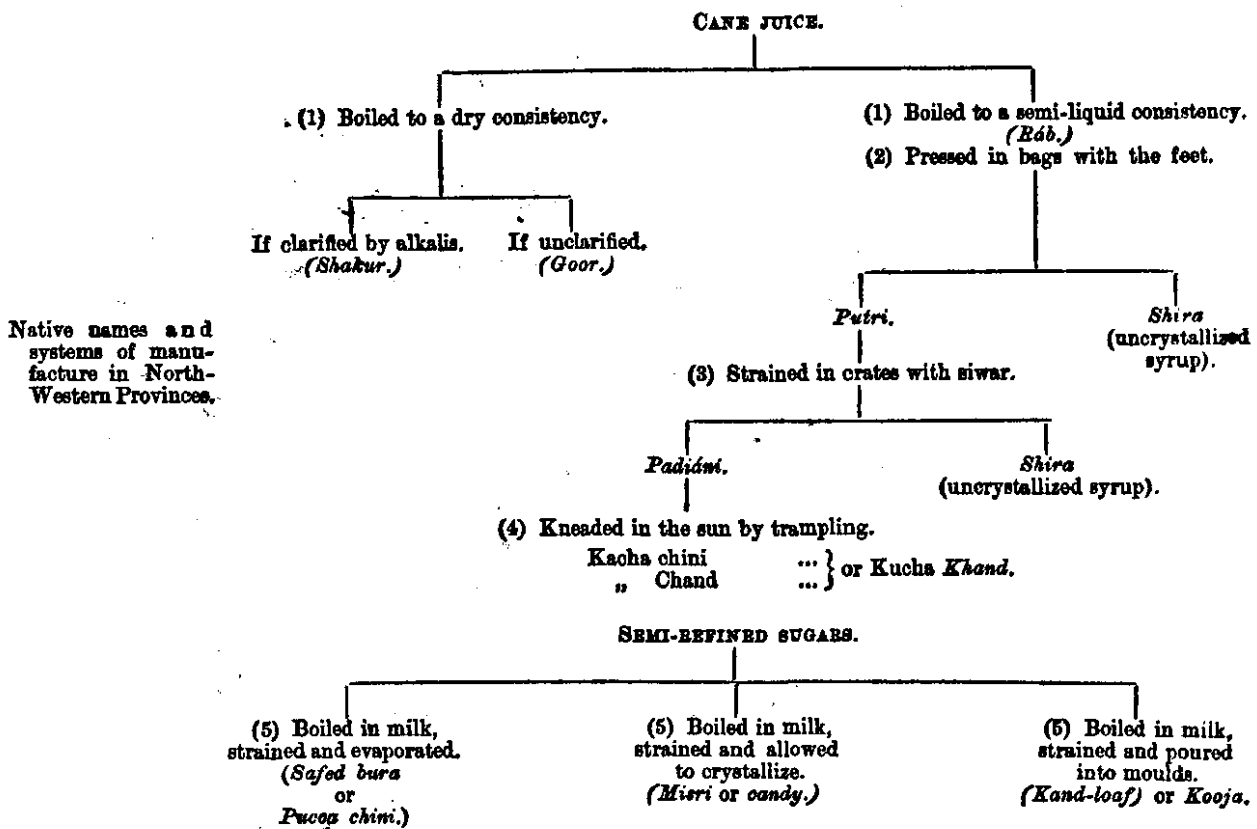
Reasons for division.

4. The difficulties of dealing with a comparatively new subject have been greatly enhanced by the indiscriminate use of the word "sugar," which is so often loosely applied not only to the first product of the boiling of the juice, whether in the form of "rab" or "goor,"

Indiscriminate use of the word "sugar."

but also, equally incorrectly, to all the later modifications of forms in which any sugar remains present at various stages of purification or preparation, whether in *Shakur* (goor slightly clarified by lime), in *Kooja* or *Kand* (white loaf), in *Chini* (fine powdered, and white or brown, pucca or kucha), or in *Misri* (white tablet or sugarcandy); the term, in fact, being even used to cover not only the finest refined sugars, but often references to mere molasses, which eventually remain as an uncrystallizable residue therefrom.

5. The following table is mainly adapted from a report in the Agricultural Department, and gives with clearness the Native names applied to the product at the various stages of its manufacture at the hands of Natives in the North-Western Provinces. Such several successive processes of Native treatment are consecutively numbered, and will be later more fully dealt with under their appropriate heads:



Native names and systems of manufacture in North-Western Provinces.

The work of the ordinary Native agriculturist may be said to be complete after the first stage, whilst that of the sugar-maker practically ceases after the fourth, the fifth being more often left to the refiners, or to "hulwaies," or sweetmeat-sellers and Native confectioners.

In Bengal the product is also known to the purchasers, at various stages, by other names, the 1st class "*Chini*" obtained being termed "*Ras*," and the second "*Doma*." In an earlier state when granulating it is described as "*Chasni*."¹

Ditto in Bengal.

In Calcutta the date sugars, again, are known to the English refiners as "*Akra*" (or *Akra-Dulwa*) and "*Ghore*," both Chandpore raw sugars of the Jessore District; also as "*Nimchandi*" and "*Chandpore Dulwa*," with "*Gurpatta*" sugars and "*Santipore ghore*," the last two from the Nuddea District, and probably merely

¹ These three names are obviously the same as those of "*Ras-ki-chini*," "*Doim Chini*," and "*Chashni*," referred to in paragraph 461 of an admirable Settlement Report on Azimgurh District by J. Reid, Esq., C. S.

named after the site of their production. It will be obvious, therefore, how readily confusion is capable of ensuing in dealing with the subject, unless the greatest precision is exercised in explaining at each stage of a report to what exact description of the saccharine material special allusion is made.

6. Correctly defined, "Sugar" is a transparent, crystallizable, soluble solid composed of oxygen, carbon, and hydrogen. Its crystals are anhydrous (*i. e.*, free from the waters of crystallization), though the first and last (*i. e.*, the oxygen and hydrogen) are contained in water in precisely the same proportions as in sugar.

What is sugar?
and how obtained?

The whole principle of its extraction as true sugar, as now practised, whether in the higher or lower forms, may be described as being based upon its ready solubility in water, but more particularly when heated. At the temperature of boiling water* in fact it is found to be soluble in almost all proportions. The treatment to which it is subjected in refining, therefore, is that of obtaining the desired deposit of solid crystals by first reducing the whole mass to a solution by heating it with water, and then again getting rid, by means of careful evaporation, of some of the water so added, and which is thus again thrown off from the weak solutions to which the sugar present has been reduced. When what remains is less than would have sufficed when cold to dissolve all the sugar present, the sugar (which has remained in solution in virtue of the high temperature) commences, whilst cooling, to deposit in the form of solid crystals.²

* 212 Fahrenheit.
100 Centigrade.

7. As will be later explained, owing to its excessive sensitiveness to heat, the sugar is extremely liable to injury at every stage of its extraction from the vegetable juices in which it is found, whilst a complete modification of its actual structure ensues, even when in solution, if it is subjected for too long a period to the action of excessive heat, it becoming gradually changed into a mixture of dark substances, which, so far as science has yet discovered, are absolutely incapable of crystallization, the precise composition of which even yet remains unascertained.

Influence of heat
on sugar.

One of the most important points, therefore, to be kept persistently in view is the reduction, or rather the prevention of the possible formation, of any large proportion of such insoluble matter, the scientific theory now being in this regard that with due and proper care there should be little room for the presence at all of any such unreduceable substance which, when finally separated from the sugar, takes the form of molasses or treacle. How much room for improvement in this respect there must yet be in India may be judged when it is stated, as the result of recent Government enquiries, that whilst the West Indies can reduce the quantity thus lost to a minimum of 2 per cent. on the cane juice expressed, it is still upwards of 12 per cent. in the North-Western Provinces even in the largest sugar-producing districts; and when goor is less carefully prepared it may amount to much more, the loss on Glucose alone in the analysis on Port Blair sugars representing in two cases upwards of 18 per cent. In the East Indies, indeed, whilst the returns yet give more than twice as much molasses as dry sugar on the production per acre, in the West Indies the latter is actually equivalent to three times the weight of the former.

8. The acidification due to want of cleanliness and to the absence of careful method, to needless exposure to the air of the cut ends of the cane and also of the juice, to the permitted admixture of foreign

² Art. on Sugar Refining by Assistant Professor of Chemistry, London University, 1876, later cited.

Other causes of loss
in manufacture.

substances, and to other causes which need not here be enumerated, also tends greatly to contribute to this deplorable result, and thus to materially reduce the bulk of valuable dry sugar eventually obtainable. This point, though apparently trivial in itself, therefore, is virtually one of the very highest importance, and should never be lost sight of, as the quantity of the true sugar ultimately obtainable from a given bulk of saccharine material almost alone determines the latter's market value, other points being of comparatively subsidiary importance.

The analysis adopted in the European refineries for testing sugar is thus first directed to the express detection of the percentage of the precise amount of sugar eventually obtainable *after deduction of that which is uncrystallizable*, though present; for though a much greater quantity may be actually there, and requiring to be dealt with in the sample offered, it is of course of little or no saleable value if incapable of extraction in the purer form, and the price which can be paid for a given bulk of saccharine matter is consequently mainly thus regulated by the consideration first indicated.² An example of the loss thus sustained may be given in the analysis of the best quality of goor or jaggery recently forwarded to Calcutta from Port Blair, and of local manufacture, tending to clearly establish the importance of so preparing the cane juice as to reduce to a minimum the serious loss involved by the presence both of large proportions of uncrystallizable matter and of numerous impurities (all removeable defects) due to carelessness and other causes in the early treatment of the juice under the existing system.

The analysis is of a 100 parts, and is as follows :

	Cane-sugar	...	70·		Cane-sugar	...	70·
Other matters.	{	Glucose ...	12·95	} 80	Deduct ...		*18·75
		Salt ...	1·16		Obtainable 51·25 only.	
		Moisture ...	10·05		Glucose ...	12·95	
	Insoluble ...	1·74	Salt (1·16 × 5) =	5·80			
	Extractive ...	2·86		*18·75			
	Ash ...	1·24					

A deduction of five particles is made for each particle of salts, its destructive power being great.

² One of the samples forwarded gave but 34·40 per cent. of obtainable sugar, and was thus almost wholly valueless from a refiner's point of view, though of course saleable for ordinary consumption as ghoor and for use in certain manufactures.

Having regard to the vast importance of all such minor points of detail, then, even in the very earliest stages of the production and manufacture, it has been deemed preferable to enter very fully upon each branch of the subject under the separate and distinct heads above selected, which, it is desired, may thus be found to comprise information in a form admitting of ready reference, and which may thus, it is hoped, prove of value, whether in the present or later consideration of the introduction to the Andamans of the sugar industry on a more extended scale than has been hitherto contemplated or attempted.

² Of course the colour and other impurities present receive due consideration, but the cost and labour involved in extracting the pure sugar present increases in proportion with the increased bulk of insoluble and other matters requiring to be first eliminated before the true sugar can be reached or dealt with.

CHAPTER I.

THE GROWTH OF THE SUCARCANE.

9. The branches of this portion of the subject, suggesting need for separate consideration, are briefly as follows :

I.—THE PREPARATION OF THE LAND,

II.—THE SEED AND ITS PLANTING,

III.—THE OUTTURN OF CANE,

and these will each be dealt with in turn.

To what an enormous extent sugarcane is already cultivated in the Indian Peninsula may be gathered from certain statistics recently collated and furnished by an article in the *Produce Markets Review*, dated 22nd February 1879, cited in a recent despatch of Her Majesty's Secretary of State for India, from which it would appear that the acreage now under sugar cultivation in all India may be estimated (moderately) at no less than 3,750,000 acres, inclusive of the production of the Native Feudatory States.

Area of sugarcane
cultivation in
India.

The approximate extent of cultivation in acres in the several presidencies and provinces is thus ascertained to have been as follows, so recently as from three to four years since (viz., in 1876-1877)¹ :

Bengal	...	...	...	1,400,000	approximate.
Native Feudatory States			...	750,000	do.
North-Western Provinces			...	703,163	
Punjab	...	...	...	391,630	
Oudh	...	...	...	203,538	
Central Provinces			...	107,805	
Assam (excluding hills)			...	85,738	(in 1875-76).
Bombay	...	...	...	49,849	
Madras	...	...	...	33,000	
Mysore	...	...	...	14,737	
Hyderabad	Assigned	Districts	and		
Berars	...	...	...	5,594	
British Burma			...	4,271	
Sindh	...	...	...	4,058	

10. That sugarcane is so readily capable of production with profit in such large quantities in such varied climates and soils as those of the provinces above enumerated is in itself an encouraging fact, whilst with so wide a field for the selection of the best systems in vogue, and found from prolonged experience to be those most readily capable of adoption in dealing with Native races, there should be little difficulty experienced in determining, after due and full enquiry, the future course of action in the Settlements of the Andamans, where both the land and its occupants are so completely under the control of the Government.

Prospects of cultivation at Port Blair inferred.

The sugarcane plant, one of the most valuable of all the tropical grasses, is found to flourish in the Western Hemisphere, only in those countries lying between the 40° parallel of North latitude and a corresponding degree South; in the Eastern the same parallels may be perhaps taken as those of its more general production.

¹ See Secretary of State's Despatch, Agriculture and Commerce, No. 37, dated 20th March 1879.

Situation. As regards the situation of the Andamans, Port Blair is geographically placed in latitude $11^{\circ} 41' 18''$ North, and longitude $92^{\circ} 43' 00''$ East. It has a temperate climate with extreme ranges of some 28° only (68° to 96° Fahrenheit), and an average annual rainfall of 114 inches, well distributed throughout the year. It has also as yet a virgin soil wholly unexhausted by prolonged cultivation.

Moisture. The greatest difficulty, perhaps, which is experienced in the east in the growth of the sugarcane is that of the absence of any sufficient natural moisture at the most convenient seasons of the year, resort being necessarily had in consequence to artificial irrigation, which not only enormously enhances the cost of production, but cannot be continuous. This difficulty—an all important one, as affecting in the dryness of the cane the quantity of the juice which it will yield—would never, thus it would seem, be capable of being locally experienced in the Andaman Settlements, for the tests of the cultivation of cane for many years past have now sufficiently demonstrated that, even in the absence of high cultivation without manure, and without any special care, whether in the preparation of the soil, or in rotation of crops, a valuable and luxuriant growth of cane can be secured upon almost any class of land in the Settlement, proving rich in its yield of the saccharine juice; and not only is this indeed the case for the first year, it is still more so in “ratooning” for the second and third, as will be subsequently explained. The comparatively small expenses of production, therefore, being thus proportionately reduced, would, without doubt, allow (with reasonable rates of export freight) of the most extensive competition on the part of the Andamans, thus specially favoured by nature in climate and soil for the growth of the cane, with almost any other part of India. Some of the largest purchasers of the saccharine material in its cruder forms appear to be those of the presidency seaports of Calcutta and Bombay, at which the products could be ultimately, no doubt, landed by water at rates far short of those now paid for the transport of sugar across India by rail or for other modes of land conveyance.

Its advantages in production.

PART I.

PREPARATION OF THE LAND.

11. It has been already explained that the recent local enquiries instituted, and on which this Report originates, were confined to the North-Western Provinces and Behar respectively. In the former, the districts of Azimgurh and Shahjehanpore were selected for special report as covering the most important sugar-producing areas of the North-West. In the latter, Shahabad was chosen as the principal cane-sugar district of Bengal, having regard to the more favourable conditions of its production with improved mills, canal irrigation, and other appliances. In both instances the best outturns of the province in quality are said to be there attained, and the data afforded by the results thus ascertained should consequently prove of some value as a guide in respect to the merits of the systems severally pursued.

To what districts
Report confined.

12. The North-Western Provinces will be first dealt with. The total area now under sugarcane in the North-Western Provinces and Oudh has been most recently ascertained, within the current year, to extend to 1,067,000 acres, or an increase of area of no less than 160,300 acres since 1876-77.²

Area, North-Western
Provinces.

The system pursued in the preparation of the soil is as follows: In the district of Shahjehanpore the land receives its first ploughing for a cane crop with the first or earliest rains, ordinarily in June (or July) and up to the end of February or the beginning of March. When the planting is to take place, the soil is constantly turned over with the plough, it being affirmed that whilst 25 ploughings may be assumed as the normal number adopted, there is no fixed rule, and consequently these vary from 5 to 50 in number, merely in accordance with the leisure of the ryot, the state of the weather, and his personal possession of draught cattle in lieu of his requiring to hire or borrow them.³ Where a digging is resorted to on hard land, one such is deemed to equal about five or six ploughings.³

Soil preparation in
North-Western
Provinces.

The cultivation is not restricted to selected fields, the cane being planted in ordinary rotation in almost any land. In good soil it is followed by wheat for two years, or by gram, but ordinarily there will be an interval of some two or even three years before cane is re-planted on the same land. The cane may follow rice, bajra, or kodon, but the land is always permitted to lay fallow for at least three months, and frequently for a year (in fact both for a *khureef* and *rubi* season), which is no doubt necessary both on account of the poverty of the soil and the small expenditure of manure ordinarily devoted to its improvement. In the low alluvial lands and in river valleys the land needs and receives less ploughing and preparation, but an inferior tougher cane is usually grown producing a smaller yield. These lands are known as "Khadir," whilst the better lands, to which more attention is devoted, are termed "Bangur." It is only the better class of land that is now reported on.⁴

Rotation of crops.

13. In the Azimgurh District the best crop, it is said, is expected from land fallow from the preceding rubi harvest up to sowing

² Report, Assistant Director of Agriculture and Commerce, North-Western Provinces, Circular No. 8, dated 7th July 1880.

³ Art. IV., Vol. III., No. 1, *The Revenue Reporter*, 1874.

⁴ Settlement Report, Shahjehanpore District, by Mr. Currie, c. s.

In Azimgurh.

time, and which has been dug up and left for the winter; the next best from land fallow during winter; and the worst from land from which a crop has just been taken.⁵ Experience is also said to have conclusively shown that the land near villages does not produce the best sugarcane owing to the excess of salts in the soil, the effects of which upon the saccharine matter will be elsewhere more fully explained. A clean clay soil of dark colour is preferred to a loamy one, the latter being, however, sometimes capable of improvement by the aid of excavations from the bottom of a tank, or the addition of similar correctives.

Manure.

14. Manure is almost always used, and the folding of sheep upon land is said to be of great advantage to it. Ashes and the sweepings of the villages are all given to cane land in the cold weather—it is roughly calculated ordinarily to the extent of some five to eight tons per acre. The cane trash is, however, used for fuel, and is not returned to the land as manure, in which form it, would doubtless prove of great value. In all other countries, where the nutrition of plants is understood and studied, manures rich in animal matters and phosphates are largely resorted to to encourage and foster the growth of the plant; no such course is, however, here adopted. Its value may be judged from the fact that 11lbs. of the “yellow cane” originally imported from India and acclimatized, grown in North Peru with Guano manure in a rich soil, will yield the same quantity of juice (viz., 1 gallon) as from 22 to 24lbs. of this same cane in India.⁶

Irrigation, N. W. P.

15. Irrigation prior to planting is only resorted to in the absence of full winter rains, or when it has been found impossible to plant out before April (or the end of March). The average rainfall of the North-West would seem, however, to be comparatively very light, and is computed at some 37 inches only, whilst that of Port Blair exceeds 114 inches.^{6a} There is little likelihood, therefore, of any need for irrigation at these Settlements, owing to the distribution being ordinarily such as would cover the planting season, and it is indeed from this cause practically unknown.

Bengal area.

16. The area of land under sugar cultivation in Bengal has been roughly estimated at 1,400,000 acres. No information was, however, in so short a time capable of being collated other than that relating to the district of Shahabad, where the practice of preparing the land is somewhat different to that followed in the North-West Provinces.

Rotation of crops.

Under no circumstances apparently is land permitted to remain fallow for a year, the utmost period covering five to seven months. The ordinary course would appear to be to plant out the transplanted paddy in July or August, and also to sow broadcast (after the paddy's final watering) a pulse called “khessary” (a dāl similar but inferior to urhūr), the paddy being reaped in October, November, and December, and the “khessary” in the February—March following. Where the land is intended for cane, it probably is permitted to remain uncultivated until July, when a light spring or early rain crop of serhá or sathi (early rice) or marooáh (a small red grain) is put in, which matures in September or October following. In some cases the land then remains up to January uncultivated; in others a crop of peas again follows in October, which is harvested in January, and is

⁵ Settlement Report, Azimgurh District, by Mr. J. Reid, c. s., Settlement Officer.

⁶ Messrs. Thomson and Mylne's letter, 26th February 1880.

The comparison in “raw sugar,” however, is in favour of India on the gallon of juice, the 22lbs. yielding 2 or 2½lbs. against 1·35 or 1½lbs. sugar owing to greater density.

^{6a} Average rainfall 10 years past, Allahabad 37” ; largest 70” in 1879 ; smallest 18·3 in 1868. Port Blair in 1878-79 registered 130” of rainfall.

immediately succeeded in the same month or in February by the cane crop. The land should in fact be ready, and the cane be planted in all January, although planting is, as above explained, from various causes, too often delayed even until the end of March.

The number of ploughings varies from 6 to 10 (termed "chassees") in preparation for the cane planting, and is, as will be observed, considerably less, therefore, than in the North-Western Provinces. It is not improbably due to a larger rainfall, and to the fact that the soil is more readily pulverized, that in Bengal fewer ploughings will suffice. It may be, however, of course that it is merely owing to the altered succession of crops (requiring to take place in such rapid rotation), and to the small period of time allowed for the land to lie fallow, that the ryots necessarily have to content themselves with a less number of ploughings, and that the soil is in consequence prepared with less care for the reception of cane; but upon this point it is unnecessary to dwell.

Ploughings.

17. In Port Blair little or no preparation of the land is needed, a ploughing on from four to five occasions being deemed amply sufficient. This is the maximum number ever accorded, whether in hill or valley land, and in the majority of instances from two to three ploughings only are given. No irrigation is ever resorted to, the rainfall being so copious, whilst the cultivation required is slight, "ratooning" being invariably practised for three (and occasionally even four) years. It is alleged by all experienced local cultivators that the yield of the 2nd and 3rd years in such ratooning is in fact more than double that of the first. In the 4th year again, however, the yield is comparatively poorer and in less quantity than in the first. The subject of ratooning (or "kunteari," as it is termed in Bengal) will be however later fully dealt with, no further remarks on the preparation of soil being here needed.

Port Blair lands.

PART II.

THE SEED AND ITS PLANTING.

The seed. 18. There is probably no portion of the subject to which less attention is paid than that of the description of seed to be used, and yet of all others it is perhaps that most deserving of thoughtful care. The varieties of cane in use are extremely numerous, and the differences of yield are exceptionally large, yet it is found that practically cultivators continue from year to year to propagate with sections of the same culm without any attempt at improvements, even that of planting from cane grown on other land being usually ignored.

Outturn of canes. 19. The ascertained average outturn of sugarcane per acre (without leaves or succulent tops) in other sugar-producing countries of the world is said to range at from 25 to 30 tons per acre, whilst in India it is computed at a maximum of from 15 to 20 tons only. (The latter figure being very rarely reached—15 to 16 tons being, it is believed, a high average.)

20. The sugarcane, which originally grew wild in India, has many varieties, those now best known and most often planted being as follows :

	NORTH-WEST PROVINCES.		BENGAL (BENGAL). ^a	MAURITIUS. ^a
	Shahjehanpur.	Azimgarh.		20 varieties best.
Varieties of cane now used.	1. Dikchan.	(1) Mángo.	(1) Mongo (or Khoosihari).	(1) White cane (of Otaheite).
	2. Dhaur.	(2) Rakswá.	(2) Bhoorli.	(2) Bamboo (of Batavia).
	3. Matna.	(3) Raourá.	(3) Raourá or Reongrá, also	(3) Gringham (or violet striped).
	4. Chain or charri.	(4) Sarautin.	(4) Sarotyá (unirrigated and grown near Ganges) and	(4) Belloguet (or purple Java).
	Also food-canes.	(5) Phatwayá.	(5) Pansáree (a food-cane).	(5) Penang.
	(1) Paunda.			(6) Diard (resembles 4).
	(2) Katahra.			
	(3) Kálagáná.			
	(4) Thun.			

It is desirable, however, to offer a few remarks upon the subject of the canes of the North-West and Bengal, respecting which several enquiries were made.

North-West Provinces canes. 21. First, then, as regards those of the North-West Provinces. There seems little reason to doubt that all the varieties now in use in these Provinces and in Bengal are far inferior to those of Penang, the Mauritius, and elsewhere, having regard to the outturn of canes per acre; for, whilst in most of the known sugar-producing countries the outturn of raw sugar per acre averages some $2\frac{1}{2}$ tons to 3 tons (in the Straits of Singapore 3 tons), favourable experiments in

^a Article by Dr. Leery translated for "The Sugarcane Magazine" 69, published by Galt and Company, Manchester.

^a All these varieties are given in Martin's History of Eastern India, 1838, except Pansahi. He gives also Bhooronga and Kewa varieties, now not grown. "Bhooronga" is referred to by Martin as that most extensively cultivated, and in the estimation of the Shahabad ryots has not, Messrs. Thompson and Mylne report, been re-placed to this day.

Shahabad gave $1\frac{1}{2}$ and $1\frac{1}{10}$ tons only of such yield. In the vicinity of Calcutta 2 tons per acre have, it is estimated, been attained; but Scinde (North-Western India) gives an outturn of some $1\frac{1}{10}$ tons only.

The "Dikchán," originally the best and favourite quality in the Shahabad District, is now, it appears, being gradually abandoned in favour of the "*Dhaunr*," which yields the largest return of juice, though of a thinner quality. The cause of such abandonment would seem, from local enquiry, to be that the "*Dikchan*" has, for some years past, proved unhealthy, although the reason cannot be ascertained, and the ryots in consequence are in despair now ceasing to cultivate it, although greatly preferring it themselves. The "*Matna*," which is the thinnest cane, yields by far the richest juice, though of course in somewhat smaller quantities, and hence is not as great a favourite as the two varieties named. It is often planted successfully in sections of the culm cut from the entire cane, although in other cases only the top piece next the arrow is planted as with other varieties.

22. In Shahabad (Bengal) the "Mongo" and "Bhoorli" canes are those the most largely cultivated on account of their general healthiness, their freedom from blight, and the quantity and quality of their outturn. The "*Sarotyá*" is grown only where irrigation is unneeded, as on low-lying river banks, and the "*Reongra*," but in comparatively small quantities. The "*Sarotyá*" would probably prove a very valuable cane in a humid moist climate such as that of the Andamans. Bengal canes.

On the other hand, the practice of growing "Barookh" and "Pansahi" is extending for this reason—that the canes mature frequently a month or more in advance of the "Mongo" crop, and thus, being ready to be pressed into goor much earlier, they not only anticipate the ordinary market, but bring in money at an earlier season, and when it is most urgently needed for rent and for the canal and water-rates, &c., the realization of its value thus often obviating the sale of the grain store, to which resort is otherwise necessarily, though reluctantly, had to meet these demands.

In the Shahabad District Messrs. Thomson and Mylne are of opinion that, although the outturn per acre has thus remained stationary, and in consequence unsatisfactory, for many years past, the cash returns on such area owing to a general rise of prices have increased no less than from 35 to 50 per cent. within the last ten years. In fact, on an outlay of Rs. 32 to Rs. 38 per acre in the growth of canes in Shahabad, they roughly estimate that the return is now equivalent to from Rs. 128 to 150, the cultivator, the land-owner, the broker and the refiner all benefitting by the rise. Value of outturn.

23. The result of varied experience would seem to show that whilst the canes of softer fibre are those best suited to upland cultivation, those of harder fibre with the knots closer together are best adapted to low land.

Food-canes are cultivated mainly as garden crops in the immediate vicinity of cities, and are never pressed for manufacture. It will be unnecessary, therefore, to farther refer to them in this Report, their introduction locally not being at present contemplated. Food and other canes.

The actual planting of the cane seed takes place in the North-West in February and March (the first being the best month),

North-Western
Provinces.
Time of planting.

unless unavoidably delayed to April. In Bengal, as already explained, the planting should take place in January, though it is often there also delayed on account of the land being uncleared from other prior crops and from other causes already adverted to.

Method.

The cultivator has himself ordinarily kept a little cane for seed, or he has to purchase it from those who have done so. The method of propagation consists merely of cutting sections of the culm or stalk with buds in them, and planting them in the ground. These pieces of the culm are ordinarily simply laid horizontally in trenches, and the young canes develop from each node or joint of the culm so planted.

Quantity of seed.

The top portion of the cane stalk only is used for seed; the top leaves, or brush, being first snapped off, the upper joints of about a foot in length are taken, some 3 or 4 knots being left to develop the new shoots. These upper joints are mature and contain little or no juice, and consequently there is no sacrifice of present value. They are simply tied in bundles and covered over with earth until needed, from 12 to 15 or 16 thousand such cuttings being used per acre.⁷

Sowing, N. W. P.

In Azimgurh three ploughs are employed for the sowing, the first and second merely preparing the trench, the seeds being thrown into the earth horizontally between the trenches, and placed at about a foot's distance from each other each way. The trenches are about three furrows apart only. A third plough, with a bundle of grass tied round its edge to prevent its entering the earth, or a patoo or kodali, is then run over the ground to smooth over the furrows and to cover in earth over the seed.

Sowing in Bengal.

24. In Bengal the cane seed is ordinarily laid in plough furrows about 18 inches apart, and close to the surface (said to be a careless practice in itself, and open to many objections), the depth at which the seed is placed being determined by the previous rainfall, the state of the ground and other considerations.

Mauritius planting.

25. On the other hand, however, the practice in the Mauritius, where cane cultivation is conducted upon the most recent scientific theories, varies considerably from this, and is in consequence deserving of record in view to future experiment. The Mauritius has a moist climate somewhat similar to that of Port Blair, with more frequent showers of rain than are enjoyed in India, yet the cane-cuttings are buried deeper, and the greatest care is evinced in their protection both from heat and drought.

The procedure is thus described by Messrs. Thomson and Mylne:⁸

' The surface of the field is cleaned of grass and weeds with the hoe, the weeds laid in lines 4 feet apart; lines of holes are dug between the rows; each hole is about 15 inches long and nine or ten inches deep and wide; a 9-inch space of earth is left between each hole; these holes are carefully made of a rectangular form with perpendicular sides, the earth being laid on the rows of grass and weeds.

⁷ Mr. Reid's Settlement Report gives 21,000 in the Azimgurh District, and he allows 5,000 whole canes per acre of entire canes when reserved for seed only, paragraph 431.

⁸ Letter to J. Ware Edgar, Esq., c. s. l., Collector of Shahabad, dated 28th February 1880.

Three cane-cuttings are laid in each hole, and covered with about two inches of finely prepared earth mixed, if necessary, with manure. This filling is repeated as the cane grows till a ridge is formed round the cane-roots, leaving the ground hollow in the spaces between the ridges; all weeds and dry leaves are carefully removed or disposed of in such a way as to admit as much light and air into the field as possible; the earth round the roots is kept clean and loose. The number of cane-cuttings planted per acre in the usual Native way is 16,000, and by the Mauritius 16,500, so that a better style of cultivation is secured with no loss of space.'

26. In India the cane once sown as already described, the land usually requires deep hoeing. In the North-West the first hoeing is that undertaken some four or five days after the seed has been put down, the second and third follow with harrowing after but a few days' interval. A large proportion of land is only once irrigated, and this is when the shoots first appear, when the watering should be very light. The hoeing and top-dressing with manure is continued until the plants are about two feet high, when little more attention to them is needed.

Hoeing and irrigation of plant, North-Western Provinces.

27. In Bengal, on the other hand, in dry soils the field is irrigated on the morning following the planting of the cuttings, whilst in ordinary soils it is conducted as in the North-West; but five or six waterings are often given, and as many hoeings, before the plant attains the height above indicated in districts in which canal water is readily available, this showing that a moist humid climate such as that of Port Blair, with a copious well-distributed natural rainfall, would, in this respect at least, possess great advantages over arid, parched, and comparatively moistureless provinces.

Ditto in Bengal.

Much would, however, necessarily depend on the advent of late or early rains, it being essential to provide moisture until the rains preclude the further necessity for its provision by other means. If left at all dry, the crop is found to be at once attacked by insects, a green caterpillar (known as the dholá) being its chief enemy, destroying the head of the young plant. This prevents its upward growth, and forces it to throw out in lieu lateral side-shoots of comparatively little value. It is calculated that each root should throw up from 10 to 20 canes, an acre of fair crop thus yielding about 90,000.

28. So soon as the rains set in, the crop may be said to be abandoned as respects further attention, and it is indeed left much without it, and is thenceforward treated as a "field" rather than as a "garden" crop. No attempt is made at ridging, and, owing to the nearness to the surface at which the section of the culm for seed is laid, there is a dense mass of foliage and decaying vegetation always close to the ground obstructing both air and light. The leaves thus grown, excluding all ventilation, are allowed to remain to wither and dry, and only in Lower Bengal are they occasionally utilized to fasten up the standing canes. The soil also is never again turned over or loosened, despite the irrigation,—and hence cakes round the growing plant,—and does not allow free play to its growing roots.

Absence of further culture.

To these and other causes it would seem to be due that the yield of cane per acre, whilst it reaches in Barbadoes and Upper Egypt from 30 to 36 tons, and in Demerara from 35 to 40, does not ever in India attain more than one-half such bulk.

29. In Port Blair the cane, which is believed to have been originally obtained from Penang, is all of the one description, and is of a kind unknown by name even to its local cultivators. The sections of the culm are planted about a foot apart at a depth varying entirely with the state of the weather at the season of planting. Should

Planting at
Port Blair.

the planting be early and the season dry, the seed is buried about four inches deep; whilst, on the other hand, if wet, it is placed immediately at the surface, the earth being simply raked over it. Ordinary sowings can take place from January, but this is rare, and they are more common in April or even May, after the first rains have set in. In the Government experiments of 1871 to 1875 the sowing appears to have taken place more often in the last-named month. But a small amount of manure is ever used, it being found too heating for the crop in the rich soil, and also to rapidly generate insects. The amount of seed which does not germinate is very small indeed. Great improvements are no doubt capable of being locally effected by the introduction of new seed, that now used being simply cut from the growing cane, and returned again and again to the soil with no variety in its description or locality.

PART III.

THE OUTTURN OF CANE.

30. Much has already been said on this subject in Part II. of this chapter. It has been pointed out that, owing to various causes which may be advantageously concisely here recapitulated, the yield of canes per acre in India is less than half that of other countries, the results of whose culture of this sugar has been yet ascertained, and that this is due mainly to a defective system of agriculture there seems little reason to doubt. These defects are briefly—

Recapitulation of defects in systems.

- (1) Exhaustion of the soil by too rapid rotation of crops and neglect of "open fallows."
- (2) Absence of proper rich manures (containing phosphates or animal matters).
- (3) Neglect in selection of seed (and use of excess quantity in North-Western Provinces).⁹
- (4) Late and irregular planting (when best season has passed).
- (5) Careless surface-planting (without ridging).
- (6) Defective irrigation (the crop being submerged).
- (7) Exclusion of air and light from roots.
- (8) Early or late cutting of the crop¹⁰ (either before maturity or too late when the heat very rapidly acidifies the juice).

31. There is some difficulty in procuring accurate data in respect to the exact weight of canes obtainable per acre. Such returns, however, as were accessible give roughly the following results :

Average outturn in canes.

OUTTURN IN CANES.

<i>Other countries.</i>		<i>Shahabad experiments.</i>	
	Tons.		Tons.
Demerara	40 to 35	Jugdispore Estate, 14 11 acres plant, 1877-78.	51 places.
Barbadoes	36 to 30		
Upper Egypt	36 to 22	Ditto, 1878-79	13 2½ acres rich land.
Porto Rico	35		
Queensland	30 to 25		
Martinique and Guadeloupe	28	Ditto ditto	16-16 Home-grown, 9 acres richly manured.

⁹ Article by P. Mieses, Esq., Ghazipur District, published with Circular No. of 1880, Department of Agriculture and Commerce, North-Western Provinces, dated 1st July 1880, and paragraph 493, Asimgurh Settlement Report.

¹⁰ Article by P. Mieses, Esq., Ghazipur District, published with Circular No. of 1880, Department of Agriculture and Commerce, North-Western Provinces, dated 7th July 1880.

¹¹ Messrs. Thomson and Mylne.

	Tons.
Mauritius ¹¹ and West Indies ...	20 or about 810 maunds (<i>Elsewhere computed at 30 tons</i>).
Australia ¹² ...	35
North-Western Provinces ¹³ ...	14 or about 518 maunds.
Bengal ...	13 to 15

It is important to note, however, that with an increase in bulk of the crop there should be no diminution of the richness of the saccharine juice, for the drier the cane apparently the more concentrated is the latter. This point will, however, be more fully dwelt on under its appropriate head.

Time of cutting,
North-Western
Provinces.

32. The sugarcane attains maturity in the North-Western Provinces ordinarily about the month of January (15th). It is too often, however, cut long before it is mature, the reaping frequently commencing about the 1st December in dry lands, or the 20th in those retaining more humidity.¹³ The causes assigned for this are briefly the limited power of the rollers available, which working full hours will take 15 to 20 days to crush a bigah (the bigah being here of five-eighths of an acre); the inferior quality of concrete if delay is great; and the pressing need for ready money early in the season. Fear of the heat of the weather, if delay supervenes, and the anticipated need of turning later attention to other crops, no doubt also influence this domestic manufacture. The cutting is often continued, however, up to the month of April from causes which need not now be dwelt on.

Do., Bengal.

33. In Bengal the crop is ordinarily about ten months in the ground before cutting. If, therefore, the planting has taken place in all January, the crop would be quite matured by the early part of November following, or earlier by two to three months than that of the North-Western Provinces. If cut too early, however, before fully matured, the juice is poor and thin.

34. So far as Port Blair is concerned, there are many of the defects above enumerated which would presumably have no local existence.

Possible absence of
(or remedy for)
above defects at
Port Blair.

In regard to the first and second points alluded to as defects. The soil is extremely rich in the majority of instances (much of it being virgin soil freshly resumed from forests), whilst the rents are not now above the average,¹⁴ and the temptation to excessive rotation of crops from this and other causes would not exist. The soil does not need to lay fallow or "weather," or to absorb nutritious ingredients from atmospheric exposure, having been richly manured for so many years by the leaf manure of virgin forest timber.

As to the third and fourth points. The seed could be at first imported by Government of the best selected quality after due experiment and enquiry, whilst the time of planting could be made a condition of the lease (the Government being in every instance the direct owner of the soil), the present land settlement being for five years only, from July 1879.

¹¹ Circular No. 8 of 1880, Agriculture and Commerce, North-Western Provinces.

¹² Mr. Butt's Revenue Reporter, Vol. III., No. 1, 1874, page 160.

¹³ Journal, Agricultural and Horticultural Society, Vol. VI., Art. 1, Art. on Benares Sugar Cultivation.

¹⁴ The question of rents will be later dealt with, but it may be here observed that whilst Rs. 9 per acre is now paid annually for sugarcane land at Port Blair, the rents of the North-Western Provinces for cane average Rs. 7-8 to Rs. 18 per annum (for the two years under cane), and on the Jugdispore Estate, Shahabad, are from Rs. 8-12 to Rs. 11-4 per acre (inclusive of Government and other legalized cesses at one anna per acre), or an average of about Rs. 10.

The fifth. Is probably a mere matter of instruction.

As to the sixth. The defective irrigation in India is mainly due to the uniform flow of water tending when followed by a hot sun to keep down the cane and to too closely hold the roots. With a well-distributed natural rainfall and careful ridging this would be wholly obviated. As most of the cane is planted upon hill slopes, having a natural fall and a substratum of soft sandstone rock through which water percolates, there is no rotting of the roots, through the excessive rainfall lodging for any length of time.

The seventh. Is a mere matter of detail and remediable.

As to the eighth. The ryots cultivating cane are not, as a rule, at all a poverty-stricken class, and are not (usually) in the hands of the money-lenders to the extent to which this is the case in India. Moreover, "ratooning" is largely practised, and for this reason the crop is permitted to mature, and in fact grows as ratoons to an exceptional girth and height.

35. It is much to be regretted that no data were obtainable from Penang (which was not visited) both because the cane used is of larger growth than that of India, and that the conditions of rainfall, temperature, seasons, and other influences assimilate more closely to those of Port Blair than of Upper India or even of Bengal. There is reason, in fact, also to believe, as previously stated, that the only cane yet grown at Port Blair has been produced from some imported seed procured at Penang, and this only has been since made use of; no subsequent importation, or variations, having ever taken place. It is probably of a kind which is of slower growth than the varieties previously named.

Penang canes.

36. A few remarks only are necessary on the subject of "ratooning," which is termed "khoonteari" in Shahabad. In the North-West it is said to be rarely, if ever, practised on account of the difficulty of obtaining water in the hot season, but it is occasionally resorted to in Bengal, and is it is said almost universally adopted in the Straits as in the Andamans, the class of cane grown attaining its full growth only in the second or third years.

"Ratooning" or "khoonteari."

In Bengal, where irrigation is maintained from wells, but a few cultivators have leisure for attention to the old and new plants simultaneously, and the former in a dry season commence to wither, and are cut down and made use of as fodder for cattle; were more water available, no doubt more frequent resort would be had to the practice owing to its trifling expense in attention and cultivation. Its yield on good soil is said to be two-thirds the weight of the canes, the juice being somewhat richer, though of less quantity than in the first year of growth. The practice which obtains in Bengal where "koonteari" is contemplated is to fire the field so soon as the plant canes are cut (close to the ground), and water is then at once run over the surface, the land being, when dry, ploughed twice and then thoroughly dug up. With a few subsequent irrigations the cane will thrive without further trouble.

Bengal.

37. With the natural moisture present at Port Blair there is little doubt not only that the cane attains a luxuriant growth rarely elsewhere witnessed in the first year, but that it will repeat this in ratooning for one, two and even more seasons, as experience has shown, with great profit to the cultivator. A continuous yield, far out of proportion to the labour elsewhere required to attain corresponding results, is thus achieved. The practice of ratooning in the

Its practice at Port Blair.

Andamans is therefore habitual and universal, the crop being on no occasion removed until after the third year. The yield, indeed, is estimated for the first year at less than half that of the second and third (which are themselves equal), whilst with cane left until the fourth year there is still a yield approaching that of its first year's crop. The root clump is said to throw up four to five shoots the first season according to the number of eyes or nodes in the section of the culm planted, whilst in the second and third years the root clumps bear from 10 to 12 shoots, each representing a cane. The fields are never fired but a little earth is raked together and thrown over the roots which are then left much to themselves. No flooding, or irrigation, is ever necessary, for at the close of the cutting and pressing season the heavy rains have usually already set in, these being of earlier incidence in the Andaman Islands than in most other parts of British India.

CHAPTER II.

EXPRESSION OF THE CANE-JUICE.

38. In this, as in the former stage, there is little doubt but that India is much behind all sugar-producing countries, the juice expressed from the canes weight for weight in the pressing out of cane of corresponding bulk being very considerably less than is elsewhere attained.

It is in fact still asserted by those connected with the European sugar industry in England that there is reason to believe, even in the British West Indies, that the sugar, molasses and rum extracted do not even yet represent more than one-half the saccharine matter in the cane.¹⁵ Up to some 50 to 60 years since the quantity of juice expressed averaged in the West Indies but half the weight of the cane pressed (or about 50 per cent.), whilst from 70 to 85 per cent. is now attained. In India from 50 to 55 per cent. is still the average.¹⁶

39. Various precise experiments were some two years since made in the North-Western Provinces under the auspices of the Agricultural and Commerce Department in Court of Wards Estates, both with the Native kolhús and with an excellent mill patented by Messrs. Thompson and Mylne, of Beheea. These experiments were made at Cawnpore, Talawa, Bulandshahr, Meerut and Hurdoi.¹⁷ These latter mills possess undoubtedly very great advantages over the Native kolhú, not only in rapidity in the expression of the juice, but in its comparative cleanliness and vastly improved quality. The best test of their practical utility is in fact the large sale they have already attained despite the high price charged for them, for since their introduction (in 1872-73) no less than 9,000 mills have, it appears, been purchased by ryots (*i. e.*, within seven years) at an expenditure of no less than Rs. 6,30,000; 7,000 of these having been sold within the last three years with a large annually increasing demand. They are worked with a single bullock in lieu of a pair.

40. That they have also largely affected the sugar growth of the District of Shahabad itself and stimulated the local sugar trade there seems every reason to believe; the ascertained export of goor, or jagree, by rail from Shahabad having risen, (as shewn by the traffic returns, East Indian Railway), from 42,919 maunds in 1872 to no less than 4,61,399 maunds in 1879. It is, however, in the quality, rather than in the quantity of the juice extracted, that the advantage is so great, as, owing to the greater cleanliness possible and to the avoidance of much fermentation (due mainly to exposure to the air of the small cut sections of the cane which promotes acidification through the open ends of the pieces), a far better and lighter coloured extract is obtained, possessing, with less fermentation, improved granulating properties, and realizing a much higher price in the market. Whole canes only in lieu of sections are passed through this mill.

It is also affirmed that by the trituration of the Native kolhú substances other than the cane-juice are pressed out in large

¹⁵ Letters from Messrs. J. Travers and Sons, to Secretary of State, dated 18th December 1878, with Statistics and Commerce despatch No. 37.

¹⁶ Paragraph 3, Report Circular No. 8 of 1880, Agriculture and Commerce, North-Western Provinces.

¹⁷ Letter 910 a, c x 16 of 1878, to Secretary to Government, North-Western Provinces.

quantities, which the even pressure of the rollers of the mill do not exude to a corresponding extent. The canes being subjected in the kolhú to a grinding process, the vegetable acids are forced out in larger quantities by the breaking up of the fibres, and the acidification of the juice is in consequence considerably expedited by their presence.

Two of these mills have been purchased and forwarded to Port Blair in order that a fair trial may be afforded them during the ensuing season. These mills will be again referred to later.

41. To revert, however, to the present mode of expression of the cane-juice from the canes.

Pressing cane, North-Western Provinces.

In the North-West, as already stated, the cane is ordinarily mature by the month of January, though the cutting and pressing are frequently much earlier commenced,¹⁸ and the operations may be continued even up to the month of April. In the absence of sufficient fuel these temporarily cease on the occurrence of damp wet weather. It is ordinarily about the middle of December before cane-cutting commences in serious earnest, whilst after February there is a falling off in the yield of juice which is not so good later. If taken early, on the other hand, before the canes are mature, the juice is too thin, whilst, if taken too late, when the increased warmth of the atmosphere has a tendency largely to increase the acidification, the loss is large, the sucroes being converted into glucose in the hotter weather, the acetous fermentation settling in with the greatest rapidity at this season.

Pressing in Bengal.

42. In Shahabad the cutting takes place, as stated, ordinarily about the month of December; but where there is a large area of cane, a portion being "ratoons" or "koonti" of the previous year, and therefore ripe early, crushing begins in the second half of November, and is continued to the middle of April, or in all five months. The practice is to cut the cane "stools" or clumps down close to the roots at the surface of the ground, and to strip them at once of their dry and green leaves, and the succulent crest or brush of top leaves. The canes thus cleaned are tied up in bundles, and carried on the heads to the domestic factory, or wherever the press may be stationed.

In Bengal this service is apparently performed by the village women and children, whose only remuneration is the succulent tops which they are permitted to remove and sell for fodder. The cane cut daily is ordinarily as much only as can probably be pressed, and it has to be roughly freed by the sickles of roots and sprouts before it is cut up into short lengths to be passed through the mill. This chopping into lengths or sections of an inch or one and a half inches in length is performed on a wooden block, the consequent exposure of largely increased surfaces to the sun and air is a fertile source of earlier acidification which would not otherwise so rapidly accrue.

43. The average quantity of juice expressed in India per acre may probably be roughly estimated at from 1,300 to 1,600 gallons,¹⁹

¹⁸ No Hindus will cut any cane before the Deothán or Dithwan Festival occurring in the end of October or beginning of November.

The niwan of sugarcane is the 11th of the light half of Kártik.

¹⁹ Natal returns give 2,920 gallons, Antigua 1,550 gallons. Mr. Butt, Shahjehanpur (1872), gives 1,950 gallons per acre.

Mr. Mc'Alister, of Messrs. Carew and Company, Ross, who has great experience, gives these estimates per acre—

Juice	...	...	...	...	21,000
Rab	...	...	...	...	4,500
Goor	...	...	...	...	4,000

The Shahjehanpore Settlement Report gives from 14 to 28,000 lbs. juice according to quality of land, &c.

but there is no doubt that the loss accruing from insufficient pressure of the cane resulting in the expression of less than the entire quantity it contains of the juice is very considerable.²⁰ It may be, however, that in some respects an advantage is obtained in this in the increased saccharine value of the juice exuded, although the quantity is so much less than is elsewhere obtainable from a corresponding weight of cane. The data of Messrs. Thomson and Mylne give the following results as to the amounts of cane required respectively for the expression of one gallon of juice—

	lbs.	
Shahabad	{ 22·50 to 24· ... }	} different experiments.
Peru (North) ...	11·	
{ Porto Rico (Spanish Colony) }	}	} 10·67 only.

It is the yellow Indian cane which is exported from India to Peru and which, grown there under such different auspices, gives so very different a result.

The inference drawn by the gentlemen named being that it is the natural dryness of the climate of Shahabad which thus effects the yield of juice per pound of cane by one-half. In the absence of the results of the expression of juice from cane grown in Penang or other moist climates, it is difficult to test the exact accuracy of this inference, for much may, of course, be due to superior power and method of crushing and extraction. It is shown, however, as already explained, that with increased bulk there is less density. The lesser amount of juice being concentrated to so great an extent as to yield a more satisfactory result as regards extract.²¹

44. It has already been mentioned that the main object to be ever kept persistently in view is the prevention by every possible means of the formation of uncrystalizable matter at every stage of the manufacture, there being reason to believe that almost the whole of the sugar contained in the juice is capable of conversion into dry sugar, weight for weight, although such result is yet unattained. The estimates most recently accepted in the Agricultural Department of the North-Western Provinces give, in fact, 15 maunds of dry sugar only to the acre, against 33½ of molasses, and whilst such losses in molasses in the West Indies and Mauritius have been reduced to about two per cent., they are said to still amount in the North-Western Provinces to a minimum of 12·8 per cent. The theory at present entertained by experts being that juice, taken when ripe and not before or after its proper season, should contain scarcely any molasses; and it is in fact in the diminishing of the quantity of the latter that modern science possesses such superior advantages over the earlier and cruder systems attempted.

45. In the method of expression adopted by the natives of India the first injury is done to the future sugar. As the operation of the kolhú is extremely slow, the cane is often, as already explained, neces-

²⁰ An experiment at Bhola with a small pressing mill worked by water-power in the Government Irrigation Department gave the following results on a bigah of land (the bigah being = ½ of an acre): 256 maunds of cane, yield of juice 12,880lbs., or 52 ½ per cent.—See Prospectus, Meerut Sugar Manufacturing Company, "Limited," March 1880.

²¹ *i. e.* Raw sugar.—These results are as follows:

Shahabad lbs. 2 to 2·25	}	per gallon of juice.
Peru " 1·35		

 Thus 22 lbs. of cane would give 2·70 lbs. in Peru and 2·25 lbs. in Shahabad.

The other figures ascertained are—	
1 Demerara	1·40 to 2·19
2 Natal	1·87 to 2·19
3 Porto Rico	1·60
4 Queensland	1·32 to 1·50
5 Australia	1·12 to 1·75
6 Antigua	1 to 2

 } per gallon of juice.

Disadvantages of
Native kolhús or
mills.

sarily cut both before it is mature and after it is over-ripe, and when the heat of the sun is such as to rapidly sour and ferment the juice, whilst the cutting up of the cane into short lengths, both increases this tendency to fermentation and promotes acidification of the juice extracted.

The kolhú expressing so little juice is necessarily worked both night and day throughout the season, with reliefs; but as the cultivation is of so domestic a character, there are but few cultivators whose holdings of cane are sufficiently large to allow of their employment of a mill throughout the season, and hence it is always either hired or joint property, whilst its owners or lessees assist each other with the pressing. The work is most laborious, both for men and cattle, and any improvements of system reducing this should be gladly welcomed by the cultivators.

The cane-juice is allowed to fall unfiltered into earthen vessels, much cane trash and dirt accompanying it, and is thus often permitted, through carelessness, exposure and loss of time to commence actively to ferment before it is even removed to the boiling-pan.

Crushing by water-
power, Meerut
Company.

46. In the North-Western Provinces, the Meerut Sugar Manufacturing Company has recently been started with the intention of crushing the cane by water-power from the Ganges Canal,²² the Government having granted a concession for the utilization of 100 horse-power for ten years free of charge. The Shahabad (Nasraingunge) Sugar Company,²³ on the other hand, starts from a later stage of manufacture, and, having secured a similar concession for seven years of 100 horse-power, are working up the Native "goor" with turbines or centrifugals, and would appear, under this system, to be obtaining most satisfactory prices for the classes of sugar thus produced.

Native first product
of boiling.

47. To continue, however.—The result of the first boiling of the cane-juice is either "rab" or "goor" according as the liquid is boiled until it is in a semi-liquid condition (when it is termed "rab"), or by prolonged boiling hardened to a firm "compost" (in which case it is known as "goor"). Both consist of uncrystallized syrup mixed with crystallized sugar, and both are "unrefined." This subject, however, will be fully treated of in the next chapter.

Native agriculture
and its possible im-
provement.

48. Before closing the present one, it is only necessary to remark that, *up to this stage of the expression of the juice*, there would seem to be a general consensus of opinion amongst experts that matters are best left in the hands of Natives, subject to certain encouragements and supervision, in the direction already indicated, of the provision of the best seed, and of better expressing mills, and in the avoidance of objectionable habits, such as the use of excessive quantities of seed, the observance of the proper seasons of planting and cutting, and, in lieu of the slicing up of the canes into small sections, the pressing them entire. Greater cleanliness is also above all essential, and it is most strongly recommended by Messrs. Thomson and Mylne that vessels receiving the juice should not only have a linen cloth-strainer attached to their orifice, but should be carefully washed out after each filling, and inverted over a sulphur match, the fumes

²² The total available horse-power at the Bhola Falls, near Meerut, is 2,400. The cost for extracting six maunds of goor in 24 hours by kolhú is given in the Company's prospectus at Rs. 6-13-9, and of 12 maunds by water-power and small rollers or mill, at Rs. 2-14 only.

²³ At Nasraingunge Lock No. 2 Arrah and Patna Canal.

of which aid greatly in the removal of the germs of fermentation.²⁴

The advantages of the Beheea Mill have already been so very generally conceded by Government in the North-Western Provinces that but little remains to urge respecting it. Its cleaner, better coloured juice enables those who use it to obtain a far better price for their outturn, and hence it will, no doubt, in time be most extensively adopted. In the best interests of the sugar industry of the country, however, its adoption should undoubtedly be most warmly encouraged and fostered by the Government, for how great is the improvement needed may be gathered from the following extract from the report of Messrs. Travers and Sons already adverted to as transmitted to India by Her Majesty's Secretary of State :^{24a}

“The sugar exported to this country from India is generally also of such miserable quality that it is only used by brewers (as its yield on refining is so small), and it can only be used for cattle before refining.”

²⁴ A good sample of such match accompanies this report.

Each mill works off, in a season of four months, 15 bigahs ; (the bigah being equal to $\frac{1}{4}$ ths of an acre).

^{24a} Despatch No. 37, Statistics and Commerce, 1879.

CHAPTER III.

PREPARATION OF RAW SUGARS.

49. In the remarks and explanations which have preceded this chapter, the manufacture of sugar has been brought up to the point of the expression of the cane-juice from the canes. It will now, therefore, be necessary to deal with the further transmutation of the juice, and to explain the various forms it may be made to take, and the descriptions of raw sugars produced directly from it.

Heat as an agent.

As already stated, heat is the first and principal agent employed both in clarifying and concentrating the sugar, its action on which alone is capable of producing an alteration in its structure. Its use as such agent commences from this early stage, the extent of its application being determined by the class of product it is desired to attain. Such immediate product of the first boiling of the juice necessarily and invariably takes one of two forms known respectively in India as "rab" or "goor."

50. The juice run off into earthen vessels from the mills is at once transferred to iron vessels in which it is boiled (sometimes, but rarely, with the addition of lime or castor-oil), being meantime carefully skimmed constantly, and the surface scum removed, and evaporated to the consistence of semi-liquid syrup if for "rab," whilst, for "goor," it is allowed to be concentrated to a more solid form of "compost." A hotter fire is needed to be used for the goor preparation and is longer applied.

Boiling to goor and "rab."

The "rab" is concentrated only to crystallizing point, being intended for immediate conversion into semi-refined sugar, and would rapidly deteriorate if kept in this form, as it retains much more moisture, the degree of evaporation and density being much less in the rab.

Use of lime.

51. The use of lime is as yet but very imperfectly understood, or adopted, in India, and requires careful judgment,²³ for, whilst an overdose of lime will prevent the granulation, should too small a quantity be given, no effect is gained other than that of adding to the existing impurities already present in the juice.

Clayed process.

52. Cane-juice is also occasionally purified with earth by adding sifted earth (clay) to it before boiling, and allowing the earth to sink through it, the juice being drawn off through holes in the vessel's sides leaving the deposits of earth settled at the bottom of the pan. The process is, however, one to be deprecated unless under peculiar conditions of the soil so used, which would require to have been previously carefully ascertained.

53. It has already been explained that from various causes, such as exposure to the air of the cut sections of the cane, to the presence in the juice expressed by the kolhú, of vegetable acids, the want of cleanliness and precaution allowing acidification, and the

²³ The lime is said not to be so often used for "rab."—Mixing half per cent. of lime before boiling; heating it slightly and removing the crust that forms is recommended by Mr. Fuller, Assistant Director, Department of Agriculture and Commerce, North-Western Provinces, in his Note on this subject.

Dr. Icery (Mauritius) maintains that lime used in excess gives a brown colour to the syrup, and ultimately makes the sugar dark and clammy.

admixture of foreign substances, the juice ordinarily reaches even this first stage of boiling in a very impure and imperfect form, contributing in no measured degree to the formation of uncrystallizable matters, and resulting in the diminution of the yield of sugar subsequently attainable. The over-boiling of the cane juice in this next stage, however, too often augments the mischief already thus originated, in that the "goor," being over-boiled, forms caramel, and thus still further loses value.²⁴

Formation of uncrystallizable matter.

54. When other bodies are thus present in solution with sugar, they may interfere materially in two ways with the crystallization of that substance. The following explanation of their action is that offered by Professor Gill:²⁵

Results of defective preparation of goor and rāb.

- (1). They may act chemically upon it, and actually change it into something else; or
- (2). They may render the liquid so viscid that its particles are unable to draw together and to arrange themselves; and

if in a very large proportion they may even require so much water to keep them in solution that the liquid cannot be concentrated sufficiently to pass the saturation point of the sugar present without losing its fluidity together.

Among bodies of the first class are all strong acids which even in small quantity possess the property of converting cane sugar into two distinct but similar substances—"dextrose" (or grape sugar) and "levulose" (or fruit sugar)—when heated with it, or even allowed to remain for some time in contact at ordinary temperatures. Also the substances known as ferments, which are for the most part minute organisms, similar to the common yeast plant. These may entirely prevent crystallization.

Presence of acids and ferments.

In the second class, also, most of the alkaline salts, such as chlorides, sulphates, nitrates, acetates, &c., of potassium and sodium, combine with sugar to form new bodies which do not crystallize at all, or too slowly to allow of manufacture.

Presence of saline compounds.

These uncrystallizable saline compounds and the uncrystallizable mixture of dextrose and levulose, together with gummy, albuminous and gelatinous substances derived from the plant juices brought into work, constitute the second class of bodies noted above as interfering with the crystallization of sugar from its solution.

55. To what an extent sugar is thus injured, and its market value in consequence impaired and diminished at Port Blair, may be gathered from the analysis of certain samples of local goor recently forwarded to Messrs. Turner, Morrison and Company, of Calcutta, and from this alone some inference may be formed of the loss incurred from the defects of manufacture even at this early stage.

Injury to Andaman raw sugars from above causes.

Column 2 of the following table represents the proportion of cane sugar present and capable of being crystallized into sugar in the absence

²⁴ The excess of molasses or uncrystallizable sugar is per acre in the North-West Provinces 23½ maunds more than in the West Indies, whilst the outturn of dry sugar is 16 maunds less. The weight of *dry sugar* as obtained in the West Indies is thrice that of molasses. In India it is equal to less than half the weight of the same. The loss from imperfect manufacture is represented by the molasses, which should be almost wholly absent.

²⁵ Professor Haughton Gill, Assistant Examiner in Chemistry, London University, Art British Manufacturing Industries, 76.

of any such bar as above indicated, whilst the final column shews the net result per cent. of sugar obtainable by the refiners. Columns 4, 5, 6 and 7 give the colourable and other matters removeable, whilst column 8 indicates the salts present, destroying or preventing crystallization of five times its own number of particles of sugar. It will be observed that in only two cases is 50 per cent. of sugar obtainable, whilst the worst sample gave but 34 per cent., with 18½ per cent. of glucose.

A sample of Beheea manufacture tested is added for reference, but even this gives comparatively a low return, while far in advance of that locally attained.

Port Blair Goor Samples.

Cultivator's mark.	Cane sugar.	Glucose.	Moisture.	Insoluble.	Extractive.	Ash.	Salt.	Obtainable.	
1	2	3	4	5	6	7	8	9	
Southern District ...	F. Sonee ...	70	12.95	10.05	1.74	2.98	1.24	1.16	51.25
	Pran Sing ...	70	12.07	9.85	1.52	2.04	1.32	1.20	50.93
	Do. do. ...	68	12.27	10.90	1.87	2.50	1.17	1.29	48.28
	Jeobul ...	68.50	12.32	10.70	1.74	2.29	.98	1.47	47.33
	Kifatulla ...	68.25	12.47	9.75	1.28	2.67	1.18	1.27	46.68
Northern District ...	No. 1 sample ...	68	12.90	10.80	1.23	2.24	1.18	1.02	46.10
	No. 2 ditto ...	65.50	12.41	10.75	1.98	2.41	.88	1.34	42.39
Southern District ...	Akbar Sing ...	65	12.71	11.05	1.68	2.05	1.07	1.26	41.99
	Fyzulla ...	63.50	12.25	11.85	1.79	2.98	1.16	1.37	39.40
Northern District ...	No. 3 sample ...	62	12.08	11.75	1.40	2.54	1.45	1.68	35.52
Southern District ...	Tara Sing ...	61	12.21	12.20	2.04	2.92	1.07	1.06	34.49
Sample 208 from Beheea juice strained, vessels washed and fumigated with sulphur, juice defecated with oil, and scum carefully removed.									
	79.50	5.38	6.25	1.55	2.98	0.78	2.16	63.22	

The delequescient salts, present in considerable quantities in all Indian raw sugars, remain unaffected by mere mechanical purification. The proportion of them in the Port Blair sugar is, it would appear, favourably small.

56. Some remarks are now necessary in respect to the forms in which raw sugars are usually exported. From the West Indies the sugar is, it appears, usually exported to England in the form of "Muscovado," whilst in the French, Spanish and Portuguese Settlements it is converted into what is termed "clayed sugar" prior to exportation. As this point of the form of exportation of raw sugar would be one of those first offering itself to consideration in dealing with extensive manufacture at Port Blair, it is desirable to give full particulars in respect to the several forms adopted, and in which the product is capable of being readily moved without difficulty from place to place.

Form of export adopted.

57. The Muscovado or brown sugar is thus prepared: The cane syrup is transferred from the copper pans or "teaches" to shallow vessels or coolers, in which it remains until it is granulated (*i. e.*, till as much sugar has crystallized out as is sufficient to leave the remaining liquid only just saturated with sugar at the lower

Muscovado.

temperature). The magma of crystals and dark syrup is then put into hogsheads, having holes at the bottom (which are placed in an upright position over a large cistern), and allowed to drain until all drainings of molasses cease. The casks are then headed down and shipped. The Muscovado is sold to the grocers, and is the ordinary brown sugar of the shops.²⁶

58. With the clayed sugars the following process is employed: The sugar is removed from the coolers to conical pots with perforations at the bottom, the points being downwards. A quantity of clay is laid on the top and kept moistened with water, which oozing gently from the clay through the sugar, dilutes the molasses, and causes more of it to come away than in the hogshead, leaving it whiter and purer than the Muscovado sugar.²⁷ This latter process somewhat closely resembles that adopted by the natives of India in the use of siwar, a water weed (known as the *Vallisneria Spiralis*),²⁸ which will be later adverted to, and in which the action of the moisture exuding from the wet siwar placed on the surface of the mass at this stage causes the molasses to drain gently away beneath, and the surface being thus whitened, by being freed from the uncrystallizable matter, is scraped off and collected as purified sugar.

59. To revert, however, to the forms of sugar adopted in India.

A variety of forms of pans are used for boiling the juice. In the North-Western Provinces a large deep pan is ordinarily made use of, whilst in Bengal (Shahabad) the saucer-shaped shallow pan or evaporator is most in vogue. In Lower Bengal, where concrete is made, a deeper pan is, however, also used. It would seem to be conceded that in the very shallow vessels there is less risk of overboiling or burning, as has been pointed out on this head. On this head Mr. L. Mylne remarks as follows: 'Water in the form of steam escapes in either the deep or shallow pan from the surface of the boiling cane juice, but the steam is formed at the bottom of the pans, and must force its way under more or less pressure, and consequent increase of heat, through the superincumbent mass. As evaporation proceeds, the mass increases in density and tenacity and in resistance to the rising vapour, and the steam must also increase in dryness, elasticity and consequent burning power to overcome the increasing restraint. Constant stirring may modify these tendencies, but is more complete in the shallow than in the deep pans.'

60. Both in Bengal and in the North-Western Provinces it would appear, however, that the old West Indian plan of a "battony" or row of pans or "teaches" (heated by one fire at the end of the flue over which they are set) is known,²⁹ though the

²⁶ See also Natural History of Raw Materials of Commerce by J. Yeats, LL. D.

²⁷ Loaf sugar is made by English refiners from Muscovado, which is reboiled and refined.

²⁸ (Ure III, 824). It must be had fresh daily, and is obtainable from the water's edge of any perennial stream. Montgomery Martin (Eastern India, pub. 1838, Vol. I., p. 360) states that the *Serpicula "Verticillata"* of Dr. Roxburgh and several *Potamogetons* are used when the siwar is not obtainable.

²⁹ Some of these "teaches" were seen at Shahjehanpore city, but this was in the houses of refiners, and not in use by cultivators. This was also the case in Jugdispur near Baheea, and it seems probable they are more often used in the later processes when dealing with the "goor" cheeses or "chakis," or with the "Beli" concrete manufactured on the Bel system by the khundsaree than with the fresh cane juice. Mr. Reid, in his Settlement Report on Azimgurh, speaks of two karais only as in use for the preparation of rāb.

In Lower Bengal the five pans are also used for rāb in some districts.

pans used here are iron, and not copper. When so used, the liquor is run into the first and largest of the row where it is boiled, till it is concentrated to a certain degree, and then ladled into the next teach nearer the fire, and so on, freshly clarified juice being then re-supplied to the first pan. The "teaches" are smaller and smaller as they approach the fire, and in the last and smallest one directly over it the liquid is concentrated to the "proof" point (i. e., until it can be felt and seen from its viscosity that it will crystallize on cooling).

Improvements in boiling.

61. It is strongly recommended by Messrs. Thomson and Mylne that the contents of the evaporating pans should be defecated by adding a little castor-oil, bruised castor seed, or other substance to the boiling liquor to coagulate and bring the scum to the surface, whence it is at once removed. Lime in the form of milk of lime is the alkali in general use with European refiners. In using the Litmus paper test the addition of the lime should be continued so long as acidity is apparent.

In Azimgarh the process of disintegration is said to be aided by mixing in the boiling juice a gelatinous stuff obtained from steeping in water the chopped roots and stems of a hibiscus called "Dulla," the boiling lasting from 3 to 5 hours. A little castor-oil seed is also thrown in towards the end of the boiling for coagulation of the albuminous matter, which is then first violently stirred, and subsequently left to cool. The crystals formed, either by the cooling or the evaporation of hot saturated solution of sugar, will, it is said, be the larger and more perfect the more slowly they are deposited; when they separate very quickly, they are always small and confused.

62. The amount of ráb expressed per acre is estimated in the North-West at about 4,500 lbs. If goor is made, however, the result is less—some 4,000 lbs. only being obtained.

Quantity of ráb or goor obtained.

The Azimgarh Settlement Report, it may be mentioned, gives upwards of 60 maunds per acre, or 4,800 lbs., but, having regard to the manner in which Native accounts (when kept at all, which is rare in such cases) are prepared, any estimates are probably but very rough average computations.

In Bengal (Shahabad) the yield is said to average some 49 maunds 36 seers, which is equal to about 1 ton 16 cwt.;³⁰ still comparatively a very low yield as contrasted with that of other sugar-producing countries.

Native forms of export.

63. Left to themselves, there is little doubt but that goor would be manufactured ordinarily by Indian ryots in preference to ráb, but as the latter is required by the manufacturer, the option of the description of outturn is rarely with the cultivator, but rests with the money-lender. The ráb is taken delivery of at once, and removed for refining purposes in large earthen jars.

The goor is in the North-West often made into hard balls (bhelies) varying from 2 to 5 seers in weight, in which form it will

³⁰ Taking the rupee at par value of 2s., and the value of the product at 8s. 10d. per hundredweight, gives gross value per acre of outturn at £16. The maximum outlay being estimated at £7-16 expended on cultivation, manufacture, &c., a profit of about 40 per cent. remains.

keep for some time. It is thus also both exported and sold for direct consumption or for use by sweetmeat-makers and others. In Shahabad it is made into "chuckis" or cheeses, of which the average weight is about $17\frac{1}{2}$ to 20 bazaar seers, or about $15\frac{1}{2}$ pucca seers.⁸¹ Their diameter is 12," circumference about 3' 5," and height about 7". The ryots do no packing, but the itinerant broker (bunnia or bepari) comes with his bullocks and purchases up the result of four or eight days' working, which he conveys to the nearest bazaar, where the purchasers congregate from long distances (namely, Agra, Cawnpore, and Bombay, westwards, and Rampore Haut and Calcutta, eastwards). This second purchaser, the export merchant, sees to the packing. Ordinarily each cheese is wrapped round with a cloth or piece of gunny, four or five being placed in a gunny bag, and these are thus carried to almost any distance without difficulty.

64. Ráb, owing to its semi-liquid state, is not so portable, and is bulky to store; nor will it keep for more than three or four months at most with every care. Although, therefore, it is more profitable than goor, owing to a larger yield per acre being obtainable from less concentration, the ryots will not manufacture it unless pressed to do so, or where a ready market is at once obtainable, as in the case of the immediate vicinity of sugar refineries, whether European or Native.

65. The latest data obtainable give the average prices of goor and ráb respectively per maund as follows :⁸²

	R Á B.				G O O R.			
	1877.	1878.	1879.	1880.	1877.	1878.	1879.	1880.
	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.	Rs. As. P.
Shahjohanpur ...	3 0 0	3 12 0	3 11 0	4 0 0	3 8 0	4 8 0	4 4 0	4 10 0
Beheea ...	3 15 6	4 7 9	3 10 3	4 0 0	3 15 6	4 7 9	3 10 3	4 0 0

Obviously, the higher the price obtainable, the greater the inducement to the extension of the cultivation, and the more probable the profit to Government in any experiments made at Port Blair. Even where prices are the same of goor and ráb, as shown above to be the case in Beheea, the larger outturn of the latter per acre increases the cultivator's profit thereon to no inconsiderable extent.

Prices of ráb and goor.

66. It has already been shown that the outturn of the crude product containing the true or actual sugar (as well as molasses up to this point) is exceptionally small in India.⁸³

Outturn of raw sugars.

⁸¹ At present selling at $7\frac{1}{2}$ pucca seers per rupee. The shape is obtained without pressing by pouring the goor into circular moulds made of bamboo floor matting tied round with a string, in which it cools for 24 hours, when the case or covering is removed, as the cheese has meantime hardened.

⁸² The figures are those of Mr. McAlister, of Ross, North-Western Provinces, and Messrs. Thomson and Mylne, Shahabad. The latter write as follows :

From 1864 to 1871 the average price was Rs. 2-8-6 per maund; 1872 to 1876, Rs. 2-15; 1877-79, Rs. 3-9; 1879-80, about Rs. 4. It is safe to assume a permanent rise of Rs. 1-4 per maund.

The *Government Gazette*s would furnish any further statistics of fluctuations desired.

⁸³ Messrs. Travers and Company point out that India, which could readily supply the world with sugar, is still herself an importer of it for her own use. In the tables given in the "Produce Markets Review," already quoted, an average of 8 cwt. per acre of sugar only is cited as attained (this is probably of refined sugar), whilst two tons is quoted as a low average product of the West Indies.

The following figures are those collated by Messrs. Thomson and Mylne, and courteously placed at disposal :

OUTTURN OF RAW SUGAR PER ACRE. ³⁴

	From		To		Description.
	Tons.	Cwt.	Tons.	Cwt.	
Barbadoes	4	16	1	11	Muscovado dry sugar.
Ditto	4	2	2	10	
Egypt	3	10	1	8	Sugar and 1 ton molasses.
Queensland	3	10	...	...	Dry sugar.
Australia	3	...	...	...
Singapore and Straits	3	4	...	...	Undrained, or 2·11 dry.
Jamaica	2	10	...	...
Porto Rico	2	10	...	...	And 200 gallons molasses.
Guadaloupe	2	5	...	...
Natal	2	5	...	...
Jugdispore (Arrah)	1	8	1	2	Goor, jaggeri, or ráb.
Antigua	1	5	...	...	Concrete.
Calcutta (vicinity)	1	3	...	...	"Khaus" and molasses 17 cwts.
Sindh (Kurrachee)	1	2	...	...

General remarks on raw sugars.

67. It will be apparent from remarks which have preceded that it is held that the actual culture and growth of the cane can more cheaply and efficaciously be undertaken by the ryots upon the domestic system, aided by minor improvements capable of suggestion to them, than by a larger landowner (such as the Government) with less close supervision, and such experiments as have been made tend strongly to confirm this view. It is from this stage, however, that the intervention of an improved system would seem desirable, and that, so far as Port Blair is concerned, it would probably be most profitable. Whether or not the crushing of the cane should be undertaken may be an open question owing to the expensive machinery which would probably be required to enhance the quantity of juice exuded, without extracting with it any vegetable juices of injurious properties to later manufacture. ³⁵ From such data as are available it is not recommended, and there would seem reason to believe that for the present the introduction of the Beheea pressing mills, with the minor improvements and enhanced cleanliness for which they provide, would meet all immediate needs up to this point. In the French West Indies, no doubt under the central factory system, the cultivator simply grows the cane and sells it to a large central factory where powerful machinery is used, ³⁶ but in many respects the conditions of growth differ very materially, and

³⁴ The figures of the North-West Provinces are mentioned by them with doubt, as said to approximate three tons; but this is not in accord with the notes elsewhere obtained, for instance, Mr. Butt's estimate in 1872 is of Shahjehanpur, and gives—

		Mds.		Mds.
Ráb	...	55	Dry sugar	15
Goor	...	50	Molasses	33½

³⁵ Experiments in this direction of crushing the cane are about to be made by the Meerut Sugar Manufacturing Company, Limited,—see Prospectus.

³⁶ Messrs. Travers and Sons' letter dated 18th December 1878.

though eventually pressing mills of great power might, perhaps, secure certain advantages, not now realizable, they are not at present recommended.

68. On the other hand, it would seem from the facts and conclusions recited, and to be hereinafter more fully explained, that sufficient cause may not improbably be shown for the intervention of Government agency at one or other of the stages immediately following, and either before or after the boiling of the juice.

Government inter-
vention at Port
Blair.

The earlier the intervention, in fact the greater the probable advantage, it is believed, that may be made derivable therefrom.

69. Various considerations must, however, here necessarily intervene in regard to cost of machinery and plant, as to the markets available, the class of sugar which can most profitably be produced, and, above all, the intent of the Government in the matter; and it must undoubtedly be clearly and distinctly affirmed either that there is a desire to enter upon competition with the refiners in producing the highest classes of refined sugar for the local markets, or that all that is desired is to so improve and prepare the local product as to render it saleable and fit for export, and to tender it in such form as would render it readily saleable, either to natives, or even to the refiners themselves, for the purposes of subsequent refining. Various considerations would necessarily occur as affecting any proposal to undertake refining on the part of Government. (These are now mentioned, but will be found re-stated in paragraphs 99 to 113 of this Report, to which reference should be also made.)

Considerations urged
against refining.

First.—The enormous expense of the plant, machinery and buildings necessary in first outlay (probably not less than some two lakhs of rupees).

Second.—The expensive highly-skilled staff necessary to maintain the efficiency of such an establishment (the slightest error at any stage of the process involving heavy loss).

Third.—The competition with existing refineries of Aska, Cudalore, Cossipore and Rosa (which is no doubt in itself open to exception on grounds which need not here be entered upon).

Fourth.—The fact that, for many years to come, sufficient cane cannot possibly be capable of being grown in the Andamans owing to the limited area yet cleared of virgin forest being insufficient to keep a refinery of any size supplied with sufficient juice for refining purposes.

70. On the other hand, however, it has already been explained that there is a ready market for raw sugars of almost any class at a price which for years past has been steadily advancing, and has now attained a rate when the manufacture could not fail to be highly remunerative if properly conducted. The soil, the climate, the conditions of growth all favour the Andaman Islands, and that development of the natural resources in this direction would amply repay any preliminary outlay, if judiciously incurred, there seems every reason to believe. Several courses, therefore, appear possible in this view. The first to merely obtain from the Beheea District some skilled superintendence for the instruction of the cultivators in the use of the mills, and in the best method of boiling the juice and reducing it to a Native form suited to sea export.

In preparation of
raw sugars only.

Courses possible.

71. The second, the acquirement by Government of a "concretor" (the use of which will be explained), with or without centrifugals (or

turbines) according to the form the sugar was desired to take (which machines could later be sold to capitalists, when sufficient encouragement had been found to have been given to the industry). In this case the juice would be then purchased by the Government as expressed from the cane, and worked up with the aid of the "concretor" into good sound "concrete," which would at once find a ready market, whether in England or India (the demand far exceeding the supply), and which would be an article of ready export by sea, and be no doubt purchased largely both by refiners and by Natives for home consumption as goor at remunerative prices.

Superior sugars.

72. Should it be desired, however, to go even further than this, and to prepare a sugar of a superior quality, some small centrifugal machines or drums, which are inexpensive, might be added, the outturn from which would no doubt not only obtain a higher price than that attainable for "concrete" sugar, but would be of a quality fit for export even direct to the European market on a large scale,—or again simple centrifugals might be acquired and worked by hand-power without the expense of a concretor.³⁷

Messrs. Thomson and Mylne's centrifugal experiments.

Various experiments have been most successfully made in this latter direction by Messrs. Thomson and Mylne on a small scale, with one centrifugal worked by hand, and costing but £22 only in England, and without the aid of a concretor. A full report on this subject having been furnished by those gentlemen, however, it will not be necessary to enter upon an explanation of their process, which will be found fully detailed in Appendix A. The prices obtained for clean turbine sugar thus prepared have been as follows, and should be contrasted with the prices of goor during the same period already given :

			1st quality.	2nd quality.	
1878	...	...	Rs. 14	Rs. 10	} Per bazaar maund of 82lbs.
1879	...	...	" 11	" 8	
1880	...	...	" 10	" 7	

Results thus attainable.

73. Whilst, then, there is no doubt but that the simple process so pursued would enable Port Blair to work up without any machinery of an expensive character,³⁸ and without skilled supervision, all locally manufactured "goor" for export, this form would of course not be that of all the most profitable, having regard to the large residue of sugar still unextracted from the juice, and remaining in the form of molasses, for which there would be no local sale (and which is unfit for export) unless aided by a concretor, such as has already been referred to.

Centrifugals.

Small centrifugals.

As centrifugals are made either simply for hand-power, singly or on a large scale, four or more being worked together, with steam or other motive power, it would only require to be determined what object was eventually contemplated in their introduction to decide to which class the preference should be given. Were it merely determined to introduce small centrifugal machines which could gradually be disposed of to cultivators or speculators as confidence in the experiment was acquired by them, to work up their own sugar, no doubt the small centrifugals would be preferable on account of the small outlay involved, bringing them within the reach of small capitalists. On the other hand, should it be resolved on by the Government to largely purchase all raw material, and to work it up in centrifugals into better

³⁷ In this case a possible loss in the sale of refuse molasses must be allowed for as not re-paying export, and exceeding demands for local consumption, with tobacco, &c.

³⁸ The cost of one-hand centrifugal 22", with copper cylinder wire, lined with perforated copper (by Messrs. Manlove, Allott & Co., Nottingham), was in England £22, landed in India with all charges about Rs. 330.

qualities of sugar for export, the larger centrifugals would be recommended for its concentration into hard export shape. Centrifugal with and without concretor.

With the concretor alone, of course, no centrifugals would be absolutely needed, whilst, if the concretor and centrifugals were worked together, possibly the higher results as regards profit would be attained. Four centrifugals or more could readily be worked by the prisoners' labour by such a capstan as has already been elsewhere recommended to be purchased.³⁹ A plan of four such centrifugals is attached. Such a machine would, it is believed, be later admirably suited to the requirements of the Settlement, were the raw sugar manufacture undertaken by the Government as working off the sugar most expeditiously and effectively.⁴⁰ Centrifugal with capstan.

74. The plan is of Messrs. Cail and Cie., 15 Quai de Grenelle, Paris, whose speciality is sugar machinery. The cost of such a set of centrifugals would, it is estimated, probably not exceed Rs. 6,380 landed in India. (say Rs. 7,000.) Cost incurred.

The figures given by the Shahabad Sugar Company for such turbines are as follows :

For 12 turbines, cost in France, Rs. 1,080 each, with 50 per cent. for freight, exchange and erection (at Rs. 540 each), a total cost of Rs. 19,440, giving Rs. 1,620 on each centrifugal. Messrs. Cail and Cie. having supplied a turbine, an experiment was carefully made by the promoters of this Company in Calcutta. The sugar exported sold in London at 23 shillings per cwt., giving after deduction for freight and other charges Rs. 8 per maund in Calcutta.⁴¹

75. To summarize briefly the suggestions above indicated, however, various courses would appear to be capable of local adoption in the Andamans, which will be later more fully dealt with at the close of this report under the head of general remarks and recommendations in its closing paragraphs.

(1.) The instructions of local cultivators (by means of skilled workmen from Beheea) in the use of the Beheea Mill, and in the boiling of juice and its concentration in the form of chuckies or cheeses or otherwise for export. Enhanced cleanliness, the defecation by lime, sulphur purification of vessels, &c., being enforced; aid being given by Government in the importation and introduction of the mills, payment being permitted to be made where necessary by instalments.

(2.) The introduction of a number of small hand centrifugals, costing about Rs. 330 each, to be worked and introduced first by Government, but subsequently sold to local purchasers, when better understood, the Government purchasing the "rab", and working it through to exportable sugar (or purchasing the cane as cut and pressing it with Beheea Mills, and undertaking the boiling and other later stages of its preparation up to

Preliminary review of suggestions of possible courses.

³⁹ Report on Indian Jail Manufactures, by Major W. B. Birch, July 1880.

⁴⁰ Jev de quatre Centrifuges (Systeme Weston) avec malaxeur. Planche No. 21. Etablissements Deroane and Cail.

⁴¹ Their original estimates in the prospectus favouring the promotion of the Company are thus prepared: 100 maunds of goor will yield at first 50 maunds of sugar and 50 of syrup. The latter will then be re-boiled and give 16 maunds of sugar, making a total of 66 maunds (or 66 per cent.), allowing a loss of five per cent. There will remain 29 maunds of syrup. Whether such returns can, however, be achieved appears open to some question.

The establishments at Nasrampung, Arrah, which it is to be regretted, was not visited for want of time, is now in full working order, and it would be extremely valuable to obtain the results of the experiments there made.

this form). This sugar would be fit for local consumption and for export, and thus save some import freight charges both in the present and future.

- (3.) The purchase of a set of centrifugals to be worked by "capstan" power, by gangs of convicts, the rab being purchased and worked up for export, on the same plans as are suggested in the preceding paragraph, the sugar being exported and used for local consumption.
- (4.) The purchase of a "concretor" (which would cost about £1,200 in England) for the manufacture of a hard concrete sugar fit at once for export, and which would find an immediate and ready sale in either Indian or English markets (there being no loss by this system whatever, as no molasses remain). This form of manufacture is specially suited to islands, whence the exports necessarily require to be conveyed by sea to other markets in the hot holds of vessels.
- (5.) The use of the "concretor" ⁴² in conjunction with the centrifugals for the preparation of a higher class of turbine sugar for local consumption and for export, a higher price being probably obtainable for the raw sugar in concrete form.
- (6.) The purchase of vacuum pans and other expensive machinery for a refinery, involving the employment of highly-skilled labour and a probable initial cost of some two lakhs of rupees.

Some of the above courses would no doubt find more fitting place under later heads of manufactured sugars, where it will be necessary to again allude to them; but having regard to the fact that it was desirable to here briefly state what was capable of being suggested in dealing with the juice from its earliest expression, it has been thought more convenient for purposes of reference to also first include them here together with the more primitive methods of less cost.

Having then in this chapter brought the preparation of raw sugars up to the point at which they are left by the cultivators, the next will deal with the further stages through which they pass in the hands of Native and European refiners.

⁴² A full account of the concretor will be found in Appendix B. No further information was obtainable respecting its cost, &c., in India. Should its introduction be contemplated, no doubt further particulars should be first acquired.

The most recent advices of the London markets show that Peruvian "Concrete" is now largely exported to Europe, and realizing high prices, viz., 16s. 6d. to 19s. per cwt.

CHAPTER IV.

THE REFINING PROCESSES.

76. As has already been explained, no refining in the true sense of the term is adopted in India except in the case of the European sugar refineries, where only is the raw sugar wholly freed from all admixture of the uncrystallizable syrup.

This insoluble residue of molasses or treacle is prevented from crystallizing by the pressure of the concentrated impurities of the original raw sugar left by the successive removals of various crops of pure sugar crystals from the liquor, and upon its quantity still remaining in the sugar at the various stages of its preparation is determined the degree of refinement to which at any given stage the product has attained. The end desired to be achieved in all processes having for their aim the refinement of the saccharine matter being in fact to render more and more fit for consumption that portion of the "raw sugar" which, owing to uncleanly or defective processes employed in its manufacture, cannot fitly be used for food without such further preparation. In other words refining is freeing sugar from the various impurities which accompany it on its first production from the cane.⁴⁸

Objects of refining.

What these defective processes are and to what extent the ultimate yield of sugar is injured and diminished thereby has been very fully explained in the chapters relating to the expression of the cane juice and the preparation of raw sugars, and it will be obvious therefrom how large a share of the work of the refiner is necessarily the mere effort to undo mischief already caused by careless and wilful neglect on the part of the cultivator of essential precautions in these preliminary stages of manufacture.

77. The principal process employed in the separation of pure sugar from the other bodies which become associated with it, is crystallization. In the case of the higher refining practised by the European refineries, certain operations precede the attempted crystallization however, having in view the prior elimination of these impurities, some of which (such as the colouring matter always present) would otherwise necessitate numerous and repeated crystallizations to effect their removal.

European method and objects.

Briefly these are as follows, and it is necessary to first refer to them in order to make apparent how far and in what points the crude and primitive system of attempted refining, as practised by the natives of India, falls short of the more elaborate and successful European methods.

The operations are thus enumerated—

1st.—Dissolving the raw sugar in hot water in such proportions that the solution shews a "thickness" of 27° to 30° of Baume's hydrometer.

⁴⁸ Article by Professor Haughton Gill already cited, and from which much of this chapter, so far as it relates to European refineries, is adapted.

2nd.—Passing the solution so made through cotton bags to filter off solid impurities, sand, chips of wood, cane, &c.

3rd.—Allowing the still hot liquor to filter slowly through a deep bed of animal charcoal (termed "char") to remove colour and some other impurities.

4th.—Concentrating the now decolorized liquor by boiling off more or less of its water in a vacuum pan till crystals have formed in proper quantity.

5th.—Separating the crystals (more or less completely) from adhering mother liquor by some appropriate process.

78. With the Native processes, however far less than this is attempted, the various stages being in the North-West as follows:⁴³

(1) The rab which has already been boiled to a (semi-liquid) soft consistency is placed in gunny bags on which a man tramples with his feet and forces out a portion of the syrup (or molasses, termed shira) to cause granulation.

(2) After this expression has taken place, the mass of still soft matter (known in this state as "putri") is thrown into open crates or vats, with a small escape below, whilst a wet water weed (siwar),⁴⁴ is freshly gathered, and laid thickly upon the surface of each crate. The action, or moisture, of which upon the surface is immediately beneath it, causes such softening of the mass, as allows the insoluble molasses to gently drain away from it through the escape below.

(3) This whitened-surface sugar is then scraped off to a depth of an inch or so (as it has become freed from molasses), (being at this stage termed "pacháni,"⁴⁵) and is laid out in the sun, and well trampled with the feet for two days. When thoroughly dried and the crystals partially separated, it is deemed fit for use and termed either kucha chini, or kucha kand (meaning "raw sugar"). The process is then renewed with the remainder, fresh siwar being applied with each layer until the mass in the crate has either drained away below in the form of shira or molasses, or been scraped away above as pacháni.

This is a long and tedious process, and the accumulation of these petty scrapings usually occupies a month to each row of vessels. One-fourth only of the entire bulk (in weight) is thus made into sugar, while three-fourths drain off as molasses.

⁴³ These vats or crates were (through the courtesy of the Magistrate, Mr. Porter) seen at Shah-jehanpore in the houses of refiners Moollah, Sewgolam, Behari Lal and Porun Mull). Upright frames were observed to be placed, with a cross bar, by which the performer holds on whilst trampling with the feet.

At Jugdispore, Arrah, the factory of Debee Koondoo (Hulwai) was visited, where the work was still being carried on.

The stems and leaves of the *Hydrilla verticillata*, a humid mucilaginous aquatic plant. Paragraph 456, Azimgarh Settlement Report.

It is not worked by the "khand saris," or sugar-makers, beyond this stage, though the molasses are often re-boiled and again re-pass through the various stages.

79. There is also one other form of sugar termed "shakur," which is described as the result of compression of a mass of rab. The latter is tied up tightly in bundles, averaging about a maund in weight, and on a number of these heavy weights are placed for about 20 days until the molasses has ceased to exude.⁴⁴ $\frac{1}{2}$ It is then a damp light-brown substance, and has usually lost 50 per cent. of its weight. It does not realize more than half the price of "chini."

Shakur.

80. It will be apparent, therefore, that in the case of these "raw sugars" there has been comparatively little or no purification, although to a considerable extent the sugar has been freed from the admixture of uncrystallized syrup, and the result would still remain but a raw product.

Still a raw product only.

81. The finer kinds of Native sugar, however, better known as "sufed bura," or "pucca chini," as "misree" (or candy), and as kand, or loaf, are all, on the other hand, made by re-boiling with the addition of milk for clarification (and careful straining in all cases) of the "bheli," or rab, in deep pans, or kurahis, with wood for fuel, a hot fire being needed. The processes are as follows :

Semi-refined Native sugars, North-Western Provinces.

- (1) A solution of 18 to 20 maunds of "bheli" in 50 to 60 gallons of water is allowed to stand for 12 hours to dissolve.
- (2) It is then boiled and skimmed for seven or eight hours (2 to 3 quarts of milk being added) and allowed to settle.
- (3) It is again re-boiled a second time, about eight gallons of liquid only being put into the kurahi at once. Bruised castor-seed is stirred in, and the liquid is baled and passed from the kurahi through a series of small "nands" built in close to it (the baling from, and re-filling of, the kurahi being continuous).
- (4) This is allowed to settle for seven or eight days, and subsequently refined with the siwar in the same manner as in the process described for kucha chini, passing also through all the subsequent stages of refinement there described.⁴⁵

Native processes, North-Western Provinces.

82. In Bengal (Shahabad) the process seems to differ but little—

- (1) The first stage is that of defecating, or clarifying, the goor syrup. The goor "cheeses" are first broken up and put into the boiling-pan, with about 90 gallons of water, a slow fire being applied so soon as the solution is heated, and the mixture is defecated with some four and-a-half seers of fresh milk mixed in five ghurrahs (about 15 gallons) of water, the milk acting as a

Bengal Native sugars.

⁴⁴ The weights used are merely made of sun-baked clay.

⁴⁵ Paragraphs 459-61, Azimgarh Settlement Report.

In Bengal the sugar, after the completion of the processes described, is packed in bags of two maunds Ghazipur weight, equivalent to about 3 maunds and 18 seers.

coagulum, and drawing the impurities to the surface whence they are at once carefully removed.⁴⁶ The goor syrup continues to be defecated and heated up to boiling point for four or five hours, and is then strained through a cloth filter covering a willow basket placed over an earthen vessel.

On the pan being emptied, the skimmings, with the addition of 30 gallons of water, are simply re-boiled for an hour, and then poured into the filter and the pan cleaned for the next process.⁴⁷ The amount of clean juice would be about 120 gallons.

- (2) The second stage is that of slowly boiling down or evaporating for crystallization this clean syrup, with the addition of a little castor seed solution.⁴⁸ The boiling takes place very gently, only small quantities (about three gallons) being placed in the evaporating pan at a time, the 120 gallons of defecated juice being thus worked off in the day.
- (3) The crystallized syrup is then removed and allowed to rest undisturbed to granulate for 12 days in "nands" or coolers (holding each some 25 gallons) having an escape hole in the bottom for molasses (which is covered with a piece of mat as a strainer to retain the sugar and allow only the molasses to escape), though the latter is not at this stage allowed to drain.
- (4) After 12 days rest the mass is cut out in three-inch layers, each being sprinkled with tepid water, broken into lumps and placed in similar fresh "nands," where it is allowed to drain for five days, the molasses gently escaping.
- (5) On the sixth day, after the surface has been slightly broken and disturbed, a layer of fresh "siwar," about $1\frac{1}{2}$ inches thick, is applied, and this is renewed with fresh weed every alternate day for four days (the old weed being left over the new moist layer) to ensure its retaining its freshness.
- (6) On the thirteenth day the first surface layer of sugar is taken off (to a depth of $1\frac{1}{2}$ inches), and on each alternate day fresh siwar is applied, the surface being first lightly sprinkled with water after a similar layer has been removed. From the date of the first scooping about 25 days are taken to work out the clean sugar in the nand, there being ordinarily about 200 such coolers to each evaporating pan.
- (7) The sugar removed thus is then dried in the sun and trodden out with the feet to whiten it by crushing the small crystals against each other.

⁴⁶ These skimmings amount to about 54 gallons and are collected in an earthen vessel.

⁴⁷ The average weight of dirt in the filter is five maunds puca. It is composed of cane trash or meagers, leaves, root and mud, and when dried is used for fuel.

⁴⁸ About one chittack to the three gallons the solution is prepared by finely pounding up 1lb. of dry castor seed and adding three gallons of cold water.

The molasses which has drained out in the five days' draining runs in gutters into a reservoir under the floor of one of the houses where it remains until the rains. It is then worked up into a second-quality sugar by re-boiling, three gallons of water being added to each nine gallons. No defecation with milk is adopted, nor is castor-seed solution added. The results attainable by this refining of 100 maunds of goor are given—

	Maunds.	Value per maund.		
		Rs.	A.	P.
1st class <i>Chini</i> called "ras ka chini" ...	93	15	0	0
2nd ditto ditto "doma chini" ...	15	8	0	0
Residue, or molasses, after second boiling	30	0	8	0
Refuse, ⁴⁸ cane-trash, soot, mud, &c. ...	22	used for fuel.		
Total ...	100			

83. The contrast of the procedure and time of the small centrifugal, using "rab," and of the Native refiners' process in using "goor," or concrete, in the manufacture of these sugars is thus stated by Messrs. Thomson and Mylne⁴⁹—

Contrast with turbine.

<i>Centrifugal.</i>	<i>Native Refinery.</i>
1st day.—Purchase and storage of rab.	1st day.—Purchase and storage of goor.
2nd to 9th.—Settling in nands.	2nd day.—Pounding, dissolving, defecating, filtering and removing to coolers to crystallize.
10th.—Working off in turbine.	3rd to 14th.—At rest. Settling.
Total 10 days.	15th to 19th.—Transfer to other coolers for draining of molasses.
Result, 45 per cent. turbine sugar obtained, saleable at an average of Rs. 10 per maund.	20th to 28th.—Four applications of siwar and removal $1\frac{1}{2}$ in sugar.
	28th to 45th.—Gradual removal of bulk of sugar in nand.
	Total $1\frac{1}{2}$ months.
	Result, 33 per cent. No. 1 chini obtained, saleable at Rs. 14 per maund.

84. It will probably be conceded that the Native process is one involving enormous labour, is protracted and tedious, and not over-cleanly, the sugar being so constantly in contact with the hands or feet of those refining it, whilst for result considerable impurities must necessarily yet remain present in the sugar, despite the laborious processes described, the proportionate yield of actual sugar being eventually, of course, still very small and the loss comparatively great.

Results of Native processes.

On the other hand, there are no doubt grave caste objections in the Native mind, (more particularly, of course, in the case of Hindus and Sikhs), to the use of sugar, the decolorization of which has been attained by the present European method of straining through deep beds of animal charcoal for the elimination of these

⁴⁸ Prior to the introduction of the Behea Mills this item alone gave 30 per cent.

⁴⁹ The information as to the Shahabad process is mainly that courteously collated and furnished by Mr. Louis Mylne, of Jugdispur.

and other impurities; ⁴⁹ and it is from this cause that the sugar so prepared does not find the ready sale with Natives to whom the method of its preparation is known, and that it would otherwise inevitably realize, cleanly as is this system compared with that of purification by bullock's blood, &c., once in vogue. From such objections, of course, the centrifugal process is absolutely free, in itself a most important consideration where it is desired to prepare a class of sugar suited in all respects to Native markets and consumption, and finding there the readiest local sale; ⁵⁰ whilst the prices at which such product can be sold with a wide margin of profit (owing to its extremely simple and inexpensive method of preparation), with its closer resemblance to the usual Native sugars to which consumers are accustomed, and from which many ordinary retail purchasers would fail to distinguish it, are points all commending it to special and favourable consideration. Nor it is unworthy of note that no possible risks are capable of being incurred in manufacture such as never cease to be present throughout the entire process of the more scientific methods of refining, whilst the period it is necessary to retain the perishable material in hand is very materially reduced.

European methods.

85. Having now completed a description of the several systems, in force under the Native methods, of dealing with the various forms of the products of the cane juice in the extraction of sugar, it will be necessary to also briefly explain the processes followed by the European refineries in India, in order to allow of the formation of an impartial judgment upon the desirability or otherwise of preference being accorded to the latter methods of the more advanced and scientific manufacture of sugar.

Small centrifugal alone.

86. The small centrifugal (or turbine), a separate note on which is attached (Appendix A), worked independently of all other machinery, represents the result of an experiment, by certain gentlemen interested in the subject, in endeavouring to obtain, at small cost, an improved class of sugar, suited to Native consumption, and in this it may be said to almost come between the two processes, involving as it does the use of some little machinery such as is employed in what has been termed above the fifth stage of the European refinery process, (viz., that of separating the crystals more or less completely from adhering mother liquor). It is, in fact, merely proceeding at once to the separation of the crystals from the molasses with somewhat purer rab than that ordinarily made use of by Natives, omitting all the preliminary processes now adopted with refined sugars to separate out the pure sugar from the other bodies associated with it. There is thus in this simple process no solution or dissolving of the raw sugar, nor any cleansing such as that of the bag-filters, nor decolorization by means of charcoal strainers or otherwise; the concentration in vacuum-pans for the full formation of the crystals being also omitted.

⁴⁹ Animal charcoal (or char) is made by heating bones to redness for some hours in closed vessels, and then breaking the black results into grain. The action of the heat is to drive off substantially all the hydrogen, oxygen and nitrogen, with some of the carbon of the gelatinous part of the bones, leaving the greater part of the bones behind intimately mingled with the phosphate and carbonate of lime. In good char the constituents exist in about the following proportions: Carbon (with trace of nitrogen) 12 per cent; carbonate of lime 7.5; phosphate of lime and magnesia 7.9; iron oxide 0.15; sand, sulphate of lime, fluorine and traces 1.35=100.00.

This mixture of porous substances possesses the power of absorbing some quantity of all the constituents of a solution of raw sugar (including sugar itself), and of holding them more or less firmly, especially those substances which, like the brown colouring matter, exhibit some tendency to pass into an insoluble modification.—(See Art. Sugar Refining, cited *ante*.)

⁵⁰ This point is especially urged in respect to the Meerut Sugar Manufacturing Company whose prospectus states that the object desired is to place sugar within reach of Native purchasers, manufactured without the use of animal charcoal or bones, and to employ no objectionable caste in the sugar factory (p. 2). The use of animal charcoal is specially also avoided at Nasraingunge-Shahabad Works and at Jugdispur, by Messrs. Thomson and Mylne.

The velocity at which the centrifugal is made to revolve impels the mass by centrifugal force against the perforated sides of the copper-wire cylinder (lined with perforated copper), thus throwing off the molasses, and gradually (when continued for two hours) leaving a whitened mass of partially refined sugar caked against the sides of the cylinder; a little gentle sprinkling with water takes place to assist the percolation by softening the adherent mass pressing against the cylinder sides.

About 45 per cent. of the rab made use of is recovered and retained in this form as raw sugar of the first quality. The molasses exuded, and that previously taken from the surface of the "nands," in which it has been standing, is re-boiled and passed again through the centrifugal, when a further 15 per cent. of second quality sugar is recovered, leaving still however the large proportion of 40 per cent. of molasses insoluble with the appliances here alone made use of.

As the explanation afforded in the Appendix (B) on this subject is very complete, however, no further details are here necessary, and the refined sugar of the European factory may now be dealt with.

87. It has been already stated that but two refineries were visited, the first that of Messrs. Carew and Company at Rosa, the second that of Messrs. Turner, Morrison and Company at Cossipore.

The former, situate in the midst of a large cane-growing area in Rohilkund, is enabled to acquire its raw material in the immediate neighbourhood, though not to the entire extent required for the mill consumption; on the other hand the latter, in the immediate vicinity of Calcutta, is unable to obtain supplies of cane-juice, rab or goor jaggery, and has ceased to work with other than date raw sugars which are first worked up by the Native methods to Akra or Ghore, or merely to a lower form of Nimchandi or Chandpore dulwa. In addition to these, however, sugars termed Gulpatta and Santipore ghore are acquired. It will be sufficient to dismiss them with a few words of explanation.

English refineries at
Rosa and Cossi-
pore.

The Akra or Akra dulwa has much of the liquid syrup already pressed out, the Ghore being a second-process sugar.

Nimchandi is a sugar made in the same manner as "Akra," but not cleaned or pressed out so far, whilst the Chandpore dulwa is a raw sugar, from which the molasses has been but very imperfectly and partially removed.

The above are Chandpore sugars of the Jessore District, mainly of Kissengunge and its vicinity.

The "Gulpatta" sugars again are prepared in a slightly different manner, and are acquired from the Nuddea District, mainly from Kishubpore and Santipore.

88. The treatment of the raw material by the refiners varies in no essential particulars, whether the product is that of the cane or of the date-palm, it being merely dependent on the quality of the sugar how long it shall remain in the first stage, that of dissolving it in the "blow ups," (until the solution shows a thickness of 27° to 30° of Baume's hydrometer) before permitting it to pass

Methods of
treatment.

into the filters. The more quickly it can be passed the better; but the lower the quality of the sugar the longer the time it will require for feculencies to coagulate.

Rosa.

89. In the case of the Rosa Factory, all descriptions of Native sugars are acquired. The goor being first in the market is, in doubtful seasons, largely purchased. Rab, however, is preferred, though "putri" is also taken, as well as raw sugar in its more advanced forms of preparation. In seasons in which the local prices of the raw material are high, or its supply insufficient, this is imported by rail from great distances, purchases having even been made during last year of raw sugars imported by sea from Penang in the Straits Settlements.

Cossipore.

90. In the case of the Cossipore Works, the ultimate residue of molasses is disposed of to an adjacent distillery, and is not worked further on the premises, whilst at Rosa the distillery forms a most important branch of the work, supplying as it does a considerable portion of the rum required for consumption by the European troops in India. Molasses being largely used by Natives for sweetmeats and with tobacco, it is also boiled or thickened up and exported to Central India and other markets for these purposes.

91. To revert, however, to the refining of the sugar in the various processes adopted, and which are similar in all essential respects in both factories.

The Cossipore Works having, on a previous occasion, been described, ⁵¹ those of Rosa are now more particularly reported on.

92. * *First stage*.—The first stage is that of dissolving or melting the raw material in hot water, and is termed "blowing up" the sugar.

First stage of European refining.

It is conducted in large iron tanks, into which the raw material is thrown, and one half its weight of water added, the water having been previously treated with lime ⁵² to neutralize the trace of acidity in the sugar. The dissolving is effected by means of heat and agitation, and the scum of flocculent and insoluble matter driven to the surface is skimmed off with flat ladles (perforated), the stirring gear and strikers in the blow-up keeping the seething mass in constant agitation. Eight such "blow-ups" are in use at Rosa (each 4' by 6' diameter). They are heated by "open steam heating," *i. e.*, the steam is injected directly into the liquid by perforated tube. "Close steam heating" is kept in closed copper tube coils within the blow-up, and does not pass through the liquid.

The liquor is constantly gauged by a Baume's hydrometer, and not until the proper temperature has been attained (varying from 170° to 214° F. in different factories) is the liquid let off into the filters below for filtration. When the "thickness" is more or less than 27° to 30°, Baume ⁵³ water or more raw material respectively are added.

The amount of heavier mechanical impurities and mucilage removed and dissolved at this stage is very large, and would, if not thus thrown off or softened, greatly impede the passage of the now liquid

⁵¹ In special reports submitted to Chief Commissioner in letters 26 and 115 of May 1878 on Native and European processes of sugar-refining—by Major W. B. Birch.

⁵² Great care is needed in the use of lime, as its presence in excess or in insufficient quantities renders the liquid acid or alkaline.

⁵³ 28° Baume is equal to 1.225 sp. gr. temperature, or near as possible 180°.

matter through the filter cases which next farther attempt to cleanse it.

93. *Second stage.*—The second stage is that of passing the solution through cotton bags to filter off and check the passage of the solid impurities. At Rosa there are some 16 “filter cases” to each blow-up pan. Beneath the blow-up pans an iron plate is placed, having holes perforated about 6” apart. Into these coarse hemp sheaths are fitted covering the filter bags of twilled cotton through which the liquor passes for filtration into store tanks below, where it rests until it can be passed through the char cisterns of the next or third stage. The bags, about 2 feet in width and 5 in length, are drawn into the sheaths, which prevent any great expansion when filled with the liquor, and a large filtering surface is thus attained with a minimum loss of space. The ends of the sheaths above are screwed into corresponding holes, and the solution, of which a warm temperature is still maintained (ordinarily about 10° below melting point in the blow-ups), slowly trickles down through these bags into the store tanks above alluded to. The time occupied is dependent on the quality of the raw material, a dry free sugar finding its way down rapidly, whilst lower classes of raw sugars filter very slowly. Constant renewal of the filter bags is always necessary, as these foul very rapidly, and special provision requires to be made for their cleansing and renewal on the spot. Nearly all solid matter is of course retained in these perpendicular bags, and the liquid is thus already considerably cleansed and purified before it reaches the third stage, both by the surface skimming and dissolving of the first, and the filtration of this second process now described; but, as may be repeated, no crystallization begins to be attempted until the fourth stage is reached, the first three preliminary stages being merely those of the removal of impurities to assist the separation of the true sugar from the other bodies associated with it.

Second stage.

94. *Third stage.*—The next stage is that of the decolorization of the saccharine solution, which is effected in enormous iron cylinders of great depth, filled with animal charcoal or bone black finely powdered. ⁵⁴

The sugar liquor (*i. e.*, the solution of raw sugar in water) in this state still however contains, besides the sugar colouring matters of various kinds, gummy and albuminous bodies and compounds of potash, soda and lime, with various organic and inorganic acids, all of which it is essential, as far as possible, to eliminate before the crystallization. Out of the sugar is attempted, owing to the power of carbon in porous forms, to remove various substances from solution and attach them to themselves; the removal of nearly all the colouring matter, and of a considerable proportion of the remaining impurities above enumerated, is thus capable of being effected by absorption in the passage of the solution through these char filters, the depth of which varies from 15 to 40 feet. ⁵⁵

Third stage.

At Rosa Factory these cisterns are ten in number, and are 20 feet in depth, with a diameter of 4 feet, and are painted within with the

⁵⁴ Theoretically, it is said the smaller the grist the better, but it must have a sufficient size to let the liquor pass through it within a reasonable time.

The best size is said to be that which would pass through a sieve of 20 meshes to the inch, but be detained by one of 30. The great advantages of this charcoal are, it is said, its freedom from soluble salts, and from considerable quantities of calcic sulphate or carbonate; whilst it has sufficient density to sink rapidly in the heaviest sugar liquor, having at the same time great porosity, together with such a degree of hardness, that it will not suffer sensible deterioration from constant handling and re-burning for many years. It may be re-burnt 70 to 90 times a year, the average loss on each revivification being only from 5 to 10 per cent.

⁵⁵ Professor Haughton Gill—Animal charcoal, when new, consists of carbon, calcic phosphate, and C. carbonate, with minute quantities of some other substance.

best white paint, both to save the iron and to ensure the cleanliness of the still warm syrup in passing through them. Their capacity is of about 30 tons of char. There is a large man-hole at the bottom to allow of the removal of the char spent.⁵⁶

A range of these immense cisterns stands below the store pans, and the char having been filled in almost to the top, liquor is run on until it commences to find its way out at a tap at the bottom; the supply is then stopped, and that in the cisterns is allowed to stand at rest for a couple of hours to allow of the absorption by the char of the impurities already enumerated. Subsequently, the decolorized liquor is allowed slowly to run off into tanks, from which, again, the vacuum pans are fed. The feeding continues at the top, but as the most pure solution is that which has first passed the cistern, it is ordinarily separately dealt with.

The cost of cisterns is necessarily dependent upon the current price of iron, and, whether cast or wrought iron, is adopted. Those of the Rosa Works (cast iron) above described are computed at the present price of iron as costing Rs. 6,000, *i. e.*, Rs. 600 each. The solution is now deemed to have reached a stage and purity at which crystallization out may be safely attempted, and that process will be next described.

95. *Fourth stage.*—This stage, that of crystallization, is probably the one requiring of all the most delicate skilful supervision, and the most unceasing care and attention.

The concentration is effected by means of vacuum pans of hard copper, the vapour formed in which is condensed by jets of water, whilst the vacuum is maintained by means of an air pump, the extent of the vacuum averaging about 28 inches in a good pan.

These pans are of various sizes, and cost in England from £50 to £70 for the smaller sizes, up to some £3,000 for the larger. The general opinion seems now to be in favour of the outturn of the larger pans, though good results are unquestionably obtained with the smaller.

The entire process consists in boiling off the water so as to cause some of the sugar to crystallize out, but owing to the removal of atmospheric pressure, this boiling is effected at a much lower temperature than would be needed in the open air.⁵⁷ A glass is provided in the vacuum pan through which the boiling of the liquor can be observed, and there is a small "proof-stick" which allows of the withdrawal at any time of some of the contents of the pan, in view to ascertaining by the degree of viscosity that the reduction of the proportion of water present has been sufficient to now allow the sugar to crystallize out. At this point it is "supersaturated" with sugar, and only needs to be disturbed in an appropriate way to commence the deposit of sugar in a solid form. This is effected by the drawing in of more of the original liquor with which the pan was supplied, and is termed "giving the pan a drink," and the process of drawing in further supplies and evaporating off their water (as each time the contents cease to deposit more sugar) continues until the whole has the consistency desired for the class of sugar which it is eventually

Fourth stage.

⁵⁶ At Cossipore much larger cisterns are now used, and small tramways both convey away the spent char for revivification and feed the cisterns with fresh char, as required, this being carried up by a lift.

⁵⁷ The liquor will be in full boil in the vacuum pan at a temperature of only 130° to 140°, though 220° to 230° F. would be needed in the open air.

destined to become, the only difference being in the size of grain desired, and the degree of "stoutness" it is wished may be attained before it is "let down." Loaf and white crystals require a higher temperature (160°), whilst the lower material for yellow sugars is worked at a reduced heat.

It is not necessary, however, to follow further the descriptions of the manufacture of loaf sugar to the hot chamber, and sufficient has, it is thought, been said to explain the use of the vacuum pan at this stage for all purposes of present consideration.

96. *Fifth stage.*—There remains but to describe the last stage—that of forcing out the remaining molasses by means of centrifugal drums driven at great velocity, varying from 600 to 1,200 revolutions per minute, the periphery travelling sometimes at the rate of 100 miles an hour. These centrifugal machines are vertical, open-topped drums, mounted on a spindle, and surrounded by a case, the walls being perforated, and the spindles connected with driving gear.

The boiled mass, which has been kept stirred, passes on from the vacuum pan into these centrifugals, which are then made to rapidly revolve, the centrifugal force spreading and driving the mass evenly against the perforated sides, and causing the syrup to exude through the perforations, leaving the whitened crystals only in the drum. The revolutions are continued from 10 to 20 minutes, according to the description of sugar desired, the soft pale yellow sugars not being spun so dry as the whiter crystals. Some eight of these are in use at Rosa, of 2 feet 6 inches in diameter, but a very large stationary one is now being erected, similar to those in use with exceptional success in Penang. The cost of the smaller size, with fittings, was estimated at Rs. 1,500 per pair. The whole of the Works, it may be mentioned, are conducted with three engines—one of 25 horse-power, one of 12, and one of 10. These work all air pumps, water-lifts, centrifugals and subsidiary machinery, and supply steam for pipes and all other necessary purposes.

The cost of centrifugals has been elsewhere given in this Report in connection with the Shahabad (Nasramunge) Company's Works.

97. Beyond this last stage there are of course further processes in which the collections of the syrup are re-boiled, and again pass through all the processes in a corrected form for the production of inferior classes of sugar, but to these it is not necessary to further refer.

One important point, however, still requires mention, and that is the revivification of the charcoal—an expensive portion of the work at any factory conducted on European systems. This requires to be washed and cleansed and removed to kilns to be re-burnt, where it is filled into vertical iron pipes at red heat, and the organic bodies absorbed from the sugar destroyed—a most important branch of the work, as it restores the primitive purifying powers of the char.

98. Into the endless details of costly machinery of buildings, whether for manufacture or for storage, it has not been deemed necessary to enter, nor would time admit of sufficient enquiry being made to justify the insertion of accurate particulars on this head, should such be desired, therefore further investigation will be undoubtedly needed.

CHAPTER V.

GENERAL REMARKS AND CONCLUSIONS.

Compilation of this Report.

99. This Report has been compiled from hurried notes and observations, and from information gathered during a recent short tour in India on other special duty, and which not only absorbed all leisure from its preparation, but, it is feared, in allowing of but very superficial personal examination may have prejudiced the value of the information so furnished in the possible presence of errors, to which a fuller investigation might have precluded the admission. Should such be observed, it is hoped that the facts above stated may be deemed to afford some excuse for their appearance, the more so when it is considered that the subject treated is one requiring a special knowledge and experience which is not very readily capable of being hastily acquired.

Valuable assistance received.

No pretensions to originality are made, for necessarily a large portion of such a Report must consist of a mere repetition of what has been better said by others of greater knowledge on the same subject, and must comprise excerpts and data furnished by and collated from other reports, its chief value being, in fact, the very collation of any information and statistics that such authorities can provide in a form in which they may prove capable of utilization for the purposes to which this Report is designed. Its preparation at all would have probably been simply an impossibility, but for the courteous and valuable aid so kindly accorded by Messrs. T. Watson and L. Mylne (of Messrs. Thomson and Mylne) of Beheea, by Mr. McAlister (of Messrs. Carew and Company), Rosa, and by Messrs. Turner and Morrison (of that firm) in Calcutta. The greatest assistance was also kindly given by Mr. F. Wright, Director of Agriculture and Commerce in the North-West Provinces, which, with that above mentioned, it is desired here most cordially and gratefully to acknowledge.

Increase of area of cane.

100. So far as the future increase of growth of the cane is concerned at Port Blair, it has been shewn that the conditions of geographical situation, the climate and rainfall, with a soil well adapted to such culture, all specially favour its encouragement at the Andamans. Should this point be conceded, it remains therefore but to be considered in what manner such fostering of the industry on the part of the Government could most judiciously be accorded.

Local consumption of sugar and goor.

101. It is impossible to estimate with any closeness of accuracy the exact average present local consumption⁵⁸ of Native or other sugars in the Settlement; it is probably, however, very insignificant, for it has been ascertained that little or none has been imported, except for Government purposes, in connection with the supply to troops and convicts; whilst there have been, on the other hand, from time to time, small exports of goor jaggery, although the area yet under sugarcane cultivation is exceedingly small. The consumption of sugar and goor in the Commissariat Department for the past three years has been ascertained to be as follows, the sugar being

⁵⁸ English returns give the consumption of sugar and molasses in 1878 at 62½ lbs. per head of the population, taking the latter at 33,800,000 (or = 939,030 tons).

imported (with freight at Rs. 40 per ton), whilst the goor was locally purchased and manufactured :

			Sugar.	Goor.
			lbs.	lbs.
1877-78	...	...	80,477	1,782
1878-79	...	...	143,627	22,485
1879-80	...	...	134,005	3,072

The excessive issue of goor in 1878-79 was apparently due to a special cause, viz., the issue to convicts of goor and lime-juice on medical grounds. The annual average of the sugar consumption of the troops of the garrison is limited to some 9 to 10,000lbs. only, the residue, therefore, representing the actual needs of free residents and others by whom it was purchased.

From these figures it is self-evident that, not only for the present, but for some years to come, there would not probably be an excessively large local demand in the colony for sugar⁵⁹ in any form, and that in consequence, should its manufacture be increased, it would require to be so necessarily with a view to export and to finding for it a market elsewhere than in these islands, and this point should not be lost sight of in determining the form that the raw (or refined) material should ultimately take, having regard to the necessity for any exports hence being by sea in the close temperature of a vessel's hold for some period.

102. Again, the area of land at present under sugar cultivation is infinitesimally small, and incapable of being taken into present consideration with regard to supplying any large machinery with sufficient raw material to keep it continuously at work, for which the entire extent of yet cleared land in the Settlements would probably not suffice; nor does the clearing of further forest land progress with a rapidity which would favour the reasonable probability of any really considerably extended area being available for some years to come for this purpose. Any immediate acquisition of costly machinery and appliances, therefore, would, it is suggested at present, be wholly premature, even were their ultimate purchase determined on in the remote future.

Present area of cane unequal to supply large works.

103. The manufacture of sugar and the growth of the cane, then, being locally as yet quite in their infancy, it is essential to clearly recognize and accept this fact, and to confine any recommendations in respect to immediate action to a few practical suggestions based upon and limited by this consideration.

Basis of recommendations.

104. First, then with regard to the growth of the cane. The question of the temporary present remission of any extra charges upon the rent of cane land might with advantage, it is thought, be re-considered. It is true that by the recent land settlement of 1879 the necessity for an enormous reduction of the rents previously imposed on sugarcane lands was clearly admitted and recognized. Such reduction having been in fact from Rs. 40-8 per acre for valley land, and Rs. 38-4 for hill land, to a uniform rental of Rs. 9 per acre upon land of either class (being still an excess charge, however, over present rentals of land for ordinary crops, equivalent to Rs. 4-8 per acre in the case

Temporary reduction in rents of land.

⁵⁹ The figures above cited give not quite 36 tons in 1877-78, with about 64 tons in the following year, and not quite 60 tons in 1879-80. Goor would continue to be locally manufactured under any circumstances, and the Government needs are ordinarily but small.

of valley, and Rs. 6-12 per acre in that of hill land⁵⁹). Even yet, therefore, it will be observed that in the case of valley land the rent is exactly doubled to the cultivator who grows cane, whilst to the tenant of hill (or admittedly inferior land, as it is ordinarily charged half valley rents) it is quadrupled. If even yet such rates are prohibitory to a certain extent, there would appear reason to assume that the long-continued imposition of the higher terms named may have seriously prejudiced and hampered in years past the growth of this industry to no inconsiderable degree.

In the North-West Provinces the rents appear to average from Rs. 7-8 to Rs. 13 per annum during cane growth only, whilst in Shahabad the average was quoted at Rs. 10, the rates on the Jugdispur estate varying from Rs. 5-8 to Rs. 7 per bigah (equal to Rs. 8-12-9 to Rs. 11-4 per acre) according to quality of soil and facilities for irrigation. These, however, include Government and legalized cesses (viz., half an anna per rupee for road and public works cesses, and half an anna per rupee for putwarees or kanoongo's naig or fee, altogether one anna per rupee).

In other parts of Shababad the rates are somewhat lower, except where the zemindars have invested capital in wells or reservoirs and in subsidiary irrigation channels in connection with the canals.

Sufficient has been said, however, on this subject to direct attention to it. It may be doubted whether with the ratooning practised locally, and with regard to any question of exhaustion of the soil, the causes which exist in India for an enhanced rate on this class of crop have local existence.

Improved seed.

105. Under the first head of recommendations, also, would come the introduction of improved seed into the islands, after full enquiry in the Straits Settlements, or other localities having similar conditions of soil, rainfall and temperature, as to that best suited for local adoption, judging from practical experience of its growth and the value, description and yield of its outturn.

Introduction of
Beheea Mills.

106. On the second point, that of the expression of the cane juice, it is suggested that the present local requirements in Beheea Mills might be ascertained, having regard to the annual crop requiring to be pressed; that several should then be purchased and lent to the cultivators (or the cane might be pressed for them free), that they may learn their uses and value. That trained men should, however, be obtained from Beheea to start them, in order that no mistakes may occur in the commencement, which might in so small a place at once prejudice local opinion against them. If sold later to cultivators, the price might be permitted to be made recoverable by instalments from them with some small interest to recoup the Government against loss.

⁵⁹ *Vide Gazette of India* Notification No. 162, Home, Revenue and Agricultural Department, dated Simla, 9th July 1879, under Andaman and Nicobar Islands Regulation, 1876.

The local bigah being only equivalent to $\frac{1}{3}$ rd of an acre, is much smaller than the Shahabad bigah of $\frac{2}{3}$ ths, and the calculations of comparison must necessarily be made in acres. The ordinary rents at Port Blair were then fixed at Rs. 1-8 per bigah (= Rs. 4-8 per acre) for flat valley land, and 12 annas per bigah (= Rs. 2-4 per acre) for undulating ground or hill land, the extra charges imposed for the growth of sugarcane being reduced to Rs. 1-8 per bigah for valley and Rs. 2-4 for hill plots. Previously, rented land under sugarcane was charged for at the rate of Rs. 4-8 per acre (rental), and hill land, at 12 annas only (*vide* Settlement Order No. 1037, dated 10th March 1873); but the sugarcane fee was Rs. 12 per bigah, = Rs. 36 per acre, in addition to such rental, giving Rs. 40-8 and Rs. 38-4 respectively per acre. In January 1879 only the fee was reduced to Rs. 10 per bigah, = Rs. 30 per acre, the gross payment being thence Rs. 34-8 and Rs. 31-4 respectively per acre until the settlement above quoted.

107. A few prizes might also be given annually for the purest and best native sugars produced in the forms in which it was most desired to encourage its production for future export. Prizes.

Communication might also be opened for the cultivators with markets and refineries in India, their samples being forwarded, and prices obtained thereon, whilst special reduction in export rates for such cargoes should be endeavoured to be stipulated for at the close of the present contract (or, if possible, secured during its continuance⁶⁰). Communications with Indian markets. Reduced export freights.

108. Under the third head, that of the preparation of raw sugars, to which equally some of the preceding remarks apply, the Government might contract to purchase in the local markets all coming up to a prescribed standard to the extent of local wants, previously ascertained, at a rate not below that now paid for the imported product, plus freight. Further, a few small hand centrifugals might be purchased and be lent or disposed of to the cultivators, after instruction in their use, in the same manner as is suggested in respect to the Beheea Mills. Purchase of local produce. Purchase of centrifugals.

109. Such encouragements as above indicated, with any others which may suggest themselves on this report, or otherwise, would no doubt prove of very great ultimate advantage and value, both in extending the area of cane cultivation, and in improving the quantity and quality of the product, if it be determined to leave the matter altogether in the hands of the cultivators themselves. If development left to Natives.

110. On the other hand, if it be deemed expedient for Government to intervene, and, whilst permitting the ryots to grow the crop (with the encouragement above indicated), to undertake the dealing with its yield in all or any subsequent stages, from the expression of the juice, even up to the refining of the sugar, a wholly different course would necessarily require to be pursued, determined by the exact product which it was desired to attain. If undertaken by Government.

111. Experiments might be made in the purchase of the cane, and its expression in the Beheea Mills, and the working up of the juice into raw sugars in small hand centrifugals on the plan adopted at Jittoura, Shahabad, and which is fully explained in Appendix B, it being desirable to ascertain how this form of sugar would stand sea transport. Some other small machines, costing about Rs. 1,000 complete, suited to small growers, are said to be now very extensively Beheea Mills and centrifugals, or

⁶⁰ No exports will probably ever be capable of being made from the Andamans whilst produce continues weighted in competition with other markets by absolutely prohibitory freights of Rs. 40 per ton to Calcutta and Rs. 20 per ton to Rangoon (the distances being 800 and 390 miles only respectively). The charges from the Nicobars Settlements are even higher, being Rs. 50 and Rs. 30 per ton to Calcutta and Rangoon respectively.

How detrimental has probably been the policy in this respect may be inferred when it is stated that the large steamer "Satara" of the British India Steam Navigation Company (of 1,300 tons, gross tonnage), subsidized by the Government, and costing in fact nearly two and a half lakhs annually, now frequently makes her passages monthly to and from Rangoon, and on return to Calcutta without conveying a single ton of cargo, whether Government or private, upon her trips.

The rates for Government cargo only have been reduced by a recent contract to Rs. 30 per ton outwards (from Calcutta to Port Blair), and Rs. 15 per ton inwards, and the cultivators would thus benefit by Government exporting produce for them to Calcutta to the extent of no less than Rs. 25 per ton at present contract rates. A temporary "special rate" for ghoor has, however, recently, on Major Birch's urgent personal representations, been courteously conceded by Messrs. Mackinnon, Mackenzie (since June 1880) of Rs. 2 per hogshead, = Rs. 8 per ton (each hogshead being taken as weighing 500lbs. (net), or 4 as representing a gross weight of 2,240lbs.

Hampered with Rs. 40-8 per acre of land rent, and Rs. 40 per ton of export freight, no rapid development of local resources in a sugar trade could, it is suggested, very reasonably have been anticipated.

Small Penang machines. adopted by sugar colonists in Penang and the Straits (more particularly Chinese) with great pecuniary success, and fuller information should undoubtedly be obtained in respect to them.⁶⁰

Larger centrifugal with capstan. 112. As the area of sugarcane and the raw material available increased, were the experiment successful, large centrifugals driven by capstan power by prisoners' labour might advantageously be introduced, or, if preferred, a "concretor," the use of which has been already explained, might be acquired and set up in a central convenient spot at a large mill, the canes being pressed, and the juice immediately run over the "concretor" as expressed, and hardened at once into convenient export form, there being thus no loss in molasses. Or the concretor and centrifugals might be worked together should later experiments justify this course.

"Concretor," with or without centrifugals.

Establishment of local European refinery. 113. Not, it is thought, until this at least has been fully tried, nor until the extent of the growth of cane has so increased as to compel attention being again specially given to this branch of the subject for more pressing considerations of expediency in dealing with far larger quantities of the raw materials than now exist, will the question of locally "refining" the sugar by the more scientific European methods and appliances of costly machinery need to be discussed.

With the above suggestions, therefore, this report is now respectfully submitted for the consideration of the Government.

W. B. BIRCH, Major,
On special duty.

PORT BLAIR;
The 18th September 1880. }

⁶⁰ Samples of the sugar they produced were examined, which were of excellent quality. These Mr. McAlister, of Messrs. Carew and Company, Rosa, had recently received with much valuable information respecting Penang (from the visit of a member of a large sugar firm of that Settlement).

APPENDIX A.

Note by Messrs. Thomson and Mylne on Turbine Sugar.

We received the small turbine which is at work here in 1875, and used it each season only experimentally. Owing to its small size, and to the fact that we were not sure of getting paying prices for turbine sugars, we did not pass all the yearly outturn through it.

But having latterly found that a *clean* turbine sugar can find a market in the North-Western Provinces at from Rs. 9 to Rs. 11 per maund for 1st quality, and Rs. 7 to Rs. 8 for 2nd quality, we have passed all the syrups through the turbine, small as it is, confining our operations within the limits of its capacity.

The prices obtained for these sugars have been as under—

	Rs.		Rs.
1878, 1st quality	... 14	2nd quality	... 10
1879, ditto	... 11	ditto	... 8
1880, ditto	... 10	ditto	... 7

} per bazar
maund, 82
lbs.

2. On working our ryots' raáb through the turbine, we soon found the evil effects of unfiltered juice. The sugar turned out was full of impurities, splinters of cane trash, leaves and mud, all of which gave it a dirty appearance. Even a rough filtering through coarse cloth did not remove all the objectionable foreign matter. As these impurities affected the price by Rs. 1-8 to Rs. 2 per Calcutta maund, it was necessary to induce the ryots to contract for clean raáb, and to agree to our supervising the filtration of juice at their domestic factories. The objection was at once raised, that by filtering the juice there would be a loss of weight to the detriment of the ryot. From their point of view, this objection seemed quite reasonable.

We met it by suggesting that the average loss in weight per boiling should be carefully found by a series of trials. To this end trials were made. Simultaneous boilings were made of like qualities of juice from identical fields, one pan being supplied with the ordinary unfiltered juice, and the other with very thoroughly filtered juice passed through a double fold of country cloth placed over a filter box, with a bottom of very fine brass wire gauze (see sketch 3).

The *filtered* juice while evaporating was also thoroughly skimmed twice, to remove a heavy dirty film or scum; while the unfiltered juice remained entirely unskimmed according to custom. With this double cleansing the loss in weight over a number of cases (repeated periodically afterwards to suit unbelieving ryots) was as follows:

	<i>Impure Sugar.</i>		<i>Impure Raáb.</i>
1. Boiling (15 gallons) } unfiltered juice	{ 25 kutoha seers =15½ pucca do. =31 lbs.	... } or if evaporated, ... } less and on a slow ... } fire	27 kutoha seers. =16½ pucca do. =33½ lbs.
	<i>Clean Sugar.</i>		<i>Clean Raáb.</i>
1. Boiling (15 gallons) } same juice thoroughly filtered	{ 23½ kutoha seers =14½ pucca do. =29½ lbs.	... } or if boiled ... } for raáb ... }	=25½ kutoha seers. =15½ pucca do. =31½ lbs.

So that, though there was a loss in making clean goor as compared with unfiltered goor, and clean raáb as compared with unfiltered raáb, yet, owing to a less and a slower evaporation and a looser grain, raáb was comparatively heavier than goor, so that *clean raáb* weighed out as heavy as *dirty goor*.

3. Our ryots were apparently still sceptical, probably because the whole proposal was novel and an innovation upon established custom.

Convinced against their wish on the question of weight, they then objected to the trouble involved, &c.

As we were particularly anxious to make a beginning, an inducement had to be offered, viz., that we would pay for clean raáb at the rate of 1 kutchá seer (=10 chittacks) per rupee less than current bazar prices for uncleaned goor. That is, if ordinary goor or raáb was selling at 18 seers kutchá, we agreed to pay at 17 seers per rupee. This increased price amounted to about 4 annas per pucca bazar maund of 82lbs.

We have since heard that the ryots were more than satisfied that raáb is heavier per bigha than goor, and that the increased price more than paid them for any extra labour in filtering or other inconvenience. This being the case, we believe 2 annas per maund extra will induce last year's men to supply the clean article next season.

4. To make sure of getting a clean and good raáb we engaged two special men (Rajpoots) from a village in the vicinity noted for its production of raáb to superintend filtration and evaporation, and carry out any improvements that might occur to us. It was at first arranged that every boiling (5 or 6 per day), in each contracting ryot's boiling house, should be of filtered juice, and this continued for some days. Presently, requests were made for permission to have two unfiltered boilings per day and the remainder filtered. The reason for this was not at first disclosed. But the request was granted and we were afterwards informed that the ryots were both to lose any skimmings or impurities. The filtered boilings took place first, skimmings and impurities being carefully stored away and afterwards added to the unfiltered boilings towards the close of the day.

In reply to an expression of surprise at such a proceeding, the men answered that they were ready to supply clean goor to the native petty trader if he would pay for a cleaner article, otherwise it would not suit them to filter at all for selling locally.

5. We insisted upon our two imported raáb makers attending very closely to the filtration of the juice and to the fumigation of the earthen "ghurrahs" into which the juice was run from the press. Before using the "ghurrah" it was washed out with water, allowed to drain dry, then inverted over a lighted sulphur match stuck into the ground or into a perforated board. A stock of these matches was specially prepared for the purpose and made over to the raáb boilers. The fumigation of these porous earthen vessels is, we consider, of first importance in preventing fermentation of the juice. We have observed that the juice in an unfumigated ghurrah ferments and froths over, while in a fumigated vessel scarcely a bubble is seen. The difference in the outturn is also very marked. Native earthen vessels being porous; mere washing with water will not suffice. The action of sulphur fumes upon the fermenting matter which clogs the pores arrests, if not entirely prevents, for the time being, any deteriorating change in the juice.

6. Ghurrahs being cleansed and fumigated, juice is collected in them. The filter No. 1 (see sketch 2) fitted to the ghurrahs, prevents coarser impurities from passing.


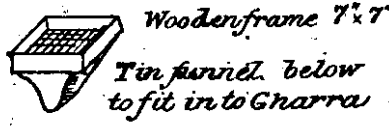
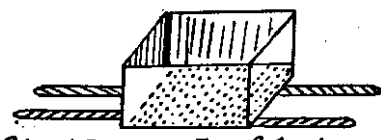
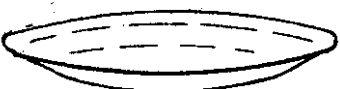
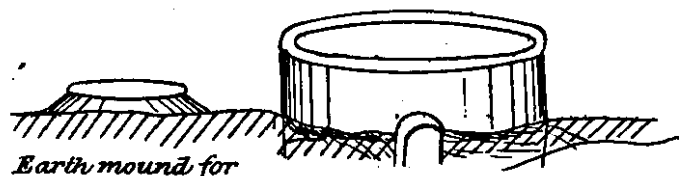
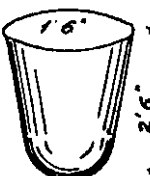


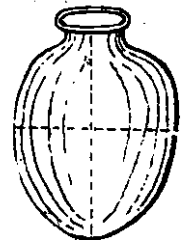
As soon as three out of five ghurrahs are full, the juice is poured through filter No. 2 (sketch 3) into the pan, (4) which has been placed over the furnace, (5) a slow fire fed with cane leaves is then applied. As evaporation goes on, the remaining ghurrahs are added. The rest of the process has been before described in answer to question No. 17.

7. As soon as a boiling is ready, the contents are poured into a "nád" sunk into the ground under cover of the ryot's shed (sketch 6). The extract gradually cools and crystallizes. Every third day the factory cart brings in what is ready. The ryot accompanies it, has his stuff weighed in his presence, and takes a receipt or cash for it as he may prefer.

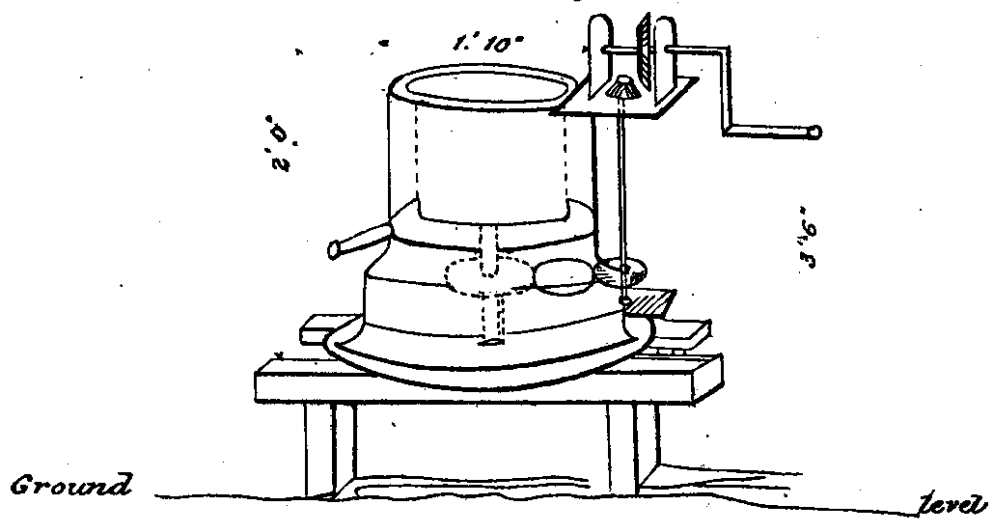
For carting the stuff, a deal or mangoe wood chest, secured against leaking and placed on the cart, answers admirably. For large quantities, a couple of barrels suspended or otherwise attached to the axle of an ordinary bullock cart would suffice.

8. Arrived at the factory the raáb is stored in rows of náds (sketch 6) sunk into the ground or built up in sun-dried bricks.

After the lapse of some days the grainy and more solid part of the raáb settles at the bottom of the náds, while treacle to the depth of 1 to 2 inches covers the

<p>1</p> <p>Earthen Gharra</p>  <p>3 Gallons</p>	<p>2</p> <p>Filter No 1 for Gharra (Coarse wire gauge)</p>  <p>Wooden frame 7x7 Tin funnel below to fit in to Gharra</p>	<p>3</p> <p>Filter No 2 of Fine brass wire Gauge to be placed over & across evaporating pan</p>  <p>Wooden frame 1' 6" long 1' 0" broad 0' 9" deep Stretcher made of 4 pieces of bamboo</p>
<p>Boiling Pan (Native) Circular 5' diameter 3' to 4' deep in Centre</p> 	<p>5</p> <p>Furnace made of Clay. Walls 9" thick. Chimney consists of a hole opposite stoke hole but on a higher level.</p>  <p>Earth mound for placing pan to cool contents</p> <p>2 feet above ground 1 foot excavated Diameter of inner circle about 4 feet</p>	
<p>6</p> <p>Earthen Nâd</p>  <p>1' 6" diameter 2' 6" high</p>	<p>7</p> <p>Goor mat</p>  <p>Open</p> <p>1' Diameter</p>  <p>Ned. to form Cheese mould</p>	<p>8</p> <p>Bharri for Râb</p>  <p>2' diameter 3' high</p>

22" Hand Centrifugal Machine



surface. Preliminary to charging the turbine, the upper layer of treacle is removed, sufficient raáb is taken out, uniformly broken up between the fingers to prevent lumping and then put into the turbine.

Each charge for the small hand-turbine is 20 seers (40 lbs). The time taken to throw off the molasses being two hours. In one day of 12 hours six charges are worked representing only three maunds of raáb per day.

The amount of the resulting sugar is 45 per cent. of the raáb used, including the surface molasses spoken of before. The molasses or syrup thrown off from the centrifugal runs into a vessel and is collected till three maunds accumulate to be re-boiled together with the surface molasses into second quality raáb. This may be done either in a native shallow pan or in a series of three continuous pans placed on one furnace as in the West Indies.

The amount of sugar obtained from this boiling depends entirely upon technical skill and experience. The utmost we have been able to gain with the aid of native boilers has been of second turbine sugar 15 per cent. on the first raáb as received from the ryots.

This makes the outturn from 100 maunds ryot's raáb—

	Valued per maund.			
	Rs.	As.	Rs.	As.
First quality sugar, 45 per cent.	...	9 0	to	10 0
Second do. 15 do.	...	7 0	„	7 8
Molasses, 40 do.	...	1 0	„	1 8

With good technical experience the amount of both might reach 65 per cent. or 70 per cent. In starting any large undertaking, experienced men would have to be employed.

The 40 per cent. of molasses is disposed of locally *with some difficulty* at rates varying from Re. 1 to Rs. 1-8.

The small hand-turbine cost in England £22=Rs. 220, to which add 50 per cent. for exchange, freight, landing and other charges=Rs. 330.

The makers are Messrs. Manlove, Alliott and Company, of Nottingham, England, and 45, Rue D. Elbeuf-Rouen, France.

Their speciality is sugar machinery; they describe the turbine as "A 22-inch hand centrifugal sugar machine, having cylinder made of copper wire lined with perforated copper."

We regret not having an exact plan or drawing of the centrifugal machine, but a rough sketch is given, showing the machine set up and ready for working.

APPENDIX B.

Extract from "the Sugar-cane Magazine", published by MESSRS. GALT AND COMPANY, of Manchester, No. 181, Vol. 12, dated the 1st June 1880.

USE OF THE CONCRETOR FOR MAKING SUGAR.

THE belief appears to be prevalent that the concretor is only applicable to the manufacture of "concrete" sugar. This is not the case, as it may with equal advantage be used in conjunction with the centrifugal machine for the production of yellow to fine counter-sugars, or in connection with the vacuum-pan for making the finest class of vacuum-pan sugars.

1st method.—Use of the concretor alone to make "concrete" sugar. When this is the object to be attained, the manufacturer proceeds as follows:

The cane is crushed, and the juice clarified, or defecated, in the usual way. After the defecation the juice passes on to the "tray" of the concretor. Here it is concentrated up to about 30° to 33° Baumé, at which density it passes into the "revolving cylinder", also forming a portion of the apparatus. The interior of this cylinder is full of spiral-blades. As the cylinder revolves these spiral-blades take up the concentrated juice, or syrup, and expose a very large surface of it to the action of a current of hot air drawn through the cylinder by a fan which forms part of the machine. The evaporation in this cylinder is conducted entirely by means of hot air, the consequence being that, though the evaporation proceeds rapidly, the temperature of the juice, or syrup, is kept low; indeed, on entering the cylinder the temperature of the syrup at once falls to about the temperature at which it would be boiled in a vacuum-pan.

In this cylinder the syrup is concentrated to such a point that, on being discharged from it and allowed to cool, it becomes quite hard, and is at once ready for sale or shipment to any distance.

In working the concretor in this way no molasses whatever is made, but for every gallon of juice at 10½° Baumé supplied to the apparatus it yields two pounds of raw sugar (or "concrete") of a quality varying according to the quality of the cane-juice from which it was made.

The advantages of this method of using the concretor are,—

- (1)—The *smallness of the outlay* required for the manufacture of a given quantity of cane.
- (2)—*Economy in labour.*
- (3)—*Largely increased quantity of sugar* from a given quantity of juice.
- (4)—*Abolition of distillery, charcoal-filters, centrifugal machine, molasses, tanks, &c.*

Its advantage is that, though very much more sugar is obtained by this process from a given quantity of cane-juice than by any other system of manufacture whatever, yet this sugar does not realize so high a price per ton as vacuum-pan sugar.

It is for the planter to decide, multiplying the quantity of sugar produced by the price he can obtain for it, and taking into account reduced interest on capital, in consequence of the comparative cheapness of the machinery needed for making "concrete" sugar, and also reduced costs of manufacture, through economy in labour and fuel, whether it might not pay him better to make the larger quantity of low-priced sugar, rather than the smaller quantity of high-priced sugar.

The inventor and the manufacturers of the concretor believe that, unless there be a demand for counter or vacuum-pan sugar for local consumption, or other exceptional circumstances, it will pay the planter better to make the large quantity of "concrete" sugar rather than the smaller quantity of higher-priced sugar.

These concretors are obtainable of Messrs. Manlove, Alliott and Company, Nottingham, England.

REPORT

OF THE

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AGRICULTURAL BRANCH

OF THE

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DEPARTMENT OF LAND RECORDS AND AGRICULTURE,

BENGAL,

For the year ending 31st March 1904.



Calcutta:

PRINTED AT THE BENGAL SECRETARIAT PRESS.

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DEPARTMENT OF LAND RECORDS AND AGRICULTURE, BENGAL.

No. 1775A.

From S. L. MADDOX, Esq., I.C.S.,

Offs. Director of Land Records and Agriculture, Bengal,

To THE SECRETARY TO THE BOARD OF REVENUE, L. P.

Dated Calcutta, the 16th June 1904.

SIR,

I HAVE the honour to submit the Nineteenth Annual Report of the Agricultural Branch of this Department, prepared in accordance with the orders contained in letter No. 92-293—5, dated the 20th January 1902, from the Government of India, Revenue and Agriculture Department.

CHAPTER I

PREFATORY.

2. I was in charge throughout the year. The farms at Burdwan, Dumraon, Scripar, Sibpur and Gouripur and the Research station at Dalsinghserai were inspected. I accompanied His Honour the Lieutenant-Governor to Pusa, attended meetings of the Bengal Silk Committee and Bihar Indigo Planters' Association, inspected several veterinary dispensaries and attended the Sonapur and Rajnagar fairs. I also visited Kalimpong, and toured through the jute-growing districts. I was on tour for 184 days, in every month except May and September, but most of my time was occupied in inspection of settlements.

Mr. Debendra Nath Mookerji was Assistant Director throughout the year. Baba Girish Chunder Dutt was my Personal Assistant on the Agricultural side up to 26th August 1903, when he was relieved by Mr. Nitya Gopal Mukerji. The expert staff of the Department included also four travelling overseers.

3. The Phipps' Agricultural Institute at Pusa has been opened by the Government of India during the past year, the buildings are under construction and the farm is being laid out.

In February His Honour the Lieutenant-Governor accompanied by the officers of the Revenue Department of this Government visited Pusa and discussed with Mr. Morrison the relations between the Institute and the Agricultural Department of Bengal. The Institute will include a Research station, an Experimental farm, an Agricultural College and a Cattle-breeding farm. It was decided to close the Bengal Agricultural College at Sibpur as soon as the College at Pusa was opened and to transfer the students to the Pusa College. The Cattle-breeding Farm at Pusa is intended primarily for the benefit of Bengal. The Veterinary Officer in charge will be for all purposes of discipline and control under the Director of the Institute, but the Superintendent, Civil Veterinary Department, Bengal, will select the herd, supervise feeding, breeding, etc., and will choose the young stock for distribution. The Director of Agriculture, Bengal, and the Deputy Director, when appointed, will be permitted to visit the Institute from time to time and to suggest experiments and subjects for research. In Government order No. 2665 Agri. of 10th Augus

1903, paragraphs 8 and 9, the general lines for the development of the Department in Bengal have been laid down :—

“It has been pointed out that for the present the work before the Agricultural Department is research, to be combined in due course with the demonstration of results. Proposals for the establishment of a Research station in Bengal, with an Agricultural College and classes attached to it, are now under the consideration of the Government of India. This station, if sanctioned, should, in future, form the nucleus of all research work, and the Deputy Director should keep in constant touch with it and utilise the results obtained by it as much as possible. Round this centre should be grouped the Divisional experimental farms, situated so as to best fit in with the prevailing agricultural characteristics of each Division, manned by minor experts trained at the Research station, and conducted on the strictest possible scientific principles. From research work the Department should proceed to demonstration: the only way to teach the cultivator is to prove to him in practice the financial superiority of the methods which are recommended. When the Department, therefore, has anything to teach, it must demonstrate its knowledge on farms attached to experimental farms or on farms situated in Government or Wards' estates. These again must be supervised by trained agriculturists, and must be inspected by District Agricultural Inspectors, who may, perhaps, combine with their duties of inspection, agricultural and crop enquiries, and the collection of agricultural statistics.

“By adopting such a scheme as this, by working patiently up to it, and by keeping it sufficiently elastic to meet unexpected demands as they arise, it is believed that the Department would gradually be able to effect many practical reforms in present agricultural methods, improve the accuracy of crop returns and statistics, and create a valuable agency which would be of assistance in times of agricultural depression. Such a scheme could be developed either slowly or rapidly, so that it could be proceeded with as funds permitted. Provided that a firm foundation is obtained in accurate expert knowledge at the Research station referred to, and that each experimental station is properly equipped and carefully managed from the first, the Department can wait patiently for results and for the gradual development of methods of demonstration.”

4. The post of Deputy Director of Agriculture has not yet been sanctioned. Government has, however, opened a divisional farm at Cuttack during the year to demonstrate the value of irrigation and to carry out the experiments suggested by the Irrigation Commission. A programme for irrigation experiments in all the farms has been drawn up in consultation with Mr. Mollison and the Chief Engineer. Sanction has also been given to the acquisition of land for one divisional farm every year for the future.

The Board of Revenue is now considering proposals for allotment from its improvement grant for Government, and, perhaps, for Wards' estates, to the upkeep of District demonstration farms in which the experiments made at the divisional farms will be tested and adapted to suit local conditions. This portion of the scheme of development must necessarily proceed slowly for want of expert officers to place in charge of the farms. The Inspector-General of Agriculture has, however, already taken two young men from Bengal for training as fieldmen on Rs. 30—50 for two years, and may be induced to take more if they will come without pay. Some four or five agricultural scholars also qualify every year at the Sibpur College, but Bengal does not yet possess an expert staff strong enough to form a training school for agricultural tutors, and it will be some time before Pusa produces a sufficient number of experts for that purpose. I may add, however, that I have received several inquiries for the Pusa College prospectus. In any proposals which may be made for increasing the *cadre* of Sub-Deputy Collectors, I trust that the Travelling overseers and Agricultural students will find a place. By this means students will be attracted and in the course of time a section of the Subordinate Executive Service may be graded according to merit or seniority in the service of the Agricultural Department. An offer of a scholarship to Pusa for the best student at the Dumraon school has been already made by the Rani, and no doubt District Boards will come forward to support promising boys who have attended agricultural classes in their own districts.

Pending sanction of the post of Deputy Director, it is not possible to submit definite proposals for his head-quarters. It is necessary to have the Deputy Director in close touch with an influential and public-spirited Association interested in Agriculture and for many reasons he should be stationed close to Calcutta. The Inspector-General of Agriculture, however, advises that the neighbourhood of Calcutta is not suitable for the farm which it is so necessary to have in close association with the Deputy Director, and further suggests that for such a farm facility for irrigation is a *sine quâ non*. For this reason he

advises a site close to the Sone Canals and having lands commanded by it. The Chief Engineer has been consulted and warmly welcomes the suggestion and promises every facility. A site will be provisionally selected in July. The subject of Agricultural Education is noticed in chapter IV of the report.

CHAPTER II.

SCIENTIFIC AND NATIONAL ENQUIRY UNDER IMPERIAL CONTROL.

5. *Sugarcane disease*.—In November last, Dr. E. J. Butler, M.B., F.L.S., Cryptogamic Botanist to the Government of India, visited the Burdwan and Dumraon farms in connection with the investigation of sugarcane diseases in Bengal and furnished the report which is reproduced *in extenso* in Appendix V.

6. *Dioscorea (yams)*.—As the result of investigations on the subject of yams, the Officiating Reporter on Economic Products has issued a note giving the scientific and vernacular names of all the yams known in Bengal and Assam with their distribution as far as ascertained. His request for further specimens and information has been circulated to the District Officers.

7. *Collection of articles for the Indian Museum and the Imperial Institute, London*.—During the year under report a few specimens of various economic products, such as, (1) *Amarantus spinosus*, (2) *Holarrhena antedysenterica*, (3) *Melia azadirachta*, (4) *Symplocos racemosa*, (5) *Rheum emadi*, &c., were collected by this Department through its travelling overseers for the Imperial Institute, London.

8. *Deterioration of jute-fibre*.—Considerable progress in the enquiry was made during the year. According to the opinion expressed by the Secretary, Calcutta Baled Jute Association, the question presents three different aspects. Either the alleged deterioration may be accounted for by impoverished seed, or by drumming the jute in an improperly dried condition, or by fraudulent adulteration with water. For the first two causes the raiyat is to blame, and for the third the middleman. The third indeed is most serious, as the result is a deterioration of strength, colour and gloss of the fibre. The Department was fortunate in obtaining the help of several expert officers. The Inspector-General of Agriculture, the Superintendent of the Royal Botanic Garden, Sibpur, the Reporter on Economic Products, and the Agricultural Chemist have all given valuable advice. The experimental work was conducted at the Burdwan farm, and also at Faridpur and Jalpaiguri. Samples of fibres and of water in which the jute was retted were sent to the Agricultural Chemist for analysis, and opinions of jute experts taken as to the quality and market price of the fibres grown under different conditions as to variety, soil, manuring and steeping. The results of 13 years' experiments has established the fact that the Burdwan farm selected seed generally gives the best results, and that the *Corchorus capsularis* yields a better fibre than *Corchorus olitorius*. The highest yields were obtained at the Burdwan farm from three Dacca varieties, viz., *kajla* (2,560 lbs. of fibre per acre), *agnishwar* (2,540 lbs.) and *belgachi* (2,520 lbs). Serajganj *deswal* jute, which ranks highest in point of quality, yielded only 2,020 lbs. per acre, while the farm selected Serajganj *deswal* yielded 2,480 lbs. The variety experiments are being repeated this year at the above places, and also at Rangpur and Gouripur (Mymensingh).

With regard to fraudulent watering or excessive moisture, very careful inquiries were conducted by Messrs. N. G. and D. N. Mukerji at various jute centres as well as in Calcutta. The inquiries elicited by the Messrs. Mukerji show that hygroscopicity depends upon certain conditions of temperature. It is suggested that any bale found to contain an abnormal percentage of water may be rejected or be bought at a lower price. It was also suggested by the Associations that legislation in the form of the Bombay Act for cotton adulteration might be adopted. Another suggestion was that notices under Government order be fixed up at the principal jute marts, to the effect that drums containing an abnormal percentage of water would be confiscated and the owners prosecuted. This means legislation and putting power in the hands of the police. It is reported, however, that one firm did put up notices at

its markets in which it declared its intention of not buying wet jute, and for a time, in the belief that the notice was issued by Government, watered jute was not brought for sale.

As regards drumming in wet condition, raiyats will be invited to see the drumming of the fibre grown in the experimental centres and will in due course be shown a list of the prices at which these fibres are valued in Calcutta, so that they may compare the prices which they obtain. Very often, however, the middleman is guilty of the fraud.

Major D. Prain, I.M.S., has suggested that in the course of steeping and retting coolies of the districts from which the varieties are imported should be brought down to handle their own varieties, as local coolies do not get equally good results from such as they are unfamiliar with. Dr. J. W. Leather has also suggested for inquiry whether climate or geographical position rather than the character of the soil affects the strength of the jute fibre. Certainly the trade classification favours this view.

A special report on the subject will be submitted to Government.

9. *Jute forecast.*—In connection with the jute forecast it is to be noted that an earnest attempt is being made by the deputation of two travelling overseers during April and May to the jute districts to ascertain the actual area under cultivation. The preliminary forecast is to be postponed till 7th to 15th July and no attempt to ascertain the outturn in bales is to be made. The omission should avert a certain amount of the speculation which has hitherto followed its issue.

10. *Cotton Cultivation.*—Since the disorganisation of the cotton markets of the world planters in Bihar and others have applied for seed of superior kinds. Arrangements were made last year for importing a small quantity of Egyptian, Broach and Goghari cotton seeds. These were distributed among planters and others. The Department is indebted to the Inspector-General of Agriculture in India for the keen interest he has been taking in the development of the cotton-growing industry of Bihar, and for the large quantities of seed he has distributed during the past and present year. He has also cultivated cotton according to the Gujarati methods with the help of trained cattle, at Shahpur Undi and Dalsinghserai in the Darbhanga district and at Arrowah in the Chapra district. Major D. Prain, I.M.S., has also given great assistance in the study of the botanical characters of the plants grown at the Dumraon and Sripur Experimental Farms. The result obtained from the seeds distributed by the Department last year was, on the whole, discouraging. Experiments were conducted by the Sub-divisional Officers of Gopalganj and Barh, the Superintendent Hazaribagh Reformatory School, the Superintendent of the Cossipur Practical Institution, the District Engineer of Rangpur and some indigo-planters. It is satisfactory to learn that at Barh the raiyats are much impressed with the improved varieties. It must be added, however, that the seeds, especially from Bombay, were all received late, and the scanty rainfall in July was also a cause of failure. Some very fine boles of Garo Hill cotton were grown at Rangpur.

Early arrangements have been made this year for the distribution of a very large quantity of Egyptian, Sea Island American and South Indian cotton seeds. The Inspector-General of Agriculture has promised to send five pairs of trained Gujarati bullocks and expert cotton cultivators to help the Bihar planters and our Dumraon and Sripur farms in sowing and cultivation.

More hopeful results are also expected from the wider cultivation of the Dacca tree cottons and others found close to temples from which the sacred thread is made. Some of these fine cottons are still used for textile purposes in Dacca. During the past year the travelling overseers of this Department made a collection of seed from such trees from several districts, and these are being distributed at present, with instructions regarding method of cultivation.

11. *Crude Saltpetre as a manure for Rice and Irrigated Wheat.*—The Inspector-General of Agriculture in India requested this Department in March 1903 to arrange for a series of experiments for demonstrating the value of crude saltpetre as a manure for rice and irrigated wheat in the different districts of this Province. The Collectors of Nadia, Faridpur, Mymensingh, Chittagong, Burdwan, Shahabad, Saran, the 24-Parganas, the Deputy Commissioner of Jalpaiguri and the Subdivisional Officer of Barh helped to conduct

these experiments and the travelling overseers of this Department were sent to advise the raiyats at the time of application of the manure. The saltpetre used was of 60 per cent. purity and was supplied by the Inspector-General. The quantity distributed was about 150 maunds. The experiments were mostly conducted in raiyats' fields, manured and unmanured side by side. The results obtained were conflicting, better produce by the use of saltpetre being obtained only in a few cases, *e.g.*, in Faridpur 6 maunds more per acre of rice and in Katwa (Burdwan) 50 per cent. larger outturn of irrigated wheat. The results show that as yet saltpetre cannot be recommended as a suitable manure for the rice crop in Bengal but will be tried more extensively this year both for rice and for irrigated wheat.

12. *Irrigation Experiments.*—A valuable report by Mr. N. G. Mukerji on crop-cutting experiments in the irrigated area of the Eden canals has been published by the Public Works Department. Inquiries have been made also as to the sufficiency of water-rates in the areas irrigated by the Midnapore, Sone and Eden canals. A recommendation for increase of occupier's rate in respect of all the three canals has been made. Under the orders of the Government of India, a farm has been acquired close to Cuttack to demonstrate the value of irrigation, and a scheme of experiments based on the recommendation of the Irrigation Commission has been drawn up in consultation with the Inspector-General of Agriculture and the Chief Engineer. The experiments will be carried out in the Cuttack, Dumraon and Burdwan farms.

13. *Bengal Veterinary Department—Cattle Breeding.*—The Annual Report of the Civil Veterinary Department, Bengal, will be separately submitted to Government. The only cattle-breeding farm at present is at Sripur in the Hatwa Raj estate under the Court of Wards, but a farm is about to be started at Pusa. Proposals have also been submitted for acclimatization depôts at Sripur, Pusa, Belgachia and other centres. The Queensland Ayrshire herd has been distributed to Bettiah, Bankipore, and Sripur. The Inspector-General, Civil Veterinary Department, has specified a local type of cattle for the Sripur herd, and the policy of the Department is now to improve this type, and not to admit crosses with the Hissar, Montgomery and other heavier breeds.

14. A sum of Rs. 2,500 was again sanctioned by the Government of India for the award of prizes at cattle fairs and should have been distributed as noted in the margin. The total sum, actually awarded, was only Rs. 1,592-14-6 because cattle, true to type and conforming with the strict conditions, were not exhibited in sufficient number. Ten silver medals were received from the Inspector-General of the Civil Veterinary Department, India, of which eight were awarded at the following fairs:—Suri 2, Kalimpong 1, Sitamarhi 2, Sonepur 1 and Rajnagar 2. The Rafiganj and Barahpur fairs were not held this year on account of the cutbreak of plague, and the contributions made to these fairs have since been refunded. The money prizes at the Rajnagar Fair, for the Bachour bulls, which are *res nullius*, have this year been given to a local manager for feeding and rearing young bulls.

The Superintendent, Civil Veterinary Department, Bengal, has made proposals, which I have submitted to the Inspector-General, for this grant to be distributed in well known breeding centres to actual breeders.

15. *The Veterinary College.*—The College at Belgachia is growing in popularity, and the new admissions are far in excess of the accommodation. Government has sanctioned Rs. 1,50,000 for extension of the premises. The success of the students in the final examinations was very creditable, but they are not sufficient to fill the vacant posts. District Boards and Municipalities might take more interest in the Veterinary dispensaries. These flourish best where the District Officer takes interest in the work, such as Mr. J. G. Cumming and Mr. E. V. Levinge take in Patna and Muzaffarpur respectively. Inoculation against rinderpest has been very successful in many districts and particularly in Noakhali.

Fair.	Rs.
Suri	240
Santrabari	180
Kalimpong	450
Sitamarhi	250
Sonepur	240
Khagra	180
Bihta	180
Rafiganj	180
Bettiah	180
Rajnagar	150
Barahpur	240
Total	2,500

CHAPTER III.

SCIENTIFIC AND LOCAL ENQUIRY UNDER PROVINCIAL DIRECTION.

The Government Experimental Farms.

1. SIBPUR FARM.

16. Government actually owns three farms—Sibpur, Chittagong and Cuttack. Of these, the oldest is Sibpur, established in 1887. Generally the season was unfavourable.

(a) *Manure experiment* were, as in previous years, conducted without analysis. The crops chosen were rice, ordinary jute and *hibiscus cannabinus*, sugarcane, cabbages, potatoes and country peas.

The results may be summarised as follows :—

Rice.

Manure per acre.	GRAIN PER ACRE IN—			STRAW PER ACRE IN—		
	1903.	1902.	1901.	1903.	1902.	1901.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
10 maunds castor-cake	1,640	1,715	1,742	2,644	2,827	2,152
1½ maunds saltpetre ...	1,106	1,330	1,476	1,824	3,641	1,501
Unmanured ...	Average 1,279 lbs.			Average 2,438 lbs.		

The average value of the increased yield of the plots manured with castor-cake over the unmanured is about Rs. 12 per acre but the 10 maunds castor-cake costs Rs. 24. The reluctance of cultivators to use manures for rice, except when they are available at almost no cost, is therefore easily understood.

Jute.

	1903.	1902.	1901.	
	Mds. srs.	Mds. srs.	Mds. srs.	
Manured ...	11 13	18 30	21 0	} Outturn per acre.
Unmanured ...	5 37½	16 10	19 20	

Mesta-pat (*Hibiscus cannabinus*).

		Mds. srs.	
Manured ...	...	12 25	} Outturn per acre in 1903 only.
Unmanured ...	...	11 10	

The latter crop should be further experimented with. It is said to stand drought better than jute and its fibre commands a higher price. In the case of *sugarcane*, cattle-dung applied at the rate of 300 maunds per acre gave the best result. The *cabbage* experiment was a failure owing to the heavy rainfall last October. In the case of *potatoes*, castor-cake applied at the rate of 20 maunds per acre gave the best result. *Peas* showed the best result from an application of 20 maunds of lime per acre.

(b) *Experiments in methods of cultivation.*Jute.—*Thick and thin sowing.*

Quantity of seed per acre.	1901.	1902.	1903.	REMARKS.
	Outturn per acre.	Outturn per acre.	Outturn per acre.	
7 lbs. ...	1,804	The outturn is expressed in lbs. of fibre.
7½ " ...	...	1,435	1,422
9 " ...	1,844	...	...
10 " ...	...	...	1,482
12 " ...	1,742	...	...
12½ " ...	...	1,435	...

The quantity used by the raiyats, *i.e.*, 9 lbs. per acre, or about one and a half seers per bigha, is the right quantity to sow.

(b) *Sugarcane*.—Methods of planting—

(i) Bengal.	|	(iii) Poona.
(ii) Bihar.	|	(iv) West Indian.

The last gave the best results both this year and last year and seems to show that sufficient space for the canes should be left and that in Lower Bengal they are grown too thick.

Aus paddy.—Mr. N. G. Mukerji made a discovery that the seed of the shoots coming up after the first cutting are highly drought-resisting and prolific. Two years' experiments have corroborated this fact.

The figures actually obtained were:—

	Outturn of grain per acre.			
	1903-1904.		1902-1903.	
	Mds.	Srs.	Mds.	Srs.
Central Provinces fine <i>aus</i> , seed of 1st cutting, transplanted ...	8	30	18	0
Ditto, do. 2nd do., do. ...	11	12½	22	0
Ditto, do. 1st do., broadcasted ...	Failed.		Failed.	
Ditto, do. 2nd do., do. ...	6	12½	15	10
Peshwari, Swati, do. 1st do., do. ...	Not grown.		Failed.	
Ditto, do. 2nd do., transplanted ...	Ditto		20	5

The value of the discovery for this Province is obvious, and the experiment will now be taken up by the other farms that its utility may be tested under different conditions of soil and climate.

(c) *Variety experiments*.—*Corchorus capsularis* gave a larger produce than *Corchorus olitorius*, Java cane yielded a heavier crop than either *Samsara*, *Khari*, or Chittagong *Patnai*. The Java cane cuttings were kindly supplied by Mr. E. R. Osgood, Superintendent of the Cossipore Sugar Works.

A large variety of crops is also grown at this farm in small patches for demonstration to students of the Agricultural classes of the Civil Engineering College.

(d) The only new implement tried at this farm during the year was Hauser's grain cleaner and winnowing, which was purchased at a cost of Rs. 250. The Agricultural Lecturer reports very highly on its merits.

(2) *The Chittagong Farm.*

17. Four varieties of sugarcane, three varieties of paddy, *sunh* hemp, two varieties of *arhar*, maize, two varieties of cotton, brinjals, *patal* (*Trichosanthes dioica*), potatoes, wheat, oats, onion, cabbages and cauliflowers, turnips, peas (English and country), radishes and mustard were grown in the farm during the year under report. Of these, only *patal* and cabbages and cauliflowers may be said to have been successful. They found a ready market in the town of Chittagong and yielded a good profit. The introduction of the *patal* crop is recognised as a benefit by the people and its cultivation is being locally taken up by cultivators and others. Plantains, pine-apples, liches and other fruit trees were planted and are doing well. The receipts of the farm during the year amounted to Rs. 1,060-11-3 as compared with Rs. 1,223-7-9 in the preceding year. Excluding Rs. 1,045-12-8 for land acquisition charges, the cost has been Rs. 5,668-15-6 during the year. Mr. Luson, Officiating Commissioner of the Chittagong Division, who visited the farm lately, has reported unfavourably on the working of the farm and I shall hold an enquiry next month.

(3) *The Cuttack Farm.*

18. An agricultural farm was started at Cuttack at the end of the year to carry out the suggestions of the Indian Irrigation Commission.

FARMS UNDER WARDS' ESTATES. •

(1) *Sripur Farm, Hathwa Raj Estate.*

19. This farm was established six years ago, and it has been under the direct charge of Mr. N. N. Banerjee, M.R.A.C., for the last three years, during which period it has been developed chiefly as a cattle-breeding farm. During

the year under report 33 acres were under experimental crops, 557 acres under fodder crops for the use of the cattle, and 90 acres under pasture.

The following crops were successful :—Maize, Jaunpur; Jowar, Nilwa, Local, Impee; Sugarcane, Khari; Potato, Amragachi (Patna); Sweet potato, New Jersey.

Foreign varieties of sweet potatoes are much sought after for seed by the local cultivators. Soy-beans and tobacco were not successful.

Silos.—The silage experiments of this farm are of a very hopeful character. Both cut and entire fodder grasses are pitted in *kutchha* and *pucca* pits. One pit with entire stalks has been opened after three months and the silage is being eaten with relish by the cattle.

A change of policy with regard to cattle breeding was introduced during the year, under the advice of the Civil Veterinary Department. The original idea of improving the local breed of cattle by crossing them with superior up-country and foreign breeds, was abandoned and it was decided to improve the local breed by continuous selection, good feeding and proper housing. The Montgomery breed of cattle from the Punjab is, however, still being maintained in the farm with very satisfactory result as to their milking quality and is highly admired by the native cultivators of the estate and by European planters of the district. One bull calf, one heifer and one cow-calf of the Queensland Ayrshire breed are also said to be doing well. Breeding of buffaloes and goats is also carried on in the farm.

Unfortunately the farm bungalow was destroyed by fire last December, and the dairy machines were either destroyed or damaged on this occasion.

Of the agricultural implements used and found beneficial may be mentioned the following:—The Sibpur plough, Howard's cotton D plough (supplied by Messrs. T. E. Thomson & Co. for Rs. 40), the *bakhar*, a maize huller supplied by Messrs. T. E. Thomson & Co. for Rs. 100, and an iron seed-bin made locally at a cost of Rs. 13.

• (2) *The Tikari Home Farm.*

20. The Home Farm was managed by a graduate of the Saidapet College who unfortunately died last March. The total area of the farm is about 30 acres, out of which 15 acres are cultivated, 4 acres occupied by sites of buildings and roads, and the rest is pasture land. The land under cultivation is divided into 14 plots, some of them were manured with cowdung, some with cowdung and night-soil, and some left unmanured. Coriander, mustard, peas, maize, sugarcane, tobacco, white gram, linseed and oats were cultivated during the year. Maize, sugarcane and tobacco yielded satisfactory results. The dairy attached to the farm contains 7 she-buffaloes which were in milk for the first six months. Of the eleven calves of these animals, seven are kept in the *mufassal* and four in the farm. The working of the dairy was satisfactory.

After ascertaining that the present proprietor will not keep on the farm on his assuming charge of the estate, the Board have ordered the closing of the Tikari Home Farm after the 31st March 1904.

PRIVATE FARMS WORKED UNDER THE CONTROL OF THIS DEPARTMENT.

(1) *Burdwan Farm.*

21. *Area.*—31 acres, of which about one-half was under experiment, the other half being under roads, buildings, water-channels and non-experimental cultivation.

Rainfall—53.78 inches. The normal rainfall is 55 inches.

I. Manure experiments.—The scheme was generally to apply a definite quantity of nitrogen per acre in various forms. The amount of manure per acre was determined by the percentage of nitrogen ascertained by analysis.

(a) *Paddy.*—Three sets of manure experiments were continued with this crop. In the first set, which has been going on since 1891-92, the quantities of the different manures are applied empirically, *i.e.*, without any reference to their composition. In the second series (started in 1897-98) the scheme is to apply 50 lbs. of nitrogen per acre. In the third series the effects of green manuring *versus* cowdung are being investigated. This series was started in 1895-96 with jute only ploughed in for green manuring. Two plots under *sun* hemp (*Crotolaria juncia*) and *dhaincha* (*Sesbania aculeata*) have been added to the series.

The most important results obtained during the year under report are shown in the table below :—

Series.	Quantity of manure.	Outturn of unshu- ed grain per acre in lbs.	Profit per acre.		Cost of manuring.		REMARKS.
			Rs.	A.	Rs.	A.	
1st series ... (amounts of m a n u r e empirically chosen).	Bonemeal 3 maunds	4,298	112	0	7	8	Uniformly highest result.
	Saltpetre 30 seers						
	Bonemeal 6 maunds	4,116	78	12	9	0	
	Do. 8 "	3,850	76	4	4	8	
	Cowdung 100 "	3,930	79	0	4	0	
Do. 50 "	2,950	50	13	2	0		
	Unmanured	1,483	8	8	Average of three plots.
2nd series ... (50 lbs. nitrogen per acre).	Bonemeal 10 "	3,545	43	13	29	12	Ditto.
	Saltpetre 3 "						
	Bonemeal 10 "	3,915	73	6	14	8	
	Saltpetre 7½ "	3,120	22	0	38	11	
3rd series ... (green man- uring versus cowdung).	Jute ploughed in	3,125	53	4	5	11	Cost of extra labour for green manur- ing.
	Sunn hemp "	2,611	38	0	7	14	
	Dhaincha "	2,975	50	14	5	11	
	Cowdung 50 maunds	2,481	37	5	2	0	
	Unmanured	1,739	18	8	...	...

It appears that a large quantity of saltpetre applied to paddy does not give a correspondingly high outturn. This corroborates last year's experience. It is remarkable that green manuring gave better results than cowdung. This experiment may be useful to raiyats where cowdung is scarce. The plot green manured with jute was, as mentioned above, an old plot and hence probably gave the best result, but *dhaincha* is almost an ideal plant for the purpose.

(b) *Jute*.—Scheme 30 lbs. nitrogen per acre :—

Quantity of manure per acre.	Outturn of fibre per acre in lbs.	Net profit per acre.		Cost of manuring.	
		Rs.	A.	Rs.	A.
Cowdung 55 maunds	2,733	57	10	2	3
Castor-cake 5½ "	2,506	35	6	10	10
Bonemeal 10 "	2,117	7	5	15	0
Bonemeal 5 "	2,238	10	4	19	6
Saltpetre 2½ "					
No manure	2,022	16	8	...	...

(c) *Sugarcane*.—Scheme 150 lbs. nitrogen per acre :—

A mixture of bonemeal and saltpetre gave the highest outturn of *gur* per acre (6,56½ lbs.), castor-cake proved better than rape-cake (6,180 and 5,664 lbs. of *gur* respectively). Castor-cake or rape-cake with cowdung or saltpetre gave a slightly higher outturn than when used alone. Cowdung by itself gave the lowest outturn (4,746 lbs. of *gur*).

(d) *Potatoes*.—(Scheme 100 lbs. nitrogen per acre.) One hundred and eighty maunds of the farm pitted dung was found on analysis to be equivalent to, so far as nitrogen went, nearly 300 maunds of cattle manure bought of the raiyats. Yet the farm manure gave a higher yield than the raiyats' manure, showing that the nitrogen in the former was in a more readily available form than in the latter. As in the previous year the addition of saltpetre to the oil-cakes or bone made very little difference. Castor-cake by itself again gave the highest outturn.

The green manuring experiment was continued with and without the addition of other manures. The plant chosen for green manuring was *dhaincha* (*Sesbania aculeata*). The following results were obtained :—

	Outturn, Mds.
Green manuring alone	136
Ditto and cowdung, 90 maunds	197
Ditto " castor-cake 12 "	173
Ditto " bonemeal 10 "	166

II.—*Experiments in Methods of Cultivation*.—(a) *Paddy*.—Thick broadcast sowing of seed (60 lbs. per acre) gave an outturn of 1,641 lbs. against 2,016 lbs. obtained from thin sowing (30 lbs. per acre).

In the spacing experiments in transplanting paddy seedlings the following results were obtained:—

Distance apart in planting seedlings (each way).	Outturn of grain per acre in lbs.	Net profit per acre.	
		Rs.	A.
6" ... ..	... 2,016	19	2
9" (usual way with local raiyats)	... 2,394	33	4
12" ... ..	... 2,954	47	4

In both the above experiments the crop was manured with cowdung (92 maunds containing 50 lbs. of nitrogen per acre).

(b) In *sugarcane* (1) the Bengal system, (2) the Poona system, and, (3) the trench system lately adopted by some of the Bihar planters gave about equal results.

(c) The planting of whole tubers *versus* cut sets for *potatoes* showed that the outturns were almost directly proportional to the quantities of sets or whole tubers planted per acre.

(d) The spacing experiment with *jute* gave conflicting results. The experiment will be repeated.

III.—Experiments with new crops and new varieties of existing crops.—

(a) Seven varieties of rice were compared with the following results:—

Names of varieties of rice.	Outturn.	Net profit.	
		lbs.	Rs. A.
Peshwar ... ..	... 861	27	7
Amba mohor of Bombay ... ..	... 2,030	22	7
Sukhavel ditto ... ..	... 2,219	32	14
Kamod ditto ... ..	... 2,359	32	10
Balam of Bengal ... ..	... 1,855	28	7
Badshabhog ditto ... ..	... 2,366	46	14
Dadkhani ditto ... ..	... 2,240	43	3

(b) Forty-five different races of *jute* gathered from the most important *jute* districts of Bengal were grown side by side. No definite conclusions can be formed except that the Burdwan selected seed did very well.

The Board of Scientific Advice, including Mr. Burkill Mr. Mollison and Major Prain, I.M.S., are enquiring into the subject of cross fertilization.

(c) Five different varieties of *potatoes* were tried as in the previous year. Patna and Nainital again gave the best outturns (223 maunds and 226 maunds respectively). The failures were Bettiah and Colgong.

It is proposed to open here next year a manure and selected seed and implement depôt.

(2) Dumraon Experimental Farm.

22. Area—30 acres, of which 22 acres were under experimental cultivation.

The monsoon was very late in breaking and the seedlings of winter rice could not be transplanted till the beginning of August.

I.—Manure experiments.—As at Burdwan the scheme was to supply a definite quantity of nitrogen for each crop in different forms. Samples of the various manures were in every instance analysed by the Agricultural Chemist to the Government of India before they were applied to the crops.

(a) *Rice*.—40 lbs. nitrogen per acre. Cattle-dung alone and a mixture of cattle-dung and castor-cake gave very nearly the same result (2,150 and 2,100 lbs. of grain per acre respectively). Saltpetre gave very much the same outturn as in the previous year (1,810 lbs. against 1,820 lbs.). The unmanured plot gave only 1,000 lbs. The apparent anomaly of the ashes of cowdung giving as good a result as the whole dung was again repeated during the year under report.

(b) *Wheat*.—40 lbs. nitrogen per acre. Poudrette again gave the highest outturn (1,515 lbs. per acre) as in the previous year. Castor-cake and rape-cake came next with 1,400 and 1,375 lbs. per acre. Green manuring with *sunh* hemp proved superior (955 lbs.) to that with indigo, *kulthi* and *mung*.

(c) *Sugarcane*.—150 lbs. nitrogen per acre. The crop was seriously damaged by white-ants and cane-borers so that the outturns of the different plots were not comparable.

II.—Experiments in methods of cultivation.—*Khari* sugarcane was planted (as at Burdwan) according to three different systems, e.g. (1) the local system,

(2) the trench system of the Bihar planters, and (3) the Poona system. The outturn of *chakri* or hard *gur* in the three systems were 2,865, 3,405, and 3,600 lbs. per acre.

III.—*Experiments with new varieties of crops.*—(a) *Rice.*—Three Bombay varieties were compared with three local varieties with the following result:—

			lbs.
Kumode (Bombay)	...	...	1,270 per acre.
Sukhavel ( " )	...	...	1,650 "
Srikole ( " )	...	...	1,220 "
Maharajwa (local)	...	...	2,000 "
Shelea ( " )	...	...	1,400 "
Bataspheni ( " )	...	...	1,210 "

(b) *Sugarcane.*—Three Bombay varieties were compared with the local variety named *mongo* with the following result:—

			lbs.
Hullu Cabu (Bombay)	...	...	3,915 hard gur per acre.
Beta " ( " )	...	...	2,565 "
Sanna Bille ( " )	...	...	4,563 "
Mongo (local)	...	...	3,213 "

Besides the above there were a number of soft varieties of canes, *e.g.*, *samsara*, white and red Mauritius, Poona, &c., but they were seriously damaged by white-ants and cane-borers.

(c) *Wheat.*—A number of varieties were grown on small strips of land. Of these two varieties of Australian wheat, one variety of cross-bred Australian, also Muzaffarnagar wheat, Sindhi wheat and Palestine wheat gave the best promise.

(d) *Oats.*—While Australian wheats were found so suitable, Australian oats failed altogether. Canadian Welcome oats, however, did very well.

Besides the foregoing there were various other crops including some ninety varieties of cotton. The last were grown from the shoots of the preceding year's crop and included a number of American varieties. These American varieties did not bear well the first year, but the *ratooned* crop did much better.

Balance sheet.—The total receipts amounted to Rs. 950 and the total expenditure to Rs. 2,544, against Rs. 714 and Rs. 2,588 of the preceding year.

Agricultural Experiments in Government and Wards' Estates.

23. The Board are discussing proposals with Commissioners for setting aside a percentage of collections for agricultural experiments proper. At present the improvement grant contains headings;—Miscellaneous, Sanitary and Agricultural.

24. From the summary of the Divisional reports given below, it will be seen that the experiments conducted through the raiyats of Government and Wards' estates and other private individuals gave, on the whole, unsatisfactory results. In a few cases where the experiments were conducted under the personal supervision of District Officers or other responsible persons, good results were obtained. The crops that seem to have given good result almost everywhere are the Patna variety of potatoes, the *samsara* and *khari* sugarcane, a fine *aus* paddy originally obtained from the Central Provinces, Muzaffarnagar wheat, and the groundnut. Until the expert direction is stronger, we can aim at demonstration of the value of certain new crops or new varieties of old crops which have been successfully grown in our farms and elsewhere. Proposals are also under consideration for District Associations for the purpose of making known successful experiments.

BURDWAN DIVISION.

25. *Midnapore.*—In the Majnamutha estate potatoes were a failure, and peas, brinjals and English vegetables were tried in the Nayagram Ward's estate in this district.

PRESIDENCY DIVISION.

26. *24-Parganas.*—Tobacco and *khari* sugarcane were successfully cultivated in the Government estate of Port Canning. In the Diamond Harbour subdivision experiments with potato and sugarcane were conducted with indifferent results in each case.

Murshidabad.—Patna and Nainital potatoes were cultivated in Government khas mahal lands, but the result was not satisfactory. Sixty maunds of seed potato were supplied gratis by this Department to two European managers of zamindaris (Messrs. Macdonell and Keogh). Mr. Macdonell was entrusted with 50 maunds. The reason assigned by him for the indifferent result obtained is that the land chosen by him for this experiment was not suitable, as a *nullah* drained the soil of more moisture than could be supplied by irrigation. Mr. Keogh sowed a part of the seed supplied to him in his factory compound where indigo refuse had long been stacked and this required no other manuring. The yield of the crop in this plot was highly satisfactory, but his experiments in other plots was not equally good. No agricultural experiments were undertaken in the districts of Jessore, Khulna and Nadia.

Babu Romesh Chundra Sircar, an ex-student of the Agricultural class at Sibpur, at present employed as Superintendent of Gardens of the Nawab Bahadur of Murshidabad, introduced the rearing of lac, and cultivation of tapioca and coffee in the Nawab Bahadur's gardens at Murshidabad.

RAJSHAHI DIVISION.

27. *Rajshahi.*—The experiments with oats, wheat and peas are reported to have failed. This was partly due to the lands not being properly selected for the purpose. It is reported that the soil of the Terai is not suitable for wheat cultivation, but peas might do well, and it is therefore desirable to introduce the cultivation of this crop in this khas mahal. The cultivation of Patna variety of potatoes has now been introduced in the Jaipur Government estate in the district of *Bogra* after several years' experiment and has proved a complete success. Cooch Behar tobacco has also been partially introduced in this estate, but the people need a training in its cultivation. *Samsara* sugarcane was also cultivated with success during the year in some parts of the estate. Thirteen Siri bulls have been kept by Government in the khas mahals of the district of *Darjeeling* at convenient and central places for improving the breed of cattle. Two bulls were also kept for this purpose in the Government estate in *Pabna*, one of which died last July.

Dinajpur.—In the Maldwar Ward's estate the experimental cultivation of Patna potato and Muzaffarnagar wheat made during the year proved successful. In the Churamon estate *bhadoi* paddy, Ambala potato and Muzaffarnagar wheat were grown. The outturn is reported to have been good. A mixture of bonemeal and castor-cake was found to be the best manure for potatoes and wheat, while cowdung and green manure with a mixture of bonemeal proved the best for paddy.

DACCA DIVISION.

28. *Dacca.*—The only agricultural experiment tried was the unsuccessful cultivation of potatoes in the Government estate Char Bachamara in the subdivision of Manikganj.

Faridpur.—Patna and Nainital potatoes were tried, the outturn of Patna potatoes was very good, but that of Nainital was not satisfactory. This year the result of the experiment with *samsara* and Bombay sugarcanes was satisfactory, and the Collector reports that the increasing demand of the neighbouring cultivators for the cuttings shows undoubtedly that the cultivation of sugarcane will soon spread. Calcutta brinjal, radish, *ol* and *kachu* yielded a good outturn. Experiments in the cultivation of different varieties of jute were carried on in private estates close to the head-quarters under the direct supervision of this Department.

Backergunge.—Nainital potato seeds and some seeds of English vegetables were distributed among some of the tenants of the two Government estates—Tushkhali and Hesamuddin—at a reduced price with the object of encouraging cultivation of these crops. The outturn of potato was, on the whole, satisfactory, but the cultivation of English vegetables failed, owing to heavy rain at the end of October. Various indigenous seeds were tried in the Dakhin Shahbazpur ward's estate at a total cost of Rs. 535. The results of the experiments were moderately successful. The question of starting a central farm near the head-quarters of the district is under consideration.

CHITTAGONG DIVISION.

29. *Chittagong.*—In the several wards' estates the cultivation of sugarcane, chilly and English vegetables was tried on a small scale. Of these,

sugarcane gave a good outturn, but the English vegetables were damaged everywhere by the unusually heavy downpour in October.

Noakhali.—The Collector reports that the experiments made at the Sadar station and at Badur in the cultivation of potatoes, gram, peas and oats have proved a failure. In the previous year also the experiments in these crops were unsuccessful. The local officers are of opinion that the land is not suitable for such crops. The Central Provinces fine *aus* paddy and fine *aman* paddy were successfully grown in the wards' estates of Bharat Chunder Shaha and Girindra Kumar Mozumdar. *Khesari* also yielded a good outturn in the former estate.

PATNA DIVISION.

30. No agricultural experiments were undertaken in the wards' estates in the districts of Patna and Shahabad. The agricultural experiments conducted in the Tikari home farm in Gaya and in the Sripur farm in Saran have been noticed separately in this report.

The Bettiah estate in Champaran made some small experiments with hill potatoes after applying some chemical manure to the land, but the result was disappointing. Oats were tried on a virgin soil, and the result was fairly satisfactory. Wheat, *arhar*, maize and paddy were tried on the Barwat *zerat*, of which maize and paddy gave the best results.

In the Narhan Ward's estate in the district of Darbhanga, experiments were made during the year under notice with the improved varieties of the staple crops grown by the raiyats of the estate, and for this purpose seeds of Muzaffarnagar wheat, Dumraon gram and oats and Nainital potato were obtained through this Department and cultivated in several places of the estate. The surplus seeds were distributed for cultivation among the principal raiyats. The outturn of the wheat, gram and oats was not satisfactory owing to the early cessation of the rains and the consequent insufficiency of moisture in the soil. A special experiment with the Nainital potatoes was undertaken in a village appertaining to this estate. About 2 maunds of seeds were put under sand containing moisture, and when they sprouted, they were taken out and cut in pieces containing two or three buds each according to the size of the tubers and placed on prepared beds about 4 inches apart and 18 inches between the lines, and they were covered over with earth by hand. When the plants made their appearance, the fields were watered, and when they were about 6 inches high, they were earthed up on two sides to a height of about 4 inches. They were then watered according to requirement. The plot which was manured with castor cake gave the best result. *Samsara* and *khari* sugarcane cuttings were distributed among the principal raiyats for cultivation, but the result was disappointing.

BHAGALPUR DIVISION AND THE SONTHAL PARGANAS.

31. *Bhagalpur*.—In this district, Nainital potato, radish, *palval*, *masoor*, *sonamoong*, *maskalai* and chilly were cultivated in the Madhipura subdivision, but, owing to late sowing, the experiments in potato, *palval*, radishes, chillies, *moong* and *maskalai* did not prove satisfactory. The potato plants were mostly destroyed by white-ants. The Bengal variety of sugarcane has been found profitable on experiment by Mr. Christian of Pathurghat factory.

In the Lugma Ward's estate, experiments were made with Bengal and local sugarcane, *baktulsi* and *dudkhani* paddy, *duahi* wheat and oats. The paddy seedlings as soon as transplanted suffered a good deal from floods in the Kosi river. The sugarcane gave a fair outturn. The yield of the other crops was not very encouraging.

Malda.—Although the result of the experimental cultivation of potato in a village in the khas mahal and in the jail garden was not financially a success, the Collector is of opinion that this crop can be profitably grown in the district, and there is some prospect of the tuber being cultivated by a few gentlemen who have taken to gardening and later on by ordinary market gardeners.

Sonthal Parganas.—In the Damin-i-koh Government Estate in this district, experiments were made with groundnuts, agave and oats. The groundnut experiment in this estate is of special interest, as the seed (2 maunds) was distributed among raiyats who considered a portion of their holdings having been rendered unfit for cultivation by sand-drifts from hills. The groundnut crop grown in the fields so spoilt for rice and other ordinary crops has turned

out very successful. *Fourcroya gigantea* was substituted for the ordinary agave *lurida* in the Dumka jail. This experiment promises well. The oats failed completely. In the Sankara Ward's estate, Patna potatoes were successfully grown.

Purnea.—In the Khagra ward's estate *janera*, oats, wheat, barley and gram were cultivated. *Janera* yielded a bumper crop. The seeds of the other crops failed to germinate properly, owing to excess of moisture in the soil and to the land not being properly prepared and manured. The Nellore bull which has improved much in health is now serving many cows. About 25 calves were the result of the breeding during the year under report. A young bull has been kept for breeding purposes.

ORISSA DIVISION.

32. *Balasore*.—Four maunds of potato seeds were distributed among selected raiyats in the Nuanund estate who cultivated them at their own cost.

Angul.—New experiments were made with potatoes of the Nanital, Patna and Bettiah varieties and with safflower. All were successful except Bettiah potatoes. Sugarcane failed totally for want of irrigation.

Puri.—Potatoes, onions, mustard, sugarcane, wheat, &c., were tried in the gardens of Khurda, Kothdes, and Balukhand Government estates. In Khurda some potatoes and onions were distributed among the leading raiyats and sarbarahkars, and the cultivation by them is reported to have been successful. Sugarcane grown in the Government garden was remarkably successful. In the Balukhand garden potatoes, country and English vegetables were tried, but the result was not generally satisfactory.

Cuttack.—In the Banki Government estate, Patna potato and *samsara* sugarcane were grown, but the outturn was poor.

33. *Tributary States of Orissa*.—In the farm established by the Dhenkanal State, a larger number of crops than in former years was experimented with. Of these, the outturn of sugarcane, onion and potatoes was good. Paddy sustained damage by heavy rain while in flower, and the other crops were damaged by a hailstorm in the early part of March last. The cultivators of this State appreciate the value of the Behia sugarcane mill and evaporating pan and they take out on hire the State mills.

In the Pal Lahara State, Patna and Nanital potatoes were tried. The Patna seeds grew well and yielded a good outturn, but the Nanital variety failed owing to heavy rains. The produce of different varieties of maize, English vegetables and onions were superior in quality. Country sugarcane was grown with success.

The crops experimented with during the year under report in the Baramba State were *samsara* and Saharanpore canes and safflower. The sugarcane crop was very successful. Sugarcane cuttings were also distributed to selected raiyats. Behia sugarcane mill and evaporating pan are much appreciated by the people and the demand is increasing.

In the Keonjhar State a trained sericulturist has been appointed to look after the improvement of sericulture. He planted mulberry. Cocoon rearing will be commenced shortly.

The Maharaja of Mourbhanj is taking a lively interest in the improvement of agriculture and other industries allied to agriculture among his tenantry. He has employed a trained agent who has succeeded in establishing mulberry plantations and cocoon rearing and reeling at Baripada in less than a year's time, also small plantations of the rhea, the cassava, Dacca tree cotton, Peshwari paddy, Guinea grass and superior varieties of sugarcane. The farm at present consists of 4 acres of Bengal mulberry, a nursery for European mulberry trees, and 15 acres of the agricultural crops mentioned. Agriculture and sericulture will be taught in the State schools and a primer is under preparation for this purpose.

CHOTA NAGPUR DIVISION.

34. *Ranchi*.—Nainital and Patna potato seeds were distributed to some raiyats of the Government Estates for experimental cultivation. It was successful only in a few cases, where the crop was cultivated with care.

Palamau.—In the Government estates groundnut, Surat cotton and English vegetables were cultivated. Groundnut and English vegetables gave good outturns, but the yield of the Surat cotton was much below the average.

Singhbhum.—Maize, sugarcane, potato and tobacco were tried in the Government estates. The result was, on the whole, fair. The first three crops have been kept in stock for seed.

In the several Wards' and Encumbered Estates in this Division, potato, maize, barley, wheat, peas and English vegetables were tried, but the results do not appear to have been satisfactory.

Agricultural Experiments by Private Individuals.

35. Of the private individuals who worked successfully for the improvement of agriculture in this Province, the names of Babu Brajendro Kishore Chowdhary, zamindar of Gouripur in Mymensingh; Babu Ashutosh Lahiri, District Engineer, Rangpur; Babu Purnendu Narain Sing, Government Pleader, Bankipur, and Babu Charu Krishna Mozumdar, zamindar of Islampur in Murshidabad, may be specially mentioned. These gentlemen have their own private farms and have great influence with raiyats. They have introduced new staples and are trying to improve the local staples by the selection of seed and the application of proper manure. I inspected the farms of the first two gentlemen, and I am satisfied that the lines they have adopted are excellent. My expert staff is in constant touch with them and there is every reason to hope that other zamindars of Bengal follow their good example.

A table summarising the results of experiments on sugarcane conducted in some of the indigo concerns in Bihar during the year is given in Appendix VI.

36. *Trial of Improved Agricultural Implements in Government, Wards' and Private Estates.*—During the year under report iron sugarcane mills, evaporating pans and Sibpur ploughs were distributed through the agency of this Department. Demonstrations of both agricultural and of dairy implements were also made at the shows. A list of the new and improved implements that were tried in Bengal during the year is given in Appendix I.

37. *Supply of seeds and Manures.*—A list of the seeds and manures distributed by the Department during the year under report (exclusive of those used in experimental farms) is given in Appendix II. This is one of the most important items of work of travelling overseers and occupies a great deal of their time.

38. *Crop-cutting Experiments by District Officers and Settlement Officers.*—It is proposed that next year the Director of Land Records shall associate himself with Engineers in the canal-irrigated areas and jointly conduct experiments on irrigated and unirrigated areas.

The results of the crop-cutting experiments carried out in the districts of these Provinces during the year 1903-1904 have been received and compiled in my office and will be fully analysed and discussed when submitting the next quinquennial return. Three hundred and twenty-two experiments on irrigated crops and 1,204 on unirrigated were made, but the results are most conflicting.

The returns of District Officers in regard to the outturn of crops show that much more attention should be paid to crop cutting-experiments, e.g., one officer returned 484 lbs. of cleaned cotton per acre as the average yield, and within a few months reduced it to 41 lbs. I suggest that Junior Civilian at head-quarters might be employed in the cold weather to supervise these experiments. They will learn the value of the outturn of each crop for their own district and they will keep a check on the weighments, etc., of the subordinates appointed to conduct the actual experiments.

39. *Utilisation of night-soil as manure.*—The trenching grounds of the Suburban Municipalities which were visited last year by a travelling overseer of this Department were partly let out to the cultivators where there was a demand for it. The Sanitary Board have asked the Garden Reach Municipality to start a septic tank. The Meagher system of trenching was tried in the Budge-Budge Municipality, but the experiment, it is reported, was not very successful.

Locusts and other Insect-pests.

40. (1) *Locusts.*—Flights of locusts were seen within the jurisdiction of sadar thana of the Jalpaiguri district, in the Begusarai subdivision of Monghyr, in parts of Madhipura subdivision of Bhagalpur, in the Sadar and Deoghur subdivisions of the Sonthal Parganas, in the district of Muzaffarpur, in the district of Birbhum, and in parts of the districts of Hazaribagh, Palamau and

Manbhum. In the district of Muzaffarpur and in the Begusarai subdivision of Monghyr they caused damage to the indigo crop, and in other places the standing crops were only slightly damaged. No serious injury is reported from any place.

(2) *Other Insect-pests.*—Some insects appeared in the Sadar and Jajpur subdivisions of the district of Cuttack and did very slight damage to the *rabi* crops and *dalua* paddy. Specimens were sent to the Government Entomologist at Surat. I have communicated to the local officers the remedies suggested by the Entomologist. Specimens of some insect-pests which was damaging the winter rice crop in the Alipur Tahsil of the Jalpaiguri district were sent to the Entomologist at the Indian Museum, but the parcel was mislaid at the Museum and did not reach him.

A kind of insect-pest locally known as *tah* injured the mustard crop in the Binda Diara in the district of Monghyr. In Palamau the damage done by insect-pest to the *rabi* crops was considerable. It necessitated the entire resowing of the affected tracts. In the Satkania circle in the district of Chittagong about two annas of the crops are reported to have been destroyed by insects locally called "*ledu*." Insect-pests are reported to have slightly injured some *rabi* crops in the district of Burdwan and the paddy crop in Midnapore.

41. *Sericulture.*—The sericultural operations under the Bengal Silk Committee continued to make satisfactory progress during the year.

The Committee employed overseers and sub-overseers as follows:—

	Overseers.	Sub-Overseers.
Birbhum	...	2
Bogra	1	2
Malda	1	3
Murshidabad	1	3
Rajshahi	...	2

They have popularised the use of healthy seed and helped to stimulate mulberry plantations. The Committee with the help of Government now maintain three model nurseries which showed profits of Rs. 161, Rs. 264, and Rs. 52 respectively during the year and are about to open one in Rajshahi. The secret of a profitable nursery lies in having a sufficient mulberry plantation attached. The Committee also sell microscopes and other appliances to cocoon-rearers. Government has already established a model nursery in the Rajdharpur Government estate in Murshidabad and intends to establish one at Panchanandpur in Malda, and another at Benidaspur in Murshidabad.

The Committee expended Rs. 14,258 including the Government grant of Rs. 6,000 during the year.

A notice of the Rajshahi Sericultural School will be found in paragraph 44.

CHAPTER IV.

EDUCATION IN AGRICULTURE AND SERICULTURE.

42. *Agricultural class at Sibpur.*—Of the six students in the second year, four passed out in the final examination, the other two were special students and both failed. The course appears to be too stiff for special students who have generally little or no previous knowledge of science and fail in such subjects as Chemistry. Of the four students who passed two have obtained appointments in the Executive Service in Bengal and one in Assam. The fourth student has obtained employment in the Bengal Educational Service. It has been decided to keep up the classes until the Pusa College is opened, *i.e.*, at any rate for another year and probably longer. The supply of qualified scholars is not equal to the demand for their services.

43. *Agricultural education in schools.*—The results of the work of the first year of this course in the schools are as follows:—

Gaya.—At the Zilla School all except the highest and lowest classes attended lectures in agriculture. Some 73 boys have garden plots of their own in the school compound.

Dumraon.—At the High School only the first and second class attend, as the lower boys cannot understand lectures in English. It is reported that the lecturer cannot make himself intelligible in Hindi, and that the boys have no text-books. The students go once a week to the experimental farm, and many

do manual labour. A garden for the boys is being laid out close to the school.

Chittagong.—At the Collegiate school only 23 out of 188 boys attend the agricultural classes and the farm is three miles off, so they rarely go there. The Farm Overseer who is the lecturer has not time to teach and to do his work. A museum for seeds, manures, &c., has been opened at the school.

Howrah.—At the Zillah School the first four classes read agriculture, but the farm (Sibpur) is four miles off and it is proposed to make the subject only voluntary.

Burdwan.—At the Municipal School, Agriculture is taught to 50 boys, but the school is three miles off the farm and only the boys of the 1st and 2nd classes were taken for practical instruction free of charge. There is no doubt that much remains to be done, especially in the way of vernacular instruction in Agriculture. Already in the Central Provinces the uses of the village records and the relations of landlord and tenant as well as rudimentary education in agriculture are taught in the *patsalas* and here in Bengal, as soon as the guru-training schools have turned out qualified teachers, there seems no reason why, at any rate in cadastrally surveyed districts, copies of the village maps and *khasra* and samples of zamindars' accounts and receipts should not be served out to each *guru* and be prescribed for instruction.

44. *Rajshahi Diamond Jubilee Industrial School.*—This school continued to have two separate branches during the year, viz., the Sericultural and the Technical, with two separate Committees of management. The Deputy Inspector of Schools, Rajshahi, was the Secretary of the Sericultural branch, and the Principal of the Rajshahi College of the Technical branch. The District Board of Rajshahi made a grant of Rs. 600 to each branch of the school, and this Department a grant of Rs. 500 to the Sericultural branch. The pupils of the Sericultural branch were all scholarship-holders. The course of the Sericultural branch extending over six months only, two sets of pupils passed out during the year, 8 passing out in June and 9 in December. Of the former, one was employed in the Mourbhanj State, and of the latter one under the Bengal Silk Committee. Two older students got employment during the year under the Assam Government. The Head-master of the School was deputed last January to Mr. Tata's Silk Farm at Bangalore, where unfortunately he died of plague. There has been some difficulty about securing a competent Head-master. The total expenditure incurred by the school, exclusive of the pay and travelling allowance of the Head-master which were met from the funds of this Department, came to Rs. 3,682. The sum of Rs. 990-14 was realised on account of sale-proceeds of cocoons and cloths turned out by the two branches, the sale-proceeds of cocoons reared by the students coming up to Rs. 384-14. The European cocoons were again reared successfully from seed obtained from the Sericultural laboratory of Padua (Italy).

45. *Seri-Agricultural School of Sabong, Midnapore.*—This school is the outcome of a local effort and of a desire to revive the silk industry of the neighbourhood as well as to improve the agricultural condition of the people generally by affording them means of instruction in agriculture and particularly in sericulture. About Rs. 1,300 were raised by the people themselves. The District Board of Midnapore guaranteed the aid of Rs. 30 per month for two years, and a School Committee was formed consisting of the leading Hindu and Muhamamdan gentlemen of Pingla and Sabong. A microscope and a Sibpur plough have been given to this school free of cost by this Department and other special appliances and agricultural seeds have been bought out of the school funds. The lands in the neighbourhood of the village school-house have been given free of cost for agricultural experiments. Potatoes, tobacco and some English vegetables were grown last year. From half a *katta* of potatoes, two maunds of produce were obtained. Three of the cultivators were also given potato seed and they had successful crops. Potatoes never having been grown in this locality before, the school may be said to have done a good work in introducing this crop which has greatly taken the fancy of the cultivators. The first examination will be held in June 1904. It was difficult to find a teacher competent to teach both agriculture and sericulture for the salary offered, but the teacher recommended by this Department is reported by the Secretary to be "taking great interest in making the institution a success."

CHAPTER V.

Publication of Agricultural Information.

46. A monograph on "Tanning and working in leather in the Province of Bengal" by Mr. Rowland N. L. Chandra, late Personal Assistant to the Director of Land Records, was published during the year.

The usual preliminary and final forecasts on the various staple crops of the Province were published regularly during the year. The Agricultural statistics of the previous year and the statistics of minerals and gems were also compiled and published. The prescribed consolidated table showing the average prices of food-grains, &c., in Bengal during 1902-1903 was prepared and issued. A season and crop report for the year 1902-1903 was also published.

CHAPTER VI.

FINAL.

47. *Emigration to Burma.*—The number of State emigrants carried from Bihar to Burma during the year under report was 457 (367 adults and 90 children), against 797 in the previous year. The great falling off in the number of emigrants year after year is attributed to the virulence of the plague in the Bihar districts generally.

The emigrants are carried to Burma at reduced rates by the British India Steam Navigation Company, and one-third of the passage-money is paid as a subsidy in equal shares by the Governments of Bengal and Burma.

48. *Agricultural Exhibitions.*—Fifteen agricultural exhibitions and fairs, at which officers of the Department showed exhibits and made demonstrations, were held, and Rs. 2,100 was distributed in prizes. A brief account of each is given in Appendix III. Burhapur fair in Shahabad and Rangamati fair in the Chittagong Hill Tracts were not held during the year on account of plague in the former and cholera in the latter place.

49. *Provincial Museums.*—In addition to the Museum in Calcutta which is not treated in this report, there is a small museum at Dumraon which was established by the Raj in 1887. It is located in a hall of the Raj Dhuramsala building, as there is no suitable building in the farm for its accommodation. It contains a good collection of cereals, pulses, millets, drugs, dyes, oilseeds, fibres, spices, agricultural implements and miscellaneous articles of commercial value.

During the year under report a Natural History Museum was started at Darjeeling. It is managed by a Committee with the Deputy Commissioner as its President. It has already a fair collection of birds, butterflies, bees, wasps, ants, beetles and snakes from the district.

50. *Miscellaneous Experiments and Enquiries.*—The cost to Government of agricultural experiments and miscellaneous enquiries conducted under the direct supervision of this Department during the year under report amounted to Rs. 10,870-13-10, against Rs. 5,798-11-10 expended in the previous year. The details of the expenditure will be found in Appendix IV, and does not include grants amounting to nearly Rs. 75,000 for indigo research and to the Bihar Indigo Planters' Association.

51. In addition to the enquiries regarding deterioration of *jute* in several centres an attempt has been made to demonstrate the growing of varieties under expert supervision. The experiments in *cotton* growing, though a failure this year, may develop next year into useful object lessons. The fame of the improved methods of cultivation and sowing of cotton introduced by the Inspector-General of Agriculture has already spread in Behar, and this year the Inspector-General has imported five pairs of Guzarati bullocks and cultivators to make further demonstrations. In all the farms *rice* is a special field for experiment and drought-resisting and imported varieties have been grown with great success. Experiments with manures and in methods of transplantation of all kinds have been tried, and a special series of experiments with saltpetre have been included in the manure experiments.

52. *Indigo*—Government has, during the past year, kept up at a cost of Rs. 43,000 the Dalsingserai Research station. The staff consisted of Professor Bloxam and Mr. Finlow, Chemists, and Mr. Leake, Biological Botanist. They were engaged on a study of the chemistry of the leaf and improvements in the methods of manufacture. Professor Bloxam's report has not yet been published. Government has also contributed towards the cost of research conducted by Mr. Rawson at Pipra under the Behar Indigo Planters' Association. Lately a scheme for an indigo seed farm at Delhi, including experimental cultivation of the Java and other varieties, has been sanctioned. The seed-farming experiments will be duplicated in small areas by planters in Behar in order to determine whether it is necessary to obtain seed from the North-Western Provinces or whether seed can be produced in Behar. Proposals are being considered also for an "out-post" station at Mosehri near Muzaffarpur for laboratory research. This station will, it is proposed, be kept up out of the grant by Government to the Behar Indigo Planters' Association and will work in connection with the Pusa Institute. Offers have been made to Messrs. Bergtheil and Briggs to take charge of this outpost and with them Mr. Finlow will be associated for laboratory work. Inquiries into the bacteriology and chemistry of jute and analysis of soils and of water used for irrigation will also be conducted there.

53. In regard to *sericulture* much useful work has been done by the Berhampore Committee, Government has approved of the new policy of establishing nurseries with mulberry plantations and the grant is to be renewed for the current year under certain conditions. The object is to rear worms from pure "seed" examined under the Pasteur system. Itinerant overseers are also employed for the purpose of examining seed before purchase by rearers. In regard to *sugarcane* the Burdwan farm has provided canes to indigo-planters and others. In all the farms experiments have been made with varieties, in various methods of planting the canes, with irrigation and with various kinds of manures. At the request of certain representatives of the India Development Company, Government has recently sanctioned certain pumping experiments for irrigation from the Gundak of a large cane-growing area.

54. The inquiries for the prospectus of the new Agricultural College at Pusa and the large number of applications for admission at the next session to the Belgachia Veterinary College and to the Sibpur Agricultural classes seem very hopeful signs of awakening interest in these two sciences. I have also received many inquiries for assistance in various matters, *e.g.*, as to an agent for disposal of country produce in London, an expert to teach tanning, another to teach cigar-making, and several applications for teachers in sericulture. A Society in Orissa has been formed with the sole object of the development of the agricultural and industrial resources of that Province by private enterprise. Government has now sanctioned four travelling overseers instead of two and a closer supervision of experiments made by zamindars and raiyats as well as in Government and wards' estates is being exercised. It is undeniable that the experiments in Wards' and Government estates are made without much guidance or system. Until the Deputy Director takes this part of his duties off the Director's hands, this state of things must continue owing to the overwhelming settlement work in the Director's charge. The attention of the Department has also been directed to the useful work done by Agricultural Associations in the Central Provinces. In districts such as Murshidabad, Cuttack, Rangpur and Rajshahi, it has been ascertained that several gentlemen will co-operate with the District Officer in forming similar agricultural associations and an attempt will be made during the year to form them. The District Board of Rajshahi has actually offered to give land free of cost for a divisional farm and a zamindar in Mymensingh, Babu Brajendra Kishore Acherji Choudhuri, has already placed a farm of 28 acres under the direction of the Department and is bearing all expenses, including the cost of the overseer's pay. The District Engineer of Rangpur, Babu Ashu Tosh Lahiri, is conducting experiments in tobacco, cotton, and this year in jute varieties at his own expense. The Collector, Mr. P. C. Mitter, has also submitted proposals for the acquisition of 20 acres close to the cutcherry at Rangpur. As this is one of the most litigious districts in Bengal, the small farm at head-quarters may prove an attractive object lesson to suitors and others coming from all parts of the district.

55. We have not yet been able to introduce any Agricultural Gazette, but Government has allowed us to subscribe to the *Krishak* which is circulated to the agricultural staff, and our experts have been invited to contribute and make public the results of our experiments, &c.

In other ways improvements on the same lines as in the Central Provinces are being carried out. Silos have been constructed and experiments made with *juar* for fodder. Last year instruction as to the disposal of sewage was given at Municipal farms. Much more might be done if our staff was stronger and the Municipal authorities took more interest. Several new implements have been tested and, as the result of demonstrations at fairs and shows, there has been a larger sale of both implements and seeds. It is proposed also in course of time to have a seed and implement depôt at each farm. Nothing, however, has been done by the Department to encourage arboriculture. This is at present in the hands of District Boards. Two years ago they were ordered to submit a ten-years' programme, for planting of avenues, but the planting of trees by *patshala* students and an 'arbor' day remain to be introduced.

Officers of the Department.

56. I am very much indebted to both Assistant Directors, Messrs. D. N. and N. G. Mukerji, for the help and advice on scientific matters they have given me. Mr. D. N. Mukherji has made constant and useful inspections of the farms and Mr. N. G. Mukherji has ably supervised the sericultural operations, as well as the office work.

A great deal of useful work has been done by the travelling overseers. They are now four in number, and with the increase in the number of farms, the extension of jute inquiries and of cotton and other cultivation on experimental lines, a further addition to the staff will soon be necessary. Babu Hara Kumar Guha and Babu Nibaran Ch. Chowdhary have now acquired very considerable experience of agriculture. Mr. Alim has in addition to his other duties interested himself in Agricultural Banks. The work of Babu Rajeswar Das Gupta in demonstrations of machinery and implements at exhibitions and shows has been very valuable. He has received special thanks from several Committees and many inquiries for and purchases of exhibits have in consequence been made. The influence of these officers would be enhanced if they could be made Sub-Deputy Collectors, but still be seconded as travelling overseers or inspectors.

Other Officers.

57. My acknowledgments are due to Major D. Prain, I.M.S., Dr. J. Walter Leather, Mr. J. H. Burkill and Mr. J. W. Mollison. Mr. Mollison deserves the special thanks of the Department. I have had the advantage of touring with him on several occasions and he has freely given to me his time and advice regarding our cropping and other schemes. Government has also consulted him on many important matters.

I have the honour to be,

SIR,

Your most obedient servant,

S. L. MADDOX,

Offg. Director of Land Records and Agriculture, Bengal.

APPENDICES.

APPENDIX I.

A list of Agricultural Implements and Machines which have been tested in Bengal during the year ending 31st March 1904 and of those in use which are reported to have met with more or less marked success.

Designation of implements.	Use.	Special advantage or instruction.	Price.	Where procurable.	Name and designation of reporting officer.	Opinion.	Extent to which used by native agriculturists.	REMARKS.
2	3	4	5	6	7	8	9	10
Behia Sugarcane mills.	Crushing sugarcane.	Yields best and highest outturn.	Rs. A. P. 58 to 90 0 0	Messrs. Thomson and Mylne of Behia, Shaha-bad.	Commissioners of the Burdwan, Rajshahi, Patna and Orissa Divisions.	Very popular. Every part is made up of iron and cannot be easily put out of order. It has a wide reputation all over Behar and the United Provinces of Agra and Oudh.	336 mills sold by Messrs. Thomson and Mylne during the year.	
Sugarcane mill	Ditto	...	30 to 75 0 0	Messrs. Burn & Co., Howrah Iron Works.	...	...	12 mills sold by Messrs. Burn & Co. during the year.	
Shallow evaporating pan	Bolling sugar juice.	Yields best and highest outturn.	30 0 0	Messrs. Thomson and Mylne of Behia, Shaha-bud.	Commissioner of the Orissa Division.	The cultivators appreciate the value of the pan.	6 pans sold by Messrs. Thomson and Mylne during the year.	
Sibpur plough	Preparing lands for rabi crops, tilling lands and soil inverting.	Found well for rabi crops and cheap soil inverting plough.	10 0 0	Department of Land Records and Agriculture, Bengal, Calcutta.	Commissioners of the Rajshahi, Patna, Bhagalpur and Orissa Divisions.	The plough was tested with success. Two ploughings with local country plough are equivalent to one with this plough.	26 sold during the year.	The Commissioners of the Bhagalpur and Orissa Divisions say that the plough is too heavy for the ordinary bullocks.
Indian plough	Tilling the ground.	Efficiency. Low price	7 8 0	Messrs. Burn & Co., Howrah Iron Works.	Commissioner of the Rajshahi Division.	The plough was tested with success.	...	
Howard cotton "D."	For breaking and inverting soil.	Is useful practically on all kinds of lands (excepting paddy lands).	40 0 0	Messrs. T. E. Thomson & Co., Calcutta.	Commissioner of the Patna Division.	Very substantial. Made entirely of iron. Has continued to give satisfaction. One ploughing with this plough is equal to three with wooden country plough, but it requires strong pair of bullocks to work it.	.....
Bakhar (paring plough).	For distributing the sub-soil and killing weeds.	Made in the pattern used in the Bombay farms. Well serves the purpose for which it is intended.	3 8 0	Superintendent, Sripur Farm, Hathwa Raj.	Ditto	Found very useful for grubbing lands. Has continued to give entire satisfaction.	One supplied by the Superintendent, Sripur Farm, to the Chittagong Farm during the year.	
Spades (koda-lies).	...	...	8 8 to 11 per dozen.	Messrs. Burn & Co., Howrah Iron Works.	...	...	6,835 sold by Messrs. Burn & Co. during the year.	
Kate	For collecting grasses in the field.	Very useful for collecting grasses. Very simple; can be made by village blacksmiths.	18 0 0	Superintendent, Sripur Farm, Hathwa Raj.	Commissioner of the Patna Division.	Has continued to give satisfaction. Extremely useful for cultivators.	...	
Paddy husker	Husking paddy.	...	120 0 0	Messrs. Burn & Co., Howrah Iron Works.	...	...	One sold by Messrs. Burn & Co. during the year.	
Maise bullet	For separating maize from cobs.	About 10 maunds of grain is separated in a day. So light that boys can work it.	100 0 0	Messrs. T. E. Thomson & Co., Calcutta.	Commissioner of the Patna Division.	Separates grain from cobs very effectually. Can be well recommended for small farms.	...	

APPENDIX I—concluded.

A list of Agricultural Implements and Machines which have been tested in Bengal during the year ending 31st March 190.
and of those in use which are reported to have met with more or less marked success—concluded.

No.	Designation of implements.	Use.	Special advantage or instruction.	Price.	Where procurable.	Name and designation of reporting officer.	Opinion.	Extent to which used by native agriculturists.	REMARKS.
1	2	3	4	5	6	7	8	9	10
13	Winnower ...	For separating dust and small chaff from grain.	Can be used for clearing grain in the absence of wind. Works admirably.	Rs. A. P. 200 0 0	Messrs. T. E. Thomson & Co., Calcutta.	Commissioner of the Patna Division.	Clears very satisfactorily about 40 maunds of oats and 60 maunds of wheat and barley in a day. Can be well recommended for small farms.	...	
13	Chaff-cutter	For chaffing fodder.	Worked by steam power.	630 0 0	Messrs. A. Butler & Co., Muzaffarpur.	Ditto ...	Can be highly recommended for large farms where large number of cattle is kept. Can cut 175 to 200 maunds in eight hours.	...	
14	Ditto ...	Ditto ...	Worked by bullock gear.	285 0 0	Messrs. Burn & Co., Howrah Iron Works.	...	...	One sold by Messrs. Burn & Co. during the year.	
15	Ditto ...	Ditto ...	Worked by hand power.	200 0 0	Messrs. T. E. Thomson & Co., Calcutta.	Commissioner of the Patna Division.	Cuts fodder very effectually, well equipped with improvements. Cuts about 50 maunds a day. Small farms should not be without this machine. Has been found to be working most satisfactorily.	...	
16	Ditto ...	Ditto ...	Ditto ...	63 to 70 0 0	Messrs. Burn & Co., Howrah Iron Works.	...	...	Four sold by Messrs. Burn & Co. during the year.	
17	Seed Bin ...	For storing grain.	Made entirely of iron sheets, six feet in height and 4 ft. in diameter. Can hold 40 maunds of grain.	15 0 0	Superintendent, Sripur Farm, Hathwa Raj.	Commissioner of the Patna Division.	No grain can be damaged or eaten by rats. Very compact.	One supplied by the Superintendent, Sripur Farm, to Chittagong Farm during the year.	
18	Kite Motion pumps.	Raising water	Worked by hand power.	300 to 475 0 0	Messrs. Burn & Co., Howrah Iron Works.	...	...	Six sold by Messrs. Burn & Co. during the year.	
19	Water lifts ...	Ditto ...	Ditto ...	350 0 0	Ditto ...	...	...	Two sold by Messrs. Burn & Co. during the year.	
20	Ditto ...	Ditto ...	Worked by bullock gear.	1,080 0 0	Ditto ...	...	...	One sold by Messrs. Burn & Co. during the year.	
21	Flour grinding mill.	Grinding flour	Efficiency ...	210 0 0	Ditto ...	...	...	Ditto ...	
22	"Inhos" ...	Ditto ...	Worked by bullock gear.	500 0 0	Ditto ...	...	...	Ditto ...	
23	The "Humming Bird" Cream Separator.	For separating cream from milk.	Works effectually ...	200 0 0	Messrs. T. E. Thomson & Co., Calcutta.	Commissioner of the Patna Division.	Cream separated with this machine is far superior to that turned out by ordinary process. Found more useful in the cold than in hot weather.	...	
24	Butter churn	Churns cream into butter.	Works most satisfactorily.	70 0 0	Ditto ...	Ditto ...	Yields very good results and gives a quick output. Can be highly recommended.	...	
25	Eclair Vaporizer.	For applying insecticide to diseased crops.	Useful for spraying. Can be easily carried by one man.	50 0 0	Can be obtained through the Department of Land Records and Agriculture, Bengal.	Ditto ...	Can be recommended only for small holdings and small farms. Found fairly useful in doing work on a small scale.	...	

APPENDIX II.

List of Seeds and Manures distributed by the Department during 1903-1904.

	SEEDS.			Mds.
(1) Potato	441
(2) Gram	19
(3) Wheat	53
(4) Oat	52½
(5) Cotton	30
(6) Paddy	7½
(7) Onion	5½
(8) <i>Patal</i> root	6
(9) Peas	3
(10) Barley	6
(11) Maize	1½
(12) Jute	1½
(13) <i>Mung</i>	1½
(14) <i>Musur</i>	1½
(15) <i>Maskalai</i>	1
(16) Cassava	740 outtings.
(17) Betelnut seed	1,000
(18) Sugarcane about 49 kahans (1 kahan=1,280 outtings).				

Also brinjal, long peper, white mustard, radish, carrot, French-beans, onion, chilli, peas cabbage, cauliflower, beet, *methi*, kholrabi, tomato, lucern, *jeera*, *kalajeera*, *panmouri*, castor seed and other seeds.

	MANURE.			Mds.
Bonemeal	162
Castor cake	161
Saltpetre	63
Rape cake	8
Mustard cake	1

APPENDIX III.

Agricultural Exhibitions and Fairs.

Suri Cattle and Produce Show.—This show was opened on the 1st February 1904 and lasted for five days. The Collector of Birbhum, who is also President of the Managing Committee, reports that the people have been paying more attention to the improvement of agriculture and industries, and now young cattle and poultry of better type, and grains, vegetables, and articles of arts and industries of better sorts are seen in the district and brought to the show. The Superintendent, Civil Veterinary Department, who attended the exhibition, does not share the Collector's opinion as far as the cattle exhibited are concerned. He writes:—"I have known this show now for about seven years and I cannot say that the cattle I saw this year are any improvement on those I saw seven years ago."

A sum of Rs. 240 was allotted from the Imperial grant for special prizes for country-bred cows and bulls. Selection was made by a Committee assisted by Major Raymond and a few local gentlemen. Rupees 250 was also granted by Government in aid of this exhibition.

2. *The Barasat Agricultural Show in the 24-Parganas.*—This exhibition was held on the 22nd, 23rd, and 24th January last in the Subdivisional Cutcherry compound. The principal agricultural and horticultural products of the subdivision were exhibited. Rupees 175 in cash and medals were given away as prizes to the successful exhibitors. As a result of holding an annual agricultural exhibition in the midst of an agricultural population many persons have begun paying systematic attention to improvement of certain kinds of agricultural produce. An overseer of this department was deputed to demonstrate the use of improved agricultural implements. He found the cassava plant growing wild at Barasat and demonstrated to the people the edible property of the root, and he also showed them how to make arrowroot and flour out of the roots. Rupees 100 was paid by Government in aid of this exhibition.

3. *The Khulna Exhibition.*—An exhibition of agriculture, industry and art was held at Khulna on the 15th February 1904 and continued till the 28th of the same month. Of the exhibits various kinds of fine and sweet-scented paddy, fibres of *Dharos*, Taleswar potteries, clay figures from Krishnagar, country-made steel trunks and boxes, silk cloths from Murshidabad, and silver works from Daoca deserve special notice. No other than indigenous articles were admitted as exhibits. Rupees 351 and 18 medals were awarded to successful exhibitors. An overseer of this department was deputed to this exhibition with some improved agricultural implements to explain to the people the advantage of their use. Government grant in aid of this show was Rs. 200.

Mr. N. G. Mukherjee, Assistant Director of Agriculture, who visited this exhibition, reports that button-making is a local industry. Links and studs are made out of

horns, bones, ivory, shells and wood. One or two of the men engaged in this industry might be sent to Mr. M. S. Das's workshop in Cuttack to get a wider range of experience in their own art. Cash-boxes, buckets, etc., of very good finish were exhibited by another local man. Miniature paintings on ivory in imitation of the Delhi ware were exhibited by another local man.

4. *The Kalimpong Exhibition and Fair.*—This *méla* was held on the 25th and 26th November 1903. The exhibits were much the same as in the previous year. In all there were 1,700 entries in 19 classes. Prizes numbering 390 and amounting to Rs. 1,463 were distributed. Owing to the Tibetan frontier troubles, ponies and mules were not up to the average standard, but the number brought in was quite as large as usual. The cattle showed a decided improvement, largely, it is believed, due to the special prizes offered through the Civil Veterinary Department.

The poultry continues to develop and 12 pairs of English fowls were given away as prizes by the Deputy Commissioner of Darjeeling. Grains were not quite up to the last year's exhibits, as the season had been unfavourable, especially for *dhutta*. Roots, vegetables, fruits and dairy produce were up to the average, and the same might be said of exhibits illustrating local industries. An interesting feature of the last exhibition was weaving with the Serampore fly-shuttle loom. The Bengal Agricultural Department paid Rs. 450 from the Imperial fund for the award of special prizes for the improvement of cattle-breeding and Rs. 500 from the Provincial grant in aid of the fair.

5. *The Falakata Fair.*—This fair commenced on the 21st January 1904 and lasted till 20th February 1904. There were various amusements at the fair to attract the people. The principal articles brought in for sale were brass utensils, blankets, country and foreign cloths, and other indigenous products. No Bhutias came this year with dogs and musks as in previous years. The estimated value of the articles sold and the average daily attendance at the fair were Rs. 29,000 and 300, respectively, against Rs. 27,000 and 250 in 1902-1903.

6. *Santrabari Fair.*—The fair was announced to be held on the 10th January 1904, the date of payment of the Bhutan subsidy. All preliminary arrangements were made for the fair, but it was not held. It is reported that no Bhutia tradesmen came down, nor did any people go to Santrabari, owing to a rumour that there might be a rising, as the subsidy had not been paid to the Bhutan Government on the fixed date.

Out of the Government grant of Rs. 500 for the Falakata and Santrabari fairs, Rs. 300 was expended for the former, Rs. 20 for the latter. The balance (Rs. 180) was refunded. The Commissioner of the Rajshahi Division recommends the continuance of the grants, as the circumstances of the year under report were exceptional.

7. *The Tangail Industrial and Agricultural Exhibition.*—The exhibition was opened on the 14th February 1904 and lasted for ten days. It is supported by public subscription and the local zamindars take great interest in it. Among others, Mr. W. Pania, a local zamindar, presented two gold and four silver medals to the Exhibition Committee for award to the successful exhibitors. The exhibits this year were quite a good assortment. The local exhibits predominated, but there were also a decent number of exhibits from such distant places as Ludhiana, Gauhati, Malda, Berhampur, Benares, Bisnupur, etc. The silk cloth manufactured by local weavers compared favourably with those from other parts. The wooden statue of the late Roy Dwarka Nath Chowdhury, zamindar of Santosh, made by a local carpenter, was life-like. The working of the fly-shuttle loom drew crowds. The cultivation of potato and English vegetables is increasing in the locality. Rupees 150 in cash, and two gold and eight silver medals were given away as prizes to the best exhibitors.

8. *Sitamarhi Cattle Show.*—The show was held on the 27th March last. The number of bullocks brought to the show this year was about 30,000. There were only 100 cows or less of various sorts and two or three bulls of sorts. The Judging Committee consisted of the Sub-divisional Officer, Sitamarhi, Mr. J. Wilson, Mr. E. W. C. Moore, and Major Raymond. Rupees 545 was distributed in prizes. It is reported that the Imperial prizes were not distributed in accordance with rule 9 of the rules for the award of such prizes. The Imperial grant will have to be withdrawn if the Committee do not strictly follow the rule.

9. *The Sonapur Horse and Cattle Fair.*—The fair commenced on the 29th October and lasted till 18th November 1903. This year the cattle show was held a day before the bathing day on the 4th November. Notices both in English and Hindi were printed and distributed for publication in all the districts of the Patna Division. The estimated number of animals brought into the *méla* was as follows:—Elephants 600, cows 450, bullocks 19,000, horses 1,600, ponies 3,000, buffaloes 200, camels 22, and birds 2,000. About 3,000 horses and ponies, 570 elephants, 250 cows, 16,000 bullocks, 100 buffaloes, and three-fourths of the birds changed hands. Fifty-three bullocks and 200 ponies were purchased by the Military Department for the Tibet Commission. The sum total of all transactions at the fair was estimated at about Rs. 6,25,000. Veterinary Major Raymond and I visited the fair and helped the Committee in judging the animals for prizes. Twenty prizes at a cost of Rs. 365 were awarded from local funds, which includes the Government contribution of Rs. 200, and out of the Imperial grant of Rs. 240, four prizes amounting to only Rs. 55 and one silver medal could be distributed. The cows were as usual fair in number and quality. Most of the cows were from the United Provinces. No local bulls were seen. The buffalo cows of up-country breed were very good. The local buffaloes were inferior. One very good Patna bull competed, but the Patna cows were not good. The bullocks were, as usual, bad as a lot; they by no means represent the average quality of the animal brought to the fair. The chief reason appears to be that the show enclosure is far from the bullock lines, which is unavoidable on

account of the size of the fair. No real plough bullocks were exhibited, but some very fine cart bullocks were shown as plough bullocks.

A special prize of Rs. 20 was given for a bull buffalo-calf as no heifers were exhibited.

Major Raymond, Mr. O'Gilvy, and Mr. Abbott bought eight deshi cows for the Sripur herd.

10. *The Tintanga Mela and Agricultural Show.*—The *mela* was held this year on the 1st February 1904 and on the two following days. About 20,000 people gathered on the busiest day. A travelling overseer of this department attended the *mela* and helped the Managing Committee in determining the prizes distributed to the exhibitors. Copies of a useful primer on agriculture were distributed at this show. The total receipts of this year from all sources amounted to Rs. 318-13 against Rs. 276-3 of the previous year. The total expenditure amounted to Rs. 279-9-6 against Rs. 269-6 in the previous year.

11. *The Malda Agricultural Exhibition.*—This exhibition was held this year at the sadar station of the district from 2nd to 7th February 1904. The usefulness of the exhibition having been appreciated by most of the residents of this district, it proved a greater success this year than last year. All the principal zamindars came forward to strengthen the hands of the Exhibition Committee and rendered very valuable help. The exhibits this year, though not very large in number, still surpassed those of the previous year greatly in variety and excellence. Among other things, the collection of grains and vegetable products was very satisfactory and attracted special notice. The exhibits sent by this department also attracted special notice. Improved implements, such as the Sibpur plough, a five-tined grubber, the Planet Jr. hand-hoe were exhibited at work, and there have been some requests from this district for these implements. Government contributed Rs. 150 in aid of this show. Money prizes and medals of the total value of Rs. 510 were distributed to the successful exhibitors. The total income of the exhibition from all sources amounted to Rs. 1,992, which was just sufficient to meet the expenditure.

12. *The Dumka Exhibition.*—An agricultural and industrial exhibition was held at Dumka on the 21st January last and it lasted for four days. Agricultural produce, articles of local manufacture, and live-stock (cattle and poultry) were exhibited and prizes amounting to Rs. 461 were distributed to the successful exhibitors. The exhibition was managed by a Committee, with the Deputy Commissioner of the Sonthal Parganas as its President, and the expenses were met entirely by private subscription.

13. *The Khagra Mela and Cattle Show.*—The most important feature of the *mela* this year was the opening of a cattle show on the 8th January last during the continuance of the *mela*. The show was in every respect successful, considering that such a show was held for the first time in the district. Out of the Imperial grant of Rs. 180 to this show, nine prizes aggregating Rs. 150 were given to the owners of the best kind of cattle. The Khagra estate spent Rs. 155 in awarding ten prizes to the owners of the other classes of cattle not provided for in the Imperial grant. The *mela* was, as usual, very successful and the income increased. About 300 elephants were brought and some 120 of them were sold. The class of cattle brought to the *mela* is improving year by year.

14. *The Bihta Cattle Show.*—In previous years a *mela* was held annually at Bihta on the *Sheo Batri* day, in which only a few bullocks were brought for sale, but this year a very large cattle fair which is held annually at Kath Berhampore in the Shahabad district having been stopped on account of the plague, the cattle which would have been taken there came on to Bihta, and this cattle show therefore started under exceptionally favourable circumstances. Several thousands of good bullocks were brought for sale. The bulls, cows, and heifers exhibited were not really representative of the best stock available in the district, but it is hoped that if the show is again held next year, a better class of stock will be forthcoming. Rupees 180 was given from the Imperial grant for the award of special prizes at this cattle show.

15. *Rajnagar Cattle Show.*—During the year under report a cattle show was started at Rajnagar in the district of Darbhanga. It was held on the 20th January 1904. The object with which this cattle show was started was to encourage the breed of Bachour cattle. The number of cattle exhibited was large and the arrangements for housing them were good. The quality of the cattle was perhaps not so good as might have been expected and was scarcely representative of what the district can produce. Major Raymond and I attended this exhibition and helped the Judging Committee in awarding the prizes. The Maharaja of Darbhanga gave away the prizes. With the opening of the railway to Rajnagar next year and the assistance promised by the Maharaja of Darbhanga, the show should grow in size and popularity. The Provincial Government allotted Rs. 150 towards the show, and the Imperial Government Rs. 180 besides two medals. On the whole the show, considered as an initial effort, was a great success.

16. There was an exhibition held at Cuttack early in January in connection with the conference of the native Chiefs of Orissa. It was a great success.

APPENDIX IV.

Expenditure on miscellaneous experiments and enquiries made by the Department.

		Rs.	A.	P.
(1)	Experiments other than those made in experimental farms	1,602	13	7
				Rs. A. P.
(a)	Cost of Egyptian cotton seed ...	31	0	1
(b)	Ditto Australian maize ...	56	4	0
(c)	Ditto ditto oats ...	42	12	0
(d)	Purchase of seed potatoes ...	351	15	0
(e)	Ditto other seeds and manures ...	359	0	3
(f)	Miscellaneous	761	14	3
		1,602	13	7
(2)	Pay and travelling allowance of the agricultural overseers	4,708	7	3
(3)	Purchase, etc., of implements	2,698	8	0
(4)	Purchase of bulls	600	0	0
(5)	Contribution for a seed store at Dumraon	300	0	0
(6)	Miscellaneous, including Rs. 437 for pay and travelling allowance of the Head Master, Rampur-Boalia Diamond Jubilee Industrial School, and Rs. 67-11-9 for his deputation and travelling allowances to Bangalore ...	961	1	0
	Total	10,870	13	10

APPENDIX V.

No. 39—XIX, dated Dehra Dun, the 22nd April 1904.

From—DR. E. J. BUTLER, M.B., F.L.S., Cryptogamic Botanist to the Government of India,

To—The Director of the Department of Land Records and Agriculture, Bengal.

IN answer to your letter No. 1107A., dated Calcutta, the 18th instant, requesting information on the results of the investigation of sugarcane diseases in Bengal, I have the honour to submit the following.

A number of fungus diseases of cane were found in Bengal. Of these by far the most serious is that usually known as "red-smut" due to the fungus *Colletotrichum falcatum*. It causes reddening of the interior with subsequent drying up of the cane. There is reason to believe that the disease is conveyed largely by the use of infected sets, and all sets showing traces of the red colour on cutting should be discarded. Excessive moisture in the ground is a predisposing cause to the disease. Severely attacked varieties should be replaced by others, as their continuance in cultivation only serves to increase the disease in succeeding years. Canes which have withered from the disease should be removed and burnt, as spore formation takes place on the surface of the cane after it has completely withered.

Cane-smut, due to *Ustilago Sacchari*, is common on certain varieties of cane. The majority, however, do not suffer.

"Khari" cane, much cultivated at Burdwan, is often attacked.

The disease is characterised by the growth of a long black whip-like organ from the tip of the shoot. On this spores are produced in great quantity and infect the ground and surrounding canes. Hence when a field has shown much disease it should be replanted with a different variety taken from some distance away. The cane from the diseased field should not be used as seed the following year.

Brown leaf-spot, due to an undescribed fungus, *Cercospora longipes*, is the commonest disease of the drier parts of the Presidency. The leaves are marked with oval spots surrounded by brown, red, and yellow rings. In the centre of these spots spores are formed, which successively infect every leaf produced, so that eventually sound leaves can scarcely be found. Every leaf in every field of certain varieties, in many parts of Champaran, Saran, Shahabad, Patna and other districts is affected by this fungus, and some of the most commonly grown sorts as Mango, Reora (Burli), Khari, etc., are specially liable to it. The extent of the damage caused, and the treatment are matters requiring further investigation. The effects are indirect by interfering with the proper functions of the leaf rather than, as in the two previous diseases, direct by destruction of the cane.

"Ring spot," due to the fungus *Leptosphaeria Sacchari*, was found in a few cases producing effects somewhat similar to the last. The leaves are marked by irregular dried-up spots and the green colour is eventually destroyed.

A rind disease caused by the fungus *Diplodia Cacaoicola* is common but causes little damage. Its effects appear to be somewhat similar to those of "red-smut," but are more

local. The rind is ruptured in numerous points arranged in line, and a black crust, formed by the spores, is found in the ruptured parts. Treatment does not appear called for at present.

The "pine-apple" disease of cane, caused by the fungus *Thielaviopsis ethacetica*, was introduced in Bengal on two occasions within my own knowledge. It has not been found so far on native canes, and it is impossible that the disease should be very widespread in Bengal without having come to my notice. The disease chiefly affects the germination of sets. In several sugar-growing countries it is responsible for a loss, estimated, in some cases, at up to 50 per cent. of planted sets. In view of the risk which exists of the importation of diseases, of which this is a case in point, the uncontrolled introduction of foreign canes is a source of great danger.

A disease locally termed "Lahi" and said to be the worst cane disease known to the cultivators was seen in Saran and is not uncommon elsewhere. Its most striking feature is the deposit of a black, flaky, crust on leaves and other parts of the cane. This crust is composed of fungus elements. The fungus is, however, only indirectly connected with the disease, which is really due to the presence of scale insects. The latter excrete a sugary matter known as "honey-dew" on which the fungus grows. As a result of the black coating the leaves, already weakened from the attacks of the scale insects, rapidly become bleached and functionless. Attention should be directed to the insects as the primary cause of the disease.

Some other diseases of minor importance were investigated. A full, illustrated account, as far as present knowledge goes, of these diseases has been drawn up and will be submitted shortly to the Inspector-General of Agriculture for publication, when copies will be furnished to your office.

APPENDIX VI.

A

Statement showing results of experiments on sugarcane made by some of the Indigo Planters in Behar,
1903-1904.

Burhogah Experimental Plots.

Irrigated.

Saran District.

	Average yield per acre.	Increase.	Value of Increase.	Cost of manure per acre.	Profit per acre.	Loss per acre.	Brix.	Sucrose.	Purity Co-efficient.	REMARKS.
1	Tons C. Q.		Rs. A. P.		Rs. A. P.					
1	NO MANURE--									
	Lalgira or Pounds ...	14 18 1	...	...	...	...	16.5	18.7	88	
	Samsara ...	10 7 0	...	...	...	...	17.1	14.4	83.4	
	Raora or Bhurli ...	15 9 0	...	...	...	...	19.1	17	89	
2	RAPE SEED CAKE--									
	Lalgira or Pounds ...	19 3 1	4 10 0	38 12 0	17 12 0	16 0 0	...	17.7	16	84.7
	Samsara ...	14 12 0	4 5 0	38 10 0	17 12 0	14 14 0	...	16.5	15.4	81.8
	Raora or Bhurli ...	18 16 0	5 6 0	38 2 0	17 12 0	20 2 0	...	19.1	16.7	87.4
3	CASTOR CAKE--									
	Lalgira or Pounds ...	17 10 0	2 6 3	17 4 0	30 8 6	...	13 4 0	16.4	13.4	81.7
	Samsara ...	15 18 0	3 11 0	42 8 0	30 8 6	11 15 6	...	16.3	12.7	77.9
	Raora or Bhurli ...	20 0 0	6 11 0	44 10 0	30 8 6	14 1 6	...	19	16.7	87.9
4	RAPE SEED AND SULPHATE OF AMMONIA--									
	Lalgira or Pounds ...	19 9 0	4 15 3	35 0 0	29 15 3	5 0 9	...	15.5	12.2	76.7
	Samsara ...	13 11 0	3 4 0	24 7 0	29 15 3	...	5 3 3	15.9	13.6	79.2
	Raora or Bhurli ...	20 7 0	6 18 0	47 0 0	29 15 3	17 0 8	...	19.6	17	86.7
5	SUPER PHOSPHATE SULPHATE OF AMMONIA AND POTASH--									
	Lalgira or Pounds ...	20 18 3	6 5 3	46 14 0	71 1 3	...	24 3 3	16.5	13.6	82.4
	Samsara ...	13 11 0	3 4 0	24 7 0	71 1 3	...	40 10 3	15.1	11.5	76.1
	Raora or Bhurli ...	17 2 0	3 13 0	24 14 0	71 1 3	...	46 3 3	19.2	16.6	87.6
6	SEED--									
	Lalgira or Pounds ...	20 0 0	5 6 3	39 12 0	...	...	...	17.7	15.1	85.3
	Samsara ...	28 19 0	18 12 0	142 9 0	...	...	...	14.4	10.8	75
	Raora or Bhurli ...	19 1 0	6 12 0	38 3 0	...	...	...	19	17	89.4

B

Burhogah Experimental Plots.

Not irrigated

1	NO MANURE--										
	Lalgira or Pounds ...	4 13 0	18.4	15.9	86.4	NOTE-- The Samsara seed used in the B series with the exception of Plot 4, was delivered by cart and was in much better condition than that used in series A which was delivered by rail from Secraha. Hence the better germination and heavier crop of this variety in B series. The comparison of irrigated versus non-irrigated was vitiated by the fact that the non-irrigated (series B) was irrigated by Mr. Mackenzie in August during a prolonged break in the rains. So that practically no deductions can be drawn from this series, so far as the plant (present) crop is concerned. Judging from the low co-efficient of purity, the big canes in both series were still far from ripe when cut. VALUE OF INCREASE TO GROWER calculated at 4) annas per maund big cane, 6 annas per maund small cane.
	Samsara ...	13 18 0	...	...	...	...	...	17.8	14.9	84.6
	Raora or Bhurli ...	8 19 0	...	...	...	...	...	20.2	18.2	89.0
2	RAPE SEED CAKE--										
	Lalgira or Pounds ...	13 16 0	3 3 0	62 8 0	17 12 0	44 12 0	...	17.2	14.2	82.3	
	Samsara ...	13 3 0	Nil.	...	17 12 0	...	17 12 0	17.8	14.1	81.5	
	Raora or Bhurli ...	13 19 0	5 0 0	34 1 0	17 12 0	16 5 0	...	17.5	14.8	84.6	
3	CASTOR CAKE--										
	Lalgira or Pounds ...	17 19 0	13 6 0	101 12 0	30 8 6	71 4 6	...	15.8	12.6	79.7	
	Samsara ...	20 12 0	6 16 0	53 0 0	30 8 6	21 7 6	...	16.7	13.2	79	
	Raora or Bhurli ...	16 11 0	7 12 0	51 12 0	30 8 6	20 4 6	...	17.8	15.0	84.2	
4	RAPE SEED AND SULPHATE OF AMMONIA--										
	Lalgira or Pounds ...	24 12 0	19 19 0	145 11 0	29 15 3	115 11 9	...	16.9	13.5	79.3	
	Samsara ...	17 17 0	4 1 0	31 0 0	29 15 3	1 0 9	...	16.4	13.1	79.8	
	Raora or Bhurli ...	18 13 0	9 14 0	66 2 0	29 15 3	33 2 9	...	17.5	14.4	82.2	
5	SUPER SULPHATE OF AMMONIA AND POTASH--										
	Lalgira or Pounds ...	18 15 0	14 2 0	108 2 0	71 1 3	37 0 9	...	16.8	13.2	79.1	
	Samsara ...	19 10 0	5 14 0	43 9 0	71 1 3	...	27 8 3	16.2	12.8	79	
	Raora or Bhurli ...	16 0 0	7 1 0	49 1 0	71 1 3	...	23 0 3	18.5	16	83.4	
6	SEED--										
	Lalgira or Pounds ...	18 7 0	13 14 0	94 0 0	...	...	...	17.5	14.7	84.0
	Samsara ...	14 7 0	0 11 0	3 15 0	...	...	...	16.3	12.8	78.5
	Raora or Bhurli ...	17 0 0	8 1 0	54 14 0	...	...	...	18.6	16.2	87.0

APPENDIX VI—concluded.

Statement showing results of experiments on sugarcane made by some of the Indigo Planters in Behar, 1903-1904.—concluded.

Seeraha Experimental Plots. Irrigated. District Muzaffarpur.

	MANURE CONSTITUENTS.			Average yield per acre.	Increase.	Value of increase.	Cost of manure per acre.	Profit per acre.	Loss per acre.	Brix.	Sucrosa.	Purity Co-efficient.	REMARKS.
	Nitrogen.	Potash.	Phosphoric acid.										
NO MANURE—													
Kalgara (Bourbon) ...	...	...	...	T. C. Q.	T. C. Q.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A.	17'6	16'15	90'7	
Samsara ...	...	...	...	15 16 4	...	...	...	...	...	18'3	16'2	88'5	
Bhurli ...	...	...	...	11 6 1	...	...	...	...	...	19'2	17'2	89'5	
SEED—													
Kalgara (Bourbon) ...	219'5	...	...	6 4 4	Nil	Nil	...	...	...	16'90	15'0	88'7	
Samsara ...	219'5	...	...	20 14 3	9 3 2	79 8 4	...	...	...	17'62	16'83	89'8	
Bhurli ...	219'5	...	...	11 11 2	3 2 1	15 13 6	...	...	...	18'98	15'13	89'1	
RAPE SEED CAKE—													
Kalgara (Bourbon) ...	88'6	...	...	12 4 2	Nil	Nil	21 10 0	Nil	21 10 0	17'3	15'36	86'7	
Samsara ...	88'6	...	...	18 8 3	7 0 2	59 4 4	21 10 0	37 10 4	Nil	18'47	16'20	87'7	
Bhurli ...	88'6	...	...	12 0 2	2 11 1	19 3 6	21 10 0	Nil	2 6 6	18'25	15'98	87'4	
CASTOR OAK—													
Kalgara (Bourbon) ...	89'2	...	...	7 19 1	Nil	Nil	28 0 0	Nil	28 0 0	Diseased plot.		84'7	
Samsara ...	89'2	...	...	18 12 1	7 6 0	61 9 6	28 0 0	33 9 6	Nil	18'88	15'16	84'7	
Bhurli ...	89'2	...	...	12 19 0	3 4 2	24 4 6	28 0 0	Nil	3 11 6	18'95	17'03	86'8	
RAPE SEED AND SULPHATE OF AMMONIA—													
Kalgara (Bourbon) ...	88'8	...	...	6 8 2	Nil	Nil	34 0 8	Nil	34 0 8	16'95	15'2	89'8	
Samsara ...	88'8	...	...	16 2 2	4 16 2	40 11 4	34 0 8	6 10 8	Nil	17'85	15'46	88'6	
Bhurli ...	88'8	...	...	12 2 2	2 19 1	22 3 6	34 0 8	Nil	11 18 2	18'25	15'9	87'1	
CASTOR OAK AND SULPHATE OF AMMONIA—													
Kalgara (Bourbon) ...	91	...	...	11 4 3	Nil	Nil	38 8 0	Nil	38 8 0	18'12	16'6	91'6	
Samsara ...	91	...	...	19 8 1	8 0 0	67 8 0	38 8 0	39 0 0	Nil	16'75	13'8	89'3	
Bhurli ...	91	...	...	13 6 2	3 17 1	28 15 6	38 8 0	Nil	9 8 6	18'78	15'63	84'9	
SUPRE PHOSPHATE, SULPHATE OF AMMONIA AND POTASH—													
Kalgara (Bourbon) ...	94'5	22'6	22'8	7 2 2	Nil	Nil	67 8 0	...	67 8 0	19'02	17'4	91'4	
Samsara ...	94'5	22'6	22'8	17 6 3	0 0 2	30 13 4	67 8 0	...	16 10 8	19'05	16'86	89'5	
Bhurli ...	94'5	22'6	22'8	11 4 0	1 14 3	13 0 6	67 8 0	...	54 7 8	18'38	16'3	88'6	

Seeraha Experimental Plots. Not irrigated.

NO MANURE—													
Kalgara (Bourbon) ...	...	...	...	15 10 2	...	...	...	...	...	16'83	14'5	87'7	For the sake of uniformity (vide Burhogah figs) the value of increase obtained by irrigation and manures has been calculated at 4 annas per maund for big cane and 4 annas per maund for small, but I would point out that these figures do not represent the actual value of cane to the Company nor does the relative value for small and big cane appear to be correct. I believe 11 tons of big cane will yield a ton of sugar, whereas it will take about 15 tons of Bhurli to give a like result. The respective value placed on these varieties is as 9 is to 8. The irrigated plots at Seeraha had only three waterings.
Samsara ...	...	...	...	12 16 1	...	...	...	...	...	17'88	16'03	89'7	
Bhurli ...	...	...	...	9 12 1	...	...	...	...	...	17'95	15'63	88'6	
SEED—													
Kalgara (Bourbon) ...	219'5	...	...	15 8 2	Nil	Nil	...	...	...	17'23	15'43	89'5	Apparently ALL the plots at Burhogah were irrigated but the number of waterings given is not mentioned, it is remarkable, however, that the non-manured plots at Seeraha gave an average yield of 13 tons 13c. 1 qr. per acre, whereas the corresponding plots at Burhogah only averaged 9 Tons 2 cwt. 2 qrs.
Samsara ...	219'5	...	...	9 7 2	Nil	Nil	...	...	...	17'65	16'86	88'7	
Bhurli ...	219'5	...	...	14 8 1	4 10 0	33 18 6	...	...	...	18'06	15'93	88'2	
RAPE SEED CAKE—													
Kalgara (Bourbon) ...	88'6	...	...	13 18 2	Nil	Nil	21 10 0	...	21 10 0	16'13	14'3	88'8	On the other hand the manured plots at Burhogah show a larger increase in yield than the corresponding plots at Seeraha.
Samsara ...	88'6	...	...	12 19 2	0 3 1	1 5 10	21 10 0	...	20 4 2	17'6	15'36	87'2	
Bhurli ...	88'6	...	...	7 6 1	Nil	Nil	21 10 0	...	21 10 0	18'95	17'0	89'7	
CASTOR OAK—													
Kalgara (Bourbon) ...	89'2	...	...	9 16 3	Nil	Nil	28 0 0	Nil	28 0 0	Diseased plot.		87'3	On the other hand the manured plots at Burhogah show a larger increase in yield than the corresponding plots at Seeraha.
Samsara ...	89'2	...	...	17 11 1	4 18 0	40 1 3	28 0 0	13 1 3	Nil	17'7	15'46	87'3	
Bhurli ...	89'2	...	...	13 2 1	8 9 0	25 14 0	28 0 0	Nil	2 2 0	18'66	16'4	88'3	
RAPE SEED AND SULPHATE OF AMMONIA—													
Kalgara (Bourbon) ...	88'8	...	...	7 2 2	Nil	Nil	34 0 8	...	34 0 8	17'45	15'56	89'1	On the other hand the manured plots at Burhogah show a larger increase in yield than the corresponding plots at Seeraha.
Samsara ...	88'8	...	...	18 8 2	Nil	Nil	34 0 8	...	34 0 8	16'85	14'23	84'4	
Bhurli ...	88'8	...	...	10 17 0	1 3 3	8 14 6	34 0 8	...	25 2 2	19'3	17'16	85'9	
CASTOR OAK AND SULPHATE OF AMMONIA—													
Kalgara (Bourbon) ...	91	...	...	15 8 1	Nil	Nil	38 8 0	...	38 8 0	17'22	15'53	90'1	On the other hand the manured plots at Burhogah show a larger increase in yield than the corresponding plots at Seeraha.
Samsara ...	91	...	...	13 12 2	0 17 1	7 4 4	38 8 0	...	31 3 8	18'08	15'73	87'0	
Bhurli ...	91	...	...	15 8 0	5 14 3	43 0 6	38 8 0	...	Nil	18'14	16'2	89'3	
SUPRE PHOSPHATE, SULPHATE OF AMMONIA AND POTASH—													
Kalgara (Bourbon) ...	94'5	22'6	22'8	9 1 2	Nil	Nil	67 8 0	...	67 8 0	17'36	15'7	90'3	On the other hand the manured plots at Burhogah show a larger increase in yield than the corresponding plots at Seeraha.
Samsara ...	94'5	22'6	22'8	14 8 2	1 12 1	11 14 8	67 8 0	...	55 0 4	17'92	15'1	88'7	
Bhurli ...	94'5	22'6	22'8	12 10 1	2 17 0	21 8 0	67 8 0	...	48 2 0	18'6	16'96	89'2	

E. HUDSON.
26th April 1904.

REVENUE DEPARTMENT.

AGRICULTURE.

CALCUTTA, THE 15TH AUGUST 1904.

RESOLUTION—No. 3490.

READ—

The Report of the Agricultural Branch of the Department of Land Records and Agriculture, Bengal, for the year 1903-04.

Letter No. 5257A., dated the 6th July 1904, from the Board of Revenue, submitting the report with their remarks.

Read again—

Resolution on the same report for the year 1902-03.

The Department was in charge of Mr. S. L. Maddox throughout the year. Altogether 184 days were spent by him on tour in connection with settlements, agricultural work and sericultural operations.

2. *Scientific enquiries.*—Considerable progress was made during the year in the enquiry into the alleged deterioration of jute; and special investigations were made into the practice of fraudulently watering the fibre. The Department had the advantage of receiving expert advice in the course of these enquiries from the Inspector-General of Agriculture, the Superintendent of the Royal Botanic Garden, the Reporter on Economic Products, and the Agricultural Chemist; and the Lieutenant-Governor desires to thank these officers for the valuable assistance they rendered. Experiments with jute were conducted at the Burdwan farm and at Faridpur and Jalpaiguri; and endeavours were made to demonstrate the growing of varieties under expert supervision. Special attention was paid during the year under review to the subject of cotton cultivation. Experiments were undertaken with the object of ascertaining what varieties are adaptable to local conditions and what is the best method of production; seeds were widely distributed; and efforts were made to extend local cultivation. The Lieutenant-Governor regrets, however, to notice that the results obtained from the seeds distributed by the Department were on the whole discouraging. There is, in the opinion of the Inspector-General of Agriculture, great scope for extending the cultivation of superior cotton in Bihar; and it is proposed to arrange for extensive experiments at Pusa in comparing varieties, testing methods of cultivation and improving varieties by selection and cross-breeding.

3. *Experimental farms and experiments in Government estates and Wards' estates.*—An experimental farm was started during the year at Cuttack, in accordance with the suggestion of the Government of India that it might be possible to hasten the development of improved agricultural methods in Orissa by the establishment of an experimental farm which would show the cultivators what can be done with water always at command. A scheme of experiments in irrigation which has been approved by the Lieutenant-Governor will now be undertaken at this farm and at the Dumraon and Burdwan experimental farms. The results of the experiments made at the Sibpur farm were of especial value as showing that certain varieties of *aus* paddy are drought-resisting and prolific: the Lieutenant-Governor will await with interest the results of the experiments which it is proposed to make under different conditions of soil and climate.

4. Sir Andrew Fraser is gratified to observe the growing interest in agricultural progress which is being displayed in various parts of the Province. A society has been formed in Orissa with the object of developing the resources of that Province by private enterprise; the District Board of Rajshahi has

offered to give land free for a divisional farm; a gentleman of Mymensingh, Babu Brajendra Kishore Acharji Choudhuri, has already placed a farm under the direction of the Department, and is bearing all the expenses of its management; and, as the Director notices in paragraph 35 of his report, excellent work is being done by private gentlemen in advancing improved methods in their own districts. It is observed, however, that the experiments conducted through the tenants of Government and wards' estates and other private individuals gave, on the whole, unsatisfactory results; and that it was only where they were under the personal supervision of District Officers or other responsible persons that they proved successful. To remedy this state of affairs, the employment of four travelling overseers has been sanctioned by Government, and a closer supervision of experimental work in the Province is now being exercised. The Lieutenant-Governor is firmly convinced, however, that very much more requires to be done. The Agricultural Department has admittedly failed hitherto to make known among the people the results which have been attained by experiment. Accounts of the various operations undertaken are published annually, but they have not reached the cultivating classes; and even in the vicinity of the various agricultural farms improved methods of cultivation have not been adopted. There are many zamindars and merchants keenly interested in agriculture, but their sympathy and co-operation have not been enlisted. In these circumstances, the Lieutenant-Governor is of opinion that an agency is wanted to disseminate agricultural knowledge, and to awaken further interest in, and discussion of, the agricultural development of the Province. Experience in the Central Provinces has shown what immense advantage has followed the creation of advisory Agricultural Associations; and it appears to His Honour that there is a great field of work open to such Associations in Bengal. Sir Andrew Fraser has, therefore, decided, as a first step, to establish a Provincial Agricultural Association at Calcutta to co-operate with the Director in his work in this Province. Its chief work will be in connection with agricultural experiments and the dissemination of the results of such experiments; but it will also advise Government as regards the programme of work of the Agricultural Department, as well as concerning all matters affecting the improvement of agriculture and the best method of reclaiming waste lands. Sir Andrew Fraser hopes that if such an Association proves successful, it will be possible to form, in the interior, Branch Associations composed of members keenly interested in the advancement of agriculture and ready to push improved methods and to carry out in their own villages any practical experimental work which may be entrusted to them.

5. *Sericulture.*—The Bengal Silk Committee continued to carry on its useful work in popularising the use of healthy seed and extending mulberry plantations. The Lieutenant-Governor is pleased to observe the progress made in extending the silk industry in Midnapore and the Tributary States of Orissa. In Midnapore a school has been established by local efforts with the object of reviving the silk industry in the district and of improving the agricultural condition of the people by giving instruction in agriculture and sericulture. In the Keonjhar State a trained sericulturist was employed to supervise the development of sericultural operations; and in Mourbhanj, mulberry plantations were established and cocoon-rearing and reeling was introduced.

6. *The Sibpur Agricultural Class.*—The results of the examinations were satisfactory. The Director observes, however, that the supply of qualified scholars is not equal to the demand for their services, and that the scheme of divisional farms must necessarily proceed slowly for want of expert officers in whose charge they can be placed. The Lieutenant-Governor trusts that the establishment of the Pusa Research Station and College will lead to a greater number of students coming forward, and looks to that college for valuable assistance in respect of the trained managers and fieldmen who will be available for the local farms. His Honour welcomes the offer of a scholarship to be held at the Pusa College, which has been made by the Maharani of Dumraon, and shares the hope of the Director that District Boards will come forward to support promising boys who have attended agricultural classes in their own districts.

7. *Spread of Agricultural Education.*—The Director of Public Instruction has been directed to submit a report showing what measures he would

recommend both to develop rural primary schools in Bengal and to supply courses of training specially suited for the teachers of such schools. He will now be asked, in submitting his proposals to consider the suggestions made by Mr. Maddox in paragraph 43 of his report. The divisional farms will afford suitable centres for the purpose.

8. The thanks of the Lieutenant-Governor are given to Mr. S. L. Maddox for the ability and zeal with which he has conducted the administration of the Department under his control. His commendations of the Assistant Directors, Mr. D. N. Mukherji and Mr. N. G. Mukherji, and of the travelling overseers under him have been noted. ..

By order of the Lieutenant-Governor of Bengal,

H. LEMESURIER,
Offg. Secy. to the Govt. of Bengal.

REPORT

OF THE

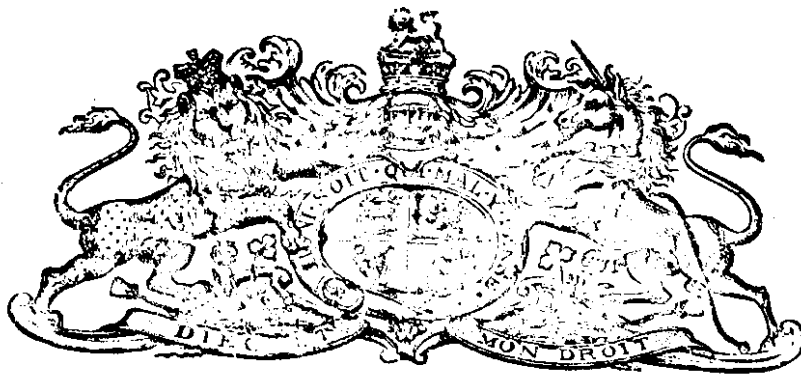
AGRICULTURAL DEPARTMENT,

BIHAR AND ORISSA,

FOR THE

YEAR ENDING THE 30TH JUNE 1913.

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DEPARTMENT OF AGRICULTURE, BIHAR AND ORISSA.

No. 5595A.

FROM

G. MILNE, Esq., I.C.S.,
OFFG. DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA,

TO

THE SECRETARY TO THE GOVERNMENT OF BIHAR
AND ORISSA, REVENUE DEPARTMENT.

Dated Ranchi, the 18th September 1913.

SIR,

I HAVE the honour to submit the Second Annual Report of the Agricultural Department, Bihar and Orissa, for the year ending 30th June 1913, prepared in accordance with the instructions contained in the Government of India's letter No. 9-91-2, dated the 25th April 1911.

I have the honour to be,

SIR,

Your most obedient Servant,

G. MILNE,

Offg. Director of Agriculture, Bihar and Orissa.

[Maximum limit, 15 pages.]

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[Maximum limit, 15 pages.]

REPORT
OF THE
AGRICULTURAL DEPARTMENT,
BIHAR AND ORISSA,
FOR THE
YEAR ENDING THE 30th JUNE 1913.

CHAPTER I.

ADMINISTRATION.

Charge.—Mr. W. B. Heycock, I.C.S., was in charge of the Department from the 1st July 1912 to the 1st April 1913 when he made over charge to me and went on combined leave for seven and-a-half months.

Mr. G. Sherrard was Deputy Director of Agriculture throughout the year. He was in charge of all the five divisions of the province in addition to the several agricultural stations under the control of this department. Mr. E. J. Woodhouse, Principal of the Agricultural College and Economic Botanist, returned from leave on the 30th September 1912 and took over charge from Mr. C. S. Taylor, who had been acting for him as Principal. Mr. Taylor, Agricultural Chemist, was granted six months' combined leave with effect from the 8th April 1913. Babu Manmatha Nath Ghose, Assistant Professor of Chemistry and Physics, is in charge of his duties at Sabour and Mr. Sherrard is temporarily in charge of the well-boring operations. Mr. McGowan was Professor of Agriculture throughout the year. Babu Nagendra Nath Ray, Deputy Magistrate and Deputy Collector, continued to work as Personal Assistant to the Director of Agriculture.

2. *Staff.*—The proposals regarding the appointment of additional Deputy Directors and of District Instructors are now under the consideration of Government. There was no change in the field staff of the department consisting of five Divisional Inspectors, two Travelling Inspectors and a Superintendent of Well-Boring. A post of Assistant Agricultural Chemist was added to the College staff during the year and Mr. A. Viswanath Iyer of the Imperial Research Institute, Pusa, has been appointed to this post. During the year under report, Babu Indu Bhusan Chatterji, L. Ag. (Nagpur), one of the two students who were given post-graduate scholarships for further training at the Pusa Research Institute, has been appointed as Demonstrator in Chemistry and Physics and Babu Jamini Mohan Talukdar, B. Ag. of the Poona Agricultural College, as Demonstrator in Botany in the Sabour College. Two appointments of Fieldmen for Mycology and Entomology were created in place of the post of Demonstrator of Mycology previously held by Babu Pramatha Nath Bhattacharjee who resigned on the 12th May 1912. On the unfavourable report of the Agricultural Adviser to the Government of India upon the work of the other post-graduate scholar, his course of training was brought to an early close.

Babu Siva Das Banerji was in charge of the Bankipore Farm from 5th April 1906 till the end of November 1912 when he was dismissed on a charge of misappropriation of Government money. It was found that he had not brought to account all the crops raised on the Farm and had abused his position of trust as Farm Superintendent. The state of affairs disclosed by this case only emphasises the necessity of closer supervision which means an increase in the staff of Deputy Directors.

3. College.—The 3rd year class was formed in June last. Fourteen students out of 18 in the 2nd year class passed the Annual Examination and were promoted to the 3rd year class. A carefully considered scheme for the revision of the Diploma Course and for improvements in the organisation of the College is now before Government, but my final recommendations have not yet been submitted pending a conference with the Patna University Committee. The quarters of the two Assistant Professors and the Sub-Assistant Surgeon were completed during the year. Some additions and alterations in the other Assistant Professors' quarters were also completed. The building of additional quarters for subordinate staff is under contemplation. Owing to want of funds satisfactory progress has not been made with the laying out of the College grounds. A sum of Rs. 9,423 has been sanctioned for the work of grading, dressing and draining the grounds, but it is doubtful whether the Public Works Department will be able to spend the whole amount during the current financial year. It is hoped that in the coming year sufficient funds will be allotted to complete this work which must eventually be carried out, but which has been hanging fire for three years, while trees and ornamental shrubs that were collected for the beautification of the grounds have been spoiling in pots. The piecemeal fashion in which the work has hitherto had to be done through departmental agency has also been a drain on the Principal's time and on energies which could more profitably have been directed elsewhere.

In view of the resolution of the Bengal Provincial Agricultural Association passed at the meeting held in Calcutta on the 5th July 1912, it was decided, with the concurrence of this Government, that the whole of the cash balance, Rs. 7,234-4-8, at the credit of the Association at the time of the redistribution of Provincial boundaries, should be made over to this Province and that the entire library of the Association should be retained in Bengal. The question of starting a library for the Agricultural Association of this Province was discussed at the first meeting of the Provincial Agricultural Association, Bihar and Orissa, held at Bankipore on the 10th February 1913 and it was decided that this fund should be utilised for improving the Sabour College Library which would be used by the members of the Provincial Association. Steps are being taken by Mr. Woodhouse, Principal of the College, to collect a library of books of agricultural interest from England and other countries, a librarian has been appointed and a catalogue will shortly be circulated to all concerned.

4. Agricultural Stations.—Experimental work continued during the year in the four Agricultural Stations, *viz.*, Cuttack, Bankipore, Sabour and Dumraon, and in two small demonstration farms at Angul and Sambalpur. The work of standardising and proving the soil has also commenced at the Bettiah farm which was started last year at the expense of the Bettiah Raj. Sanction has already been accorded to the opening of an Agricultural Station at Ranchi and arrangements are being made for the acquisition of land, building the farmstead, etc., and procuring implements.

5. Fisheries.—Mr. T. Southwell was in charge of the Fishery Department of the Governments of Bengal and Bihar and Orissa. He is assisted by two superintendents trained in Europe and America, respectively, and a third subordinate officer has recently been recruited. It has been finally decided that the Directors of Agriculture in Bengal and in Bihar and Orissa shall jointly control the Fishery Department, that they shall draw up a detailed programme for the conduct of enquiries and that the work of the officers making these enquiries shall fall naturally under the control of the Director within whose jurisdiction the operations are being carried out. As regards expenditure it has been settled that the fishery charges in excess of the amount of Rs. 39,440, which was taken as the standard expenditure when the provincial settlement with the Government of Bengal was made, shall be divided equally between the two provinces and that the Government of Bengal shall meet the whole cost, the appropriate provincial adjustment being made through the Head—III Land Revenue. All bills are drawn in Calcutta where Mr. Southwell has his headquarters.

6. Tours.—During the year Mr. Heycock, the permanent Director, spent 135 days on tour and I was on tour for 16 days in April and May last. In the former month I attended the Sitamarhi cattle fair and in May I visited

Moniarah and Sepaya in company with Mr. Milligan, the Imperial Agriculturist at Pusa, and Mr. Quinlan, the Superintendent of the Civil Veterinary Department, in connection with the establishment of a sugarcane selecting station and a cattle-breeding farm in the district of Saran.

Mr. Sherrard, the Deputy Director, spent 123 days on tour during which he visited Agricultural stations at Dumraon and Cuttack 7 times each, Pusa and Ranchi 3 times each, Bettiah, Muzaffarpur and Gaya twice each and Calcutta, Monghyr, Hazaribagh, Chapra, Bihta and other places once. His tours were principally to inspect Agricultural stations, attend Agricultural Association meetings and visit Exhibitions. As usual the other officers of the Department also made occasional tours in connection with their work.

7. *Miscellaneous.*—It was decided that this Department shall issue a half-yearly Journal under the editorship of the Principal of the Sabour Agricultural College. The first number of the half-yearly Journal was published in July last.

8. On the 28th October 1912, I was appointed for six months as a special officer to make a general survey of the cattle question in this Province with a view to hold a cattle census thereafter and in preparation for a detailed survey of cattle district by district when suitable officers are available for such work. Preliminary enquiries were made on this matter up to the beginning of April when I took over charge of the Agricultural Department. An examination of the statistics of live-stock in the Province early convinced me of their unreliability and arrangements are now being made to take a census of live-stock through Panchayats and other village agencies. Only experience can show whether accurate returns can be obtained by the means proposed but it is certain that an advance will be made on the methods previously employed and that the figures furnished by Panchayats will form an interesting basis for comparison with the statistics supplied by the Settlement Department for various districts. The defect of the Settlement figures is that they are rarely complete for any given district and that they are ordinarily compiled in the cold weather when the great annual movement of cattle to Bengal is in progress. I should expect the figures reported by the village agency to show a considerably larger number of cattle than has hitherto been recorded.

CHAPTER II.

AGRICULTURAL EDUCATION.

9. *Agricultural College, Sabour.*—The first batch of students who entered the College in November 1910 formed the 2nd year class and after the annual examination held in March 1913, 14 out of 13 students were promoted to the 3rd year class. Of 9 students of the 1st year class all were promoted to the 2nd year except one student whose intelligence was obviously not sufficient to make it worth his while to continue. Forty-three applications were received for admission to the college in June 1913; only 6 joined the college of whom two were scholars from Assam and Kalimpong, respectively. The Assam scholar left shortly after joining as he objected to any manual labour and was not satisfied with his prospects. Two more students of the 1st year class withdrew and two of the 2nd year students who were not promoted to the 3rd year did not return at the beginning of the new Session. The total number of students on the roll on the 30th June 1913 was 27, 21 from Bengal and 6 from Bihar and Orissa of whom three belonged to the first, 10 to the second, and 14 to the 3rd year class.

10. The number of admissions to the college is steadily decreasing owing probably to the absence of prospects in Government Service or private employment as pointed out by Mr. Heycock in his last Annual Report. Mr. Woodhouse has submitted a scheme, proposing radical changes in the educational work of the Department and this is under consideration.

11. During the session 1912-13 and during the present session, Babu Promotho Nath Sen Gupta now a student of the 3rd year class has continued to hold the Hari Mohan Pran Mohan scholarship of Rs. 50 per annum to

which he was nominated. Two additional scholarships have been provided of which one scholarship is of the value of Rs. 40 per mensem and has been provided by the generosity of Mr. Maling Grant of Bhagalpur for the benefit of a boy from the St. Andrew's Colonial Homes, Kalimpong. This scholarship is now held by Richard Buckley. The second scholarship is of the value of Rs. 20 per month and is granted by Government to a student from Assam. The health and conduct of the students have been good. They continued to take great interest in games.

12. His Honour the Lieutenant-Governor inspected the College in February 1913. Some expert officers of the Imperial Department of Agriculture including Mr. Coventry, the Agricultural Adviser to the Government of India, visited the college during the year under report.

13. *Short Course.*—A short six-monthly course in practical agriculture was opened at Sabour in August, 1912, for the training of the sons of land owners and cultivators. The Presidents of the Divisional and District Agricultural Associations were requested to send students to this class. The response was not a very ready one and the total number of short term students was 11, of whom two left before completing the course. The instruction was for the most part of a practical nature but opportunity was taken to give them elementary lectures on plant-growth and live-stock. Steps are now being taken to induce these students to carry out small experiments and demonstrations in their own fields with a view to establishing a connecting link between the Department and the cultivator.

14. Arrangements were made in March last to put the short course on a more satisfactory footing. A prospectus was widely published through the District Agricultural Associations and in the leading newspapers offering a *bhadoi* and a *rabi* short course in Hindi, each lasting about 4 months together with a full year's English course. In June 1913, a new batch of 7 short term students was in residence at Sabour. There should be no real difficulty in finding cultivators and zamindars to attend the short term course. The course is free and no fees are charged. Free quarters are also provided for those who wish to live at Sabour. The students are expected to pay only for their personal expenses. The short course would, however, be more attractive to the cultivators if the cost of their travelling to and from Sabour and wages during the period of training were paid by Government as they can hardly afford to keep away from their fields for several months in the busiest season without any pecuniary help. Zamindars' sons need no assistance.

15. *Training of Cultivators at Experimental Stations.*—The practice of training sons of cultivators at the Experimental Stations was continued during the year. At Cuttack two student cultivators were in training during the year under report but none at Bankipore. These student cultivators receive free quarters at the Farms and are paid as Farm labourers at the ordinary rate. They are taught practical field work on the improved lines and the use of manures and implements. The system offers a very promising means of spreading a knowledge of recommended crops and improved methods of agriculture. But the District Agricultural Associations appear to find difficulty in inducing cultivators or sons of cultivators to take advantage of this privilege.

16. *Agricultural classes in Secondary Schools.*—The Agricultural Classes in the Gaya Zilla School and the Dumraon High School worked under the superintendence of a special teacher in agriculture, up to 31st December 1912 after which they were abolished as they were held to be of no practical value. The classes worked in these schools since March 1903 at an annual cost of Rs. 1,000 for each school. The boys of the first class appeared at the final examination held in December last and successful candidates were given certificates of proficiency by the Inspector of Schools, Patna Division.

17. *Nature study and the study of plant life in Primary Schools.*—The experiment which is being tried in Orissa to encourage nature study and the study of plant life in the Guru Training, Middle English and Primary Schools by the award of medals and diplomas to the Gurus and students from the funds

of this Department appears to be working satisfactorily, but it is still premature to attempt to say anything definite about the future. It is reported that activity is shown in almost all the schools in the Orissa Division as regards gardening and keeping of notes of lessons by the teachers and students. If the experiment proves successful it will be gradually extended to the other Divisions of the Province.

CHAPTER III.

RESEARCH AND EXPERIMENTS.

I.—AGRICULTURE.

18. *Agricultural Stations.*—During the year experimental work continued in the four agricultural stations, *viz.*, Bankipore, Sabour, Cuttack and Dumraon. A brief account of the work done at each of these stations is given in Appendix I. A detailed report on each station, containing the scientific record of the year, is being published separately.

19. *Sugarcane.*—The cultivation of sugarcane by the Planters in Bihar is steadily on the increase. The area cultivated during 1912-13 is 12,271 bighas against 11,526 bighas in 1911-12. The General Secretary of the Association reports that on the whole the season was a good one although, owing to climatic influences, the return of cane per acre was not what it should have been and the grower did not do as well as in the previous year but from the manufacturer's point of view the season was a better one as the return of sugar per ton of cane crushed was considerably more than in 1911-12. The current season's crop is most promising. At the request of the Director of Agriculture, Mr. Taylor, the Agricultural Chemist, carried out some comparative experiments with the Poona type of sugar boiling furnace and the local furnace. The results obtained appear to show a saving of about $1\frac{1}{2}$ tons of fuel per acre by the employment of Poona type of furnace. It is proposed to demonstrate the work of the Poona type of furnace at the important shows this year. The difficulty is, however, that the saving of fuel can only be effected by working on what is for the Bihar cultivator a rather large scale. The best results can probably only be obtained by a combination of cultivators, cutting, pressing and boiling together. This matter might usefully be brought to the notice of well-established Co-operative Societies.

20. *Wheats.*—With the object of spreading the cultivation of the Pusa wheats, arrangements are being made to establish several stations from two centres, *viz.*, one to be controlled from Bhagalpur by Mr. McGowan, Professor of Agriculture, the other to be controlled from Bankipore by Mr. Sherrard, Deputy Director of Agriculture. Seeds of different varieties of Pusa wheats will be supplied by Mr. Howard or from factories in Bihar, where pure Pusa varieties have been grown. Excluding the Pusa estate the area under Pusa wheats during the season 1913 was 1,081 acres in the Tirhut Division.

21. *Indigo.*—During the year there was no change in the staff of the Indigo research station at Sirsiah. The Advisory Committee, consisting of four practical planters, Messrs. Bergtheil, Parnell and the General Secretary to the Association, met five times during the year, the average attendance being 62 per cent.

22. In 1904 the Sirsiah Indigo research station was leased by the Planters' Association for the purpose of improving Mr. Rawsons' methods of manufacture. From 1909 the efforts of the Scientific Staff were directed to plant-selection with a view to the discovery of a plant containing a larger proportion of *indican* than is found in an ordinary mixed field of Java indigo. These latter experiments have not produced any practical results owing to the fact that a disastrous flood prevented progress and to the sudden appearance of a widely spread disease which largely diverted the attention of the experts employed in the discovery of a disease-resisting plant. Meanwhile the Planters' Association, finding themselves crippled by the contribution required for the maintenance of Sirsiah and the staff, decided, in the beginning of 1913, to continue the experiments no longer and advised Government to that effect.

In consultation with Mr. Coventry, Agricultural Adviser to the Government of India, it was finally decided to close the Sirsiah Station from 1st May 1913 and transfer the research work to Mr. Howard at Pusa under the supervision of the Agricultural Adviser to the Government of India. The total expenditure for the year was Rs. 63,141 of which Rs. 44,375 were contributed by Government an advance being made from the current year's allotment to pay off Mr. Bergtheil before the close of his agreement. Mr. Parnell obtained the post of Agricultural Chemist to the Government of Madras.

23. *Jute*.—Prices of jute ruling in Calcutta are not high enough to pay the Planters growing this crop on a large scale. They cultivate it only for their own requirements.

24. *Flax*.—Under his agreement, which has now expired, Mr. E. Vandekerkhove, the flax expert, arrived at Dooriah Factory, Muzaffarpur district, on the 19th of October 1912 and left for Europe on the 28th March 1913. The cost of his services and passage out and home was, as usual, equally shared by the Government of India and this Government. Mr. Vandekerkhove's report on the result of his work at Dooriah during the year, with an introductory note by the General Secretary, Bihar Planters' Association, is being published by the Agricultural Adviser to the Government of India in the form of a bulletin. A copy of this report will be submitted to Government separately.

25. *Crop-cutting Experiments*.—The report on the crop-cutting experiments conducted during the quinquennium beginning 1907-08 and ending 1911-12 for the Province of Bihar and Orissa was submitted to Government in December last. The results obtained could not be accepted for fixing the rates of outturn of the different crops as there were numerous inaccuracies in the district returns due to failure on the part of the officers in charge of the experiments to comply with the instructions. Government have issued a resolution on the subject and have requested the District Officers to see that crop-cutting experiments are conducted with greater care in future. District returns showing the results of crop-cutting experiments during the year under report have been received and compiled in this office. The number of experiments amounts to 532 as against 479 in the preceding year. The result will be incorporated in the next quinquennial report for 1912-13 to 1916-17.

2.—CHEMISTRY.

26. In addition to his duties of teaching Chemistry and Physics at the Sabour Agricultural College, Mr. C. S. Taylor, Agricultural Chemist, did some research work during the year. A series of experiments has been carried out on the influence of various manurial treatments on the period of ripening of sugarcane under Indian conditions. In co-operation with Mr. Woodhouse, Economic Botanist, Mr. Tarylor made a great many determinations of the woody matter of typical sugarcanes grown from single plant cultures of different varieties grown in the Province. This woody matter technically known as fibre is of great importance in the consideration of the milling properties of cane. Some interesting results have been obtained in these investigations which will be published separately. A new series of experiments has been commenced this year to determine the effect of the time of planting of sugarcane upon the time of its maturity. Plantings have been made monthly from the middle of November until the middle of March and observations on the state of maturity will be made during the current year. In co-operation with Mr. Sherrard, Deputy Director of Agriculture, the Agricultural Chemist has started investigations of the effect of different manurial treatments upon the rice crop at the Cuttack Farm and a series of manurial experiments outlined by him is also being carried out at the Sabour Farm by the Professor of Agriculture. A continuous series of observations has been taken of the rate of formation of nitrates in certain *char* lands, south of Sabour, as they gradually dry up. The results of these observations are not yet mature for publication. A permanent series of plots is now being laid down in co-operation with Mr. Woodhouse to determine the effect of different types of cropping upon the chemical characters of the soil. Analyses of soils and manures were also done, as usual, when required.

3.—BOTANY.

27. The Botanic Garden is now rapidly settling into its final shape. During the cold weather it was very bright with some 169 varieties of annuals which had been sent for by Mr. Woodhouse from England. The Morphological area was laid out and planted up and a new road was constructed in it in continuation of the farm central road. A number of blanks in the beds were also filled up. Masonry irrigation channels in the Botanic garden were constructed and a well in the Morphological area was commenced during the year. Some minor works, e.g., permanent pillars in place of wooden posts in the Botanic garden and a small tank in the plant house, were also constructed. These additions will add greatly to the amenity of the garden. During the hot weather special attention was paid to the improvement of the garden by the acquisition of desirable new plants and the re-arrangement of many of the least satisfactory shrubs and beds. The turfing down of the beds which were no longer required, the preparation of beds for the new plants, and the manuring of all the beds in the garden were completed by the end of June. A large quantity of nursery stock has still to be maintained pending the completion of the final grading of the college grounds. Much of this stock is now four years old and has cost the garden a great deal in watering, etc., while like most things in this country it has not improved with keeping. The routine work of the garden continued as usual.

28. The plant breeding work continued during the year but, owing chiefly to the press of college work, much could not be done to advance the position. The selected single plant cultures of Soy Beans (*Glycine hispida*) were carried on and a number of samples of seed from all over India were grown for field study. The oil and nitrogen contents of samples of all the cultures were determined by the Agricultural Chemist and some botanical observations were made by the Economic Botanist on the new types. As a result of their observations they recommend the Nepali variety for cultivation in the Himalayas, on account of its satisfactory yield and habit and on account of the excellent quality of the seed as regards size and oil content. A memoir on Soy Beans was published in March 1913. At present the new varieties obtained from other provinces are being studied and the question of obtaining an early variety of high oil content is being worked out. Mr. S. K. Basu made a detailed study of the distinguishing characters of the pure cultures of sugarcane. He is now occupied in comparing them with the observations made in previous years. Of the other crops grown in the Botanical experimental area in 1912 three hundred plots of the unit species of Italian millet (*Setaria italica*) previously isolated were carried on in pure culture and 35 types are being grown again during the current season. A thousand plots of pure cultures of *Phaseolus Spp.* were grown during 1912 in order that the Economic Botanist might study their habit and some other botanical points, but unfortunately a bad attack of Bihar Hairy caterpillar spoilt them for this purpose. Plots of other miscellaneous peas and beans and of *marua* (*Eleusine Coracana*) were also grown but work on them had to be discontinued.

29. In the Herbarium 145 specimens were added and the accumulation of material for the local flora was continued. An experiment on the best methods of seed storage is also being carried out.

4.—ENTOMOLOGY.

Crop Pests.

30. The bulk of the work was directed to combating two important pests and it is satisfactory to note that better results are obtained each year. Some three and-a-half lakhs worth of crop at Mokameh has been saved from *Agrotis ypsilon* and the seed potato trade of Patna has been preserved from extinction by the potato moth. A brief summary of the results of these two items of work is given below. Full details are being published in the Department's Agricultural Journal.

31. *Agrotis ypsilon*.—The Andres Maire traps obtained from Egypt being found satisfactory in the campaign of 1911 at Mokameh 24 traps were constructed locally and worked in 1912. These traps destroyed 152,622 parent

moths during the last season. The high lands were also systematically searched for the first brood of caterpillars and 107,439 caterpillars were destroyed during October 1912. As a result of these measures the crops on the Mokameh and Barhi *Tals* were completely saved, with the exception of a nominal attack of less than 100 bighas scattered over the whole area. The normally attacked area of 15,000 bighas has now been reduced to 100 bighas only. This year the campaign will be carried out with a large number of traps.

32. *Storage of potatoes.*—The work of demonstrating the advantages of storing potatoes under sand to avoid damage by the Potato Moth (*Phthorimoea operculella*, Zell.) was continued. The results of the potato storing demonstrations in Cuttack, Bhagalpur, Colgong, Sabour, Bettiah and Bihar were very promising so far as the insect pest was concerned, but in many places the *Rhizoctonia* disease caused very considerable damage to the stored tubers. No demonstration was carried out at Bankipore during the year as the Koiris of that place had learnt to appreciate the method of storing under sand so highly that 400 of them stored 16,000 maunds of potatoes without any effort on the part of the Agricultural Department. The area under this crop is also again on the increase. This year demonstrations have been started at Bhagalpur, Sabour, Colgong, Purnea, Bihar and Tunia (Bettiah) and the stored potatoes are doing very well.

At Tunia, Mr. Woodhouse has been dealing with the Potato Lace Bug (*Ricaredus*, Sp.), which is a serious stored-potato pest. The life history of this pest is being studied and methods of dealing with it devised.

33. A large number of insect pests were dealt with at Sabour on the farm and elsewhere by advice through correspondence. Details will be found in the Economic Botanist's Report which will be published separately.

Economic Insects.

34. *Eri silk.*—The rearing of Eri silk worms was not successful during the year as the disease Pebrine appeared several times and destroyed large broods. The abnormal weather conditions in April and May also interfered a great deal with the work. A number of people round Bhagalpur are being induced to try the eri silk industry.

5.—MYCOLOGY.

35. The bulk of the work done during the year was devoted to the potato crop. A very large number of diseased potatoes from the Department's godowns have been examined in the laboratory. Besides *Rhizoctonia* and *Bacteria*, which as in other years caused much damage to the stored tubers, there was the late blight of potato caused by *Phytophthora infestans* (the Irish potato disease). It caused great loss to the cultivators of Bhagalpur and is likely to have caused similar losses in other parts of the Province. An article on the late blight of potato and a leaflet on the same subject have been prepared by Mr. S. K. Basu for publication. In addition to this a wilt disease of paddy, green ear disease of Italian millet, wilt disease of Soy Bean and Cowpea, powdery mildew of peas, and *Rhizoctonia* on *Masur* plants, and a number of less important pests have been reported and examined.

36. The Department is much indebted to the Imperial Entomologist and Mycologist and to the other officers of the Agricultural Research Institute, Pusa, for the help they have rendered.

6.—FISHERIES.

37. Mr. Southwell, Deputy Director of Fisheries, continued to hold charge of the Fishery Department of both the Provinces of Bengal and Bihar and Orissa during the year under report. He was assisted by the two superintendents of fisheries, Messrs. Das and Mohsin. Sanction was accorded to the appointment of two extra fishery Assistants for one year and one of these posts was filled up by a qualified medical student. Mr. Southwell was on tour for 184 days and visited all the important fisheries in the two Provinces. Mr. Mohsin has made a fishery survey of the Patna District and Mr. Das completed a fishery survey in Ranchi town. A survey is now in progress relating to the distribution of *hilsa* in the Ganges, Jamuna, Brahmaputra and

other rivers and the intensity of its occurrence. The object is to define the limits of distribution and to publish this information in Map form. The intensity of distribution will give very valuable clues as to the places where the actual search for breeding grounds should be made. It is expected that the survey will be concluded in October next. The programme of work during the year provides chiefly for the study of carp and hilsa.

38. *Carp culture*.—In this Province we had four carp experiment stations, Angul, Siripur, Cuttack and Bankipore. In Angul, Mr. Taylor, the Deputy Commissioner conducted a series of experiments in carp culture under the advice of Mr. Southwell. Unfortunately he fell ill and the work was not completed. But it was proved conclusively that carp will breed in small *nullas* where there is a slight current. This observation was made in water receding from paddy fields and was of great value. The work at Siripur was commenced in March 1913 under the supervision of Mr. Mackenzie, the Superintendent of the Hathwa Raj Farm there. The results of this work will not be known till September next. About 18 brood fish which consisted of equal numbers of *catla* and *mirgal* were placed in the tanks at the Cuttack Farm. The *mirgals* bred extensively but the *catla* did not. The station had to be closed subsequently as all the brood fish died and the season was too far advanced for a fresh supply of brood fish. The work at Bankipore commenced very late in the season and no definite result was obtained.

39. *Hilsa culture*.—In September 1912 a *hilsa* hatchery was established at Monghyr. The object was to rear *hilsa* eggs to the fingerling stage and then to liberate them in the river. The success of the experiment at Monghyr depended on the existence of a breeding ground there or close by. It was believed that the breeding grounds were in the immediate vicinity. But this presumption was found to be incorrect as no ripe male *hilsa* was obtained and consequently the eggs could not be fertilised. The breeding grounds may exist higher up the river, but it seems certain that there are several breeding grounds in the Ganges alone and in all probability they change from time to time. Important results are expected on the completion of the survey now in progress relating to the distribution of *hilsa* in the Ganges and other great rivers in Lower Bengal. Work in this direction has made little progress owing to the delay in procuring a steam launch for the fishery expert's use.

40. *The foreshore fisheries of Orissa*.—In Balasore the fisheries include 15 miles of foreshore and the fishing rights belong to the Ordnance Department. These are now being worked, though not successfully, by a European lessee. Puri exports only a small quantity of fish, the real cause of which appears to be that the Telugu fishermen there are not dependent on fishing alone. It appears likely that no fish will be got regularly and in quantity in Puri until new men are introduced.

41. I visited the Chilka lake recently at Mr. Southwell's instance and in company with him and was struck with the suitable conditions it appears to afford for the development of an export trade in fresh fish. I have asked Mr. Southwell to continue his enquiries in this matter.

42. *Miscellaneous*.—The officers of the Fishery Department visited, and had exhibits displayed at, several of the important agricultural shows in the Province. They distributed pamphlets and leaflets in the vernacular relating to the rearing of fish and the curing of fish for export. They also gave actual demonstrations at several places in salting and smoking fish and the fishermen attending were taught methods of transport of fresh fish from place to place and the utilisation of waste products on a small scale as well as methods of tank culture. A number of miscellaneous enquiries were also made all over the province, with regard to which it may be mentioned that it appears that the fishermen exporting to Calcutta and other places are very much at the mercy of the station staff at certain centres. Bitter complaint was made to Mr. Southwell on more than one occasion of the blackmail that is levied; in default of prompt payment in money or in kind, consignments of fish are delayed, are stolen or at least broken into or lost on the railways. This matter merits the attention both of the Government and of the controlling authorities of the railways. I am prepared to adduce particular instances.

CHAPTER IV.

AGRICULTURAL ASSOCIATIONS, SHOWS AND AGRICULTURAL DEMONSTRATIONS CONDUCTED BY AGRICULTURAL ASSOCIATIONS, AND ON GOVERNMENT WARDS' AND PRIVATE ESTATES.

43. *Provincial Association.*—The formation of a Provincial Agricultural Association for the Province of Bihar and Orissa was sanctioned by Government in their Order No. 4267R(B)—IA-95, dated 26th September 1912, with 25 non-official members representative of every division and 6 official members. The first meeting of the Association was held at Bankipore on the 10th February 1913, in the District Board Meeting Room, under the presidency of the Hon'ble Mr. Maude, Member of the Board of Revenue.

44. *Divisional and District Agricultural Associations.*—The work of the Divisional and District Agricultural Associations has been re-organised to some extent by requiring them to follow some definite lines of demonstration recommended by the Department with a view to their introduction amongst the cultivators. The Associations are now following out some definite improvements and their programmes of work are criticised and approved by this department before they are undertaken. Most of the District Associations are wanting in activity owing to the want of proper guidance and supervision of their work as the Divisional Inspector attached to each Division has hitherto been the adviser of the Divisional Association, as well as of the District Associations. The question of appointing District Instructors for each District is under consideration. As usual each Divisional Association was allotted Rs. 1,000 and made grants therefrom to the District Associations. An entirely new scheme revising the relations of the District Associations with the Deputy Directors it is hoped to recruit from Europe has recently been approved by Government, but it will not be possible to bring it into full operation until these officers as well as the future District Instructors have been recruited and trained.

45. *Patna Division.*—As in the previous year this division did much useful work. Demonstrations with recommended seed and approved methods of cultivation were carried out. The two recommended varieties of fine paddy, *viz.*, *Badshahbhog* and *Dadkhani* have been largely introduced in the Division on account of their prolificness and the excellent quality of the rice. Owing to scanty rainfall in the months of September and October the demonstrations were not very successful excepting in those places where there were facilities for irrigation. In some cases local varieties which were grown under similar conditions for comparison gave a better gross outturn but in calculating the money value of the outturn the demonstrations were considered successful. The method of transplanting one or two seedlings per hole at 9 inches apart against the ordinary method of transplantation of a number of seedlings per hole was demonstrated by some members of the Association. Though on account of the bad season the outturns obtained by them were not uniformly good, it is reported that this system is decidedly better than the ordinary one under normal conditions. My own view is that the matter has not been fully threshed out. An attempt was made during the year to grow Pusa wheat in the division. Wherever this variety was grown the neighbouring cultivators are said to have appreciated it on account of its better outturn and bigger size of grain. The cultivation of the crop is being extended. The demonstrations of storage of potatoes under sand were continued.

Groundnut has been introduced in the Gaya district specially in the Nawada subdivision. The cultivators there have taken to its cultivation as they find it profitable to grow this crop on poor sandy soil. The year under report was, however, particularly unfavourable to the crop owing to drought, but wherever the crop was watered and weeded thoroughly a good outturn was obtained.

46. *Tirhut Division.*—This Association also has done much good work. A Museum and a Library have been established at Muzaffarpur under the Association in a building lent by the Mahtha Estate. The Department contributed Rs. 500 towards the cost. The proposal to construct a permanent building for the Association, to house the Agricultural Museum and Library,

a seed-store, the "Tirhut Exhibition" office and the Co-operative Central Bank Office, is under the consideration of the Association and the department is considering whether it can usefully contribute to this scheme. The Association has done much in supplying information to agriculturists, has supplied them with the best seeds from the departmental farms as well as with manures and implements. The utility of green manuring is being more and more appreciated every year and *dhaincha* and sun-hemp are more commonly used by the members and cultivators. The improved Meston plough is also being more widely adopted by the cultivators. The members in general use this plough for their own cultivation and lend them to cultivators. During the year under report some four dozen ploughs were supplied to the ordinary cultivators, some on loan and some on cash payment. The crops demonstrated were paddy, maize, wheat and potato. The paddy crop is reported to have been a failure owing to drought. The result of maize, wheat and potato demonstrations was also not very satisfactory. The improved Pusa wheat is being tried by most of the members and new crops, *viz.*, ground-nut and Kabuli gram are receiving attention. A co-operative Bank was started at Muzaffarpur during the year under report. About Rs. 35,000 have already been lent to 7 societies comprising about a thousand cultivators for the purchase of bullocks and implements for cultivation and for the contingent expenses. The prospects of agriculture are reported to be decidedly promising in this Division, as the Indigo Planters who hold in lease much good agricultural land in this division are keenly interested in scientific methods of agriculture.

47. *Bhagalpur Division.*—The Kajra farm in Monghyr, which was presented by Raja Kamleshwari Prashad Singh of Monghyr to the Divisional Agricultural Association for demonstration purposes for the benefit of the cultivators of that locality, continued to do some useful work under the supervision of the Divisional Agricultural Inspector. The land is chiefly paddy-growing and has facilities for irrigation. The principal improvement demonstrated on the Farm is the economy of paddy seedlings. Demonstrations were made on the Farm with fine varieties of paddy, *viz.*, *Dadkhani*, *Bhadshahbhog* and *Tulsiphul*, and the transplantation of one or two paddy seedlings per hole was also demonstrated. Although the results are admitted not to have been very satisfactory owing to the *unfavourable season*, yet the cultivators in the neighbourhood of the farm are said to have appreciated and adopted the method. The application of saltpetre to paddy and the use of *dhaincha* and sun-hemp for green manure have given good results. Muzaffarnagar wheat and Kabuli gram have also been taken up in and around Kajra near the farm by a number of raiyats. The method of storing potato under sand is being steadily encouraged and good results are reported to have been obtained wherever the method has been tried. The *Khari* sugarcane introduced by the Subdivisional Officer of Banka in the district of Bhagalpur is also said to have done well.

48. *Orissa Division.*—As in the previous year a very successful meeting of the Divisional Association was held at the Experimental Farm at Cuttack which was largely attended by members and cultivators from the interior. The several improvements on local practice which have resulted in a large outturn of crops on the Farm were explained to the members and the cultivators present. The District Associations, with the exception of Angul and Sambalpur, undertook the work of demonstration through their members as there are no farms at their disposal. Angul and Sambalpur have each got a farm of their own and besides the members of the Associations, who are mostly cultivators, are said to take a lively interest in the demonstration work. The Angul Farm maintains several bulls for breeding purposes. The report from the Puri District Association is disappointing as the members do not seem to have taken any practical interest in agricultural improvements. It is understood however that the reorganisation of this Association is in hand and that a public spirited local zamindar has made the Association the offer of a suitable piece of land for a demonstration and seed farm. The District Associations generally distribute seeds to selected cultivators and the Divisional Association purchased and distributed through its Inspector seeds of groundnuts, *dhaincha*, paddy of different varieties and jute to selected cultivators.

The crops demonstrated in the Division were *dhaincha* for green manuring, different varieties of paddy, groundnut, sugarcane, jute and potato. The storage of potatoes under sand was also demonstrated. The sugarcane under the "Trench and furrow system" at Sambalpur farm gave the best results and the system is reported to have made a decided impression on the cultivators of the locality.

The Divisional Commissioner remarks that progress in introducing improved methods of agriculture in Orissa has so far been very slow on account of the conservative spirit of the cultivator and the lack of practical interest in the past on the part of many members of the Associations.

49. *Chota Nagpur Division*.—The Associations in this division made demonstrations with paddy, maize, ground-nut and potatoes. Among the varieties of paddy the cultivation of *Badshahog* and *Dadkhani*, the two finer varieties, was carried out by a good number of members and cultivators, but in most cases the crop was a poor one as in the case of other varieties owing to the cessation of the rains during August and September. The method of thin transplantation of paddy seedlings was adopted by some of the members and cultivators, and it is reported that this process is not becoming popular in Hazaribagh, where the women labourers are not used to this and much time and money is required at a time when it is difficult for the cultivators both to find labourers and cash. The cultivation of Nainital potato is said to have considerably increased and to have been taken up by the cultivators having facilities for irrigation. The sand storage of potatoes and the advantage of green manure with *dhaincha* were also demonstrated.

50. It is impossible to give a complete list of those who have done useful work in connection with Agricultural Associations, but amongst them the following members deserve special mention. Rai Harihar Prasad Singh Bahadur of Dumraon, Rai Purnendu Narayan Singh Bahadur of Bankipore, The Hon'ble Kumar Siva Nandan Prasad Singh of Monghyr, Rai Nishi Kant Sen Bahadur of Purnea, Mr. A. T. Christian of Bangaon and Babu Jnanendra Mohan Dutt of Muzaffarpur, Mr. A. L. Turnbull of Saran and the Hon'ble Maharaja Baikuntha Nath Dey of Balasore. Numbers of the Bihar planters are also in direct touch with the officers of the Agricultural Research Institute of Pusa on more points than one. The Hon'ble Mr. D. J. Reid of Belsand, Mr. Danby of Dholi, Mr. C. MacDonald of Daulatpur are among the most prominent.

51. *Agricultural Shows and Fairs*.—Exhibition work continued to receive the attention of the department. Mr. G. Sherrard, Deputy Director of Agriculture, Bihar and Orissa, was in charge. Circle Exhibits were prepared at Sahour under the supervision of the Professor of Agriculture and were sent to the different agricultural shows in charge of different officers of the department. Each Circle Exhibit consisted of all the chief crops, manures and implements recommended by the department, as also Entomological exhibits, diagrams, etc. The number of agricultural and cattle shows attended in the province was fourteen. This year the Bihar Industrial and Agricultural Exhibition was held at Bankipore on a large scale and this department made a grant-in-aid of Rs. 1,000. Circle Exhibits were sent to the fourteen exhibitions mentioned in the Appendix II against nine of the last year. The Circle Exhibits of the department were a prominent feature among the other exhibits and are said to be greatly appreciated. Practical demonstrations of agricultural implements and lectures on agricultural subjects were given by the officers in charge of Circle Exhibits. Magic lantern lectures were also given by Divisional Agricultural Inspectors at almost all the Exhibitions and these attracted considerable attention. They will be discontinued until a fresh set of slides can be prepared. A Fishery exhibit was also sent to several shows by the Deputy Director of Fisheries, and the proper method of salting and smoking fish was shown. Grants-in-aid amounting to Rs. 5,000 were made to these shows.

52. The Director of Agriculture and the Deputy Director of Agriculture personally attended several of the Exhibitions. A brief account of each show is given in Appendix II.

CHAPTER V.

AGRICULTURAL ENGINEERING AND WELL-BORING.

53. There is no Agricultural Engineer in the Province as yet. The well-boring operations were continued during the year by the Superintendent of Well-boring under the control of Mr. C. S. Taylor, the Agricultural Chemist, and of Mr. G. Sherrard, Deputy Director of Agriculture, during the absence on leave of Mr. Taylor. As in the last year the operations were mainly confined to the districts of Patna, Shahabad and Gaya. In all 132 borings were made during the year, *viz.*, 55 in Patna, 42 in Shahabad and 35 in Gaya, against 64 borings in the previous year. All the borings in the Patna district were successful and it is interesting to note that out of the 55 wells bored in this district, 47 belong to *bonâ-fide* cultivators, while five belong to zamindars, two were done for the Archæological Department, and one for the Bankipore Farm. The wells were greatly improved by the borings as some of them have been supplying four times as much water as formerly. Of the 42 borings undertaken in Shahabad springs were discovered in 36 wells and 6 resulted in failure. In one well at Buxar failure was due to the presence of black cotton soil lying at a depth of 165 feet from the surface of the ground, which filled up the bore-hole. The remaining five wells were taken up at the request of the owners with a view to improve them. But, when after boring 30 to 50 feet it was found that a thick layer of fine sand existed below the clay, the borings were abandoned. Out of the 42 wells in Shahabad, 28 belong to *bonâ-fide* cultivators, eight belong to zamindars, two to Buxar Municipality, two to Bhabua Local Board, one to the Public Works Department, and one was a trial boring. Great improvement has taken place in the water-supply of the Buxar Municipality, where wells used to go dry every year before the borings were undertaken. Of the 35 wells bored in Gaya, two ended in failure, four were abandoned on account of hard strata and the remainder proved successful. The failure was due to the refractory nature of the soil after the depth of 29 to 35 feet. Out of these 35 wells fourteen belong to *bonâ-fide* cultivators, nineteen belong to zamindars and two to Government Estates. Two borings are in progress in the Bhagalpur district at the Sultanganj distillery. During the year the Superintendent visited Purnea at the request of the proprietor of the Banaili Raj who wanted to introduce the system of boring wells in his estate.

The total length of bore-holes made during the year was 7,483 lineal feet against 3,606 in the preceding year. A certain length of pipe is left in each well to obviate the choking of the bore by fine sand. Taking the cost of the pipe at Re. 1-3-0 or 1-5-0 per foot the statistics of borings in the Patna Division for 1912-13 show that the average cost of casing pipe left in each well bored was Rs. 17-8-0 in Patna, Rs. 19-3-0 in Gaya and Rs. 21-6-0 in Shahabad. The total cost incurred in these operations during the year was Rs. 5,721 against Rs. 5,283 in the previous year.

54. So far as outturn of work is concerned the past year has been a success as with the same staff more than double the number of wells has been bored. However, from the maps of the districts of the Patna Division which I have had prepared to show the location of the wells dealt with since 1907-1908, it appeared that the principles laid down in the Government Resolution creating the well-boring section have been lost sight of. It was not intended that this section should remain permanently in the Patna Division but that it should experiment to see where in these districts wells could be bored with advantage to the agriculturist both for irrigation and for water-supply. The idea was that if these experiments proved the feasibility of obtaining a larger water-supply by boring, the work in the Patna Division together with an analysis of the experience gained by the Government Well-Boring section would be handed over to the District Boards concerned for prosecution on a largely extended scale. Government has been separately addressed on this subject, and I understand that my proposals to make over well-boring in this Division to the local authorities for prosecution on a larger scale with a definite programme have been accepted and that the same principle is to be applied in North Bihar.

CHAPTER VI.

PUBLICATION OF AGRICULTURAL INFORMATION AND SUPPLY OF SEEDS,
MANURES AND IMPLEMENTS.

55. Besides the crop forecasts, weather and crop reports and returns of prices and of rainfall and frontier and rail and riverborne trade, the following publications were issued during the year under report :—

- (1) Annual Reports of Agricultural stations.
- (2) Agricultural Statistics for 1911-12.
- (3) Season and Crop Report for 1912-13.
- (4) Report on the crop-cutting experiments conducted during the quinquennial years 1907-08 to 1911-12.
- (5) Some Notes on Cestodes (tape worm) and other Parasites in Indian Fish (by Mr. T. Southwell, Deputy Director of Fisheries, Bengal and Bihar and Orissa).
- (6) Notes on the Fish Fauna of certain tanks in Bengal (by the Deputy Director of Fisheries).

56. The College staff, also, published or prepared for publication in the Agricultural Journals of India and of Bihar and Orissa certain papers on the following subjects :—

- (1) Surface Caterpillar on *Tal* lands (2nd Report) by E. J. Woodhouse and H. L. Dutt (Bihar and Orissa Agri. Journal, Vol. I, No. 1).
- (2) The Fungus Disease of Plants by S. K. Basu (Bihar and Orissa Agri. Journal, Vol. I, No. 1).
- (3) The varieties of Soy Beans found in Bengal, Bihar and Orissa and their commercial possibilities by E. J. Woodhouse and C. S. Taylor (Memoir of the Department of Agriculture in India, Bot. Series, Vol. V, No. 3).
- (4) Potato Moth in Bengal by E. J. Woodhouse (Agri. Journal, India, Vol. VII, Part III).
- (5) The Caterpillar Pest of the Mokameh *Tal* lands by E. J. Woodhouse and T. Bainbrigge Fletcher (Agri. Journal, India, Vol. VII, Part IV).
- (6) Notes on Eri silk worm, Lac insects by H. L. Dutt (Bihar and Orissa, Agri. Journal, Vol. I, No. 1).
- (7) Supplementary leaflets to leaflet No. 1 on 1912 on Potato Moth by H. L. Dutt.
- (8) Leaflet No. 2 of 1913 on Potato Moth, both Vernacular and English, by E. J. Woodhouse.
- (9) Leaflet No. 1 of 1913, Surface Caterpillar at Mokameh, by E. J. Woodhouse.

57. *Supply of seeds, manures and implements.*—As no central seed store has been established in this Province yet, seeds, etc., recommended by this Department were supplied from the different agricultural stations under the supervision of the Deputy Director of Agriculture.

58. During the year under report 415 maunds of seeds and a large number of paddy seedlings 4,922 whole canes and 10 maunds of sugarcane, 100 sets of cassava cuttings and 100 plantain tubers, $4\frac{1}{4}$ maunds of manure (castor cake), 2 chain pumps, 8 Meston ploughs and 12 shares of Meston ploughs were supplied from the several farms under the supervision of the Deputy Director of Agriculture, Bihar and Orissa. No seed potatoes were supplied by this Department during the year.

CHAPTER VII.

MISCELLANEOUS.

59. *Arboriculture*.—Arboricultural work under District Boards in the province continued to receive attention. With a view to fixing the minimum expenditure which each District Board should spend on arboriculture annually during the next 10 years the opinions of the District Boards and of Commissioners of Divisions have been ascertained and proposals have been submitted to Government in accordance with paragraph 4 of the Manual of Arboriculture to fix the minimum annual expenditure to be incurred by each District Board in consideration of the need of the district. This matter is now under the consideration of Government. In view of the fact that roads and bridges are as yet far from completed, no great extension of roadside arboriculture was deemed desirable. During the year under report the expenditure incurred by District Boards on planting out trees, nurseries, gabions, etc., and the receipt from sale of trees, fruits, etc., were Rs. 43,633 and Rs. 11,238 respectively.

60. The class for the training of Overseers, Sub-Overseers and other subordinates of District Boards in arboriculture was held from the 12th August to the 12th September 1912 at the Sibpur Botanical Garden as usual. The Superintendent reports that 6 Sub-Overseers and one Road Mohurrir from seven districts attended the class. District Boards will be asked to take advantage more extensively than in the past of the opportunity extended to them in these classes to train a percentage of their subordinate staff in arboriculture.

61. *Rainfall Stations*.—There are at present 258 rainfall stations in this Province including Nettarehat, which was established in June last. Returns from these stations are received and compiled in this office and rainfall statistics are regularly published in the *Government Gazette of Bihar and Orissa* as usual. These stations are occasionally inspected by District officers, Subdivisional Officers and Civil Surgeons. From the inspection reports received in this office it appears that only 26 stations were inspected during the year. It is probable that more stations had actually been inspected but no reports were sent to this office. The attention of District Officers has been invited to this matter.

62. *Agricultural Implements*.—Appendix III shows the useful agricultural implements reported to have been tried in this Province during the year. The people in general appreciate the advantages of iron sugarcane mills and evaporating pans, Meston ploughs and Hindustan ploughs. During the year some four dozen Meston ploughs were supplied by the Divisional Association to cultivators either on loan or sale.

63. The expenditure on miscellaneous experiments and enquiries during the year ending 30th June 1913 other than those carried out in Agricultural Stations was Rs. 75,585. This includes contributions to research work done on special crops, *e.g.*, indigo and flax (Rs. 47,125), the financing of Agricultural Associations and their establishment (Rs. 15,368), distribution of Agricultural literature (Rs. 805), the pay of the supernumerary expert staff (Rs. 4,981) and miscellaneous expenditure in connection with the financing of agricultural and cattle show and the representation of the department at these (Rs. 6,697).

64. *Merits of Officers*.—Mr. Woodhouse continued to do excellent work as Economic Botanist and Principal of the Sabour College. His campaigns against the potato moth and the agrotis pest on the Mokameh Tal were both crowned with success. Mr. Taylor, in addition to his professorial work, was engaged particularly on research work on soy beans and on sugarcane; and the greatly increased outturn of work shown by the well-boring section may be partly attributed to the attention paid to that department. Mr. Sherrard, since October 1912, has been struggling with the difficulties involved in the management of a number of scattered farms, all of which were distinctly below a proper standard of cultivation when he took over charge. An improvement is already noticeable. Mr. McGowan has been learning his work at Sabour and is doing well, although I consider that he was much handicapped by want of a period

of training at Pusa, preliminary to taking up his duties. The officers at Sabour commend all the men subordinate to them and Mr. Woodhouse specially mentions Mr. H. L. Dutt, Mr. D. N. Pal and Babu A. P. Choudhury in connection with the work done on potato moth and agrotis. No remarks of consequence are recorded on the work of the Divisional Inspectors, but I am inclined to think that with closer supervision they would do well enough. The weakest point in the staff is undoubtedly the lowest grade of officers, *i.e.*, the Superintendents of Farms and the Overseers of the same. But I am glad to record that the man obtained from Pusa and employed at the Bankipore Farm is doing well. I have not seen the Superintendent of the Cuttack Farm who has been on leave, but was more favourably impressed with this station than with any of the others. I have pleasure also in endorsing my predecessor's remarks regarding Babu N. N. Ray, my Personal Assistant.

APPENDIX I.

Agricultural Stations 1912-13.

Dumraon.—The Dumraon Agricultural Experimental Station is on land provided by the Dumraon Raj which meets all expenses. The area of the farm is about 30 acres, of which 22 acres are under cultivation.

The total cost of the farm for the financial year from April 1st, 1912 to March 31st 1913, was Rs. 2,355-2-11. The amount deposited into the treasury was Rs. 629-4-9.

The season was an unfavourable one, and the majority of the experiments failed. From the experiments carried out it would appear that a dressing (1) of 50 maunds of cowdung per acre, and (2) of 34 maunds of cowdung + 3.75 maunds of castor-cake are very profitable manures for rice alone, and also that they produce a considerable increase in the *rabi* crop grown after the rice; the former manure giving a better result than double the quantity of cowdung. [In making these manurial experiments the well-known "law of diminishing returns" appears to have been neglected.—G. M.] It would also appear that green manure either with *dhaincha* or sun-hemp gives an increased yield both to rice and to the following *rabi* crop—these manures requiring very little initial outlay.

A demonstration outside the farm to show the advantage of manuring sugarcane was successful.

The details of these and other experiments are given in the farm annual report.

Bankipore.—The Bankipore Agricultural Experimental Station comprises about 210 acres, of which 180 acres are under cultivation.

The total cost of the farm for the financial year from April 1st 1912 to March 31st 1913, was Rs. 10,746-7-4. The amount paid into the treasury was Rs. 4,640-1-6.

The year was a very unfavourable one and the manurial and most of the other experiments failed. The conclusions arrived at as to the manuring of rice in this tract are given in last year's annual report. From experiments carried out this year, it would appear that the advantage of transplanting a less number of rice seedlings than that usually transplanted by the local cultivator is not dependent upon the time of transplanting. [I do not consider that any definite conclusions have been reached on this subject.—G. M.]

The details of these and other experiments are given in the farm annual report. This farm is both very expensive in cost of labour owing to its proximity to Bankipore, is on a bad site, is bad in shape and liable to periodical flooding, which vitiates the experiments undertaken, while though irrigated from the canal, the canal authorities are not at all times able to supply water when called upon, as the farm is at the far end of the canal system. The abandonment of much the greater portion of this farm is therefore contemplated. A new farm will be selected for South Bihar during the coming cold weather, and much of the existing farm-steading removed to the new site.

Cuttack.—The Cuttack Agricultural Experimental Station comprises about 120 acres, of which 20 acres are taken up by tanks.

The total cost of the farm for the financial year from April 1st, 1912, to March 31st, 1913, was Rs. 6,297-1-2. The amount deposited into the treasury was Rs. 4,656-13-9.

From the experiments carried out during the year under report it would appear (1) that 50 maunds of cowdung per acre is a more profitable manure than the same quantity of village *khatta*, the local manure; (2) that green manure (*dhaincha*) is a cheap and profitable manure for rice; (3) that it is better to transplant two or four rather than eight rice seedlings in a place [It must be recollected that the farm is under irrigation.—G. M.] and (4) that a smaller seed rate than that locally sown can be used for broad-cast rice. Jute and rice in rotation on the same land gave a very profitable outturn.

Demonstrations outside the farm (1) for the introduction of sugarcane, (2) for the introduction of new varieties of rice, (3) to show the value of green manure for rice, and (4) to show the advantages of an economy of seedlings, were successful.

* The details of these and other experiments are given in the farm annual report.

Sabour.—The Agricultural Station at Sabour comprises an area of about 300 acres, of which about 150 acres are under cultivation, the rest of the area being occupied by the College, with the Botanical garden and other grounds, the residences of officers and the farm buildings.

In addition to the experimental work carried out by the staff the farm provides for a practical course of instruction for the College Students, and during the season under report a short separate course of practical agriculture was given for the benefit of *bond-fide* cultivators and zamindars.

The College gives the farm an annual grant of Rs. 1,200 for maintaining the College Dairy herd, and the Dairy produce is sold to the students and staff. The expenditure for the year amounted to Rs. 583-1-3 excluding a sum of about Rs. 1,150 which was spent on the

construction of a brick floor to the Dairy shed. The total receipts amounted to Rs. 1,188-2-6. The cattle are Montgomeries obtained from the Pusa herd and some of them are really good milkers. The strain is being kept pure and the herd will be gradually increased to meet the growing requirements of the staff and the hostel.

Miscellaneous improvements comprised (a) the erection of a sluice gate, (b) the consolidation of the Western Road, (c) the strengthening of the tank *bandhs* and (d) the construction of the stone floor to the Dairy shed.

The total cost of the farm for the financial year was Rs. 13,902-3-5 and the receipts amounted to Rs. 3,645-9-6. This latter figure does not set forth the receipts correctly as produce to the value of Rs. 5,000 has been kept in stock this season as a beginning, for a Provincial Seed Store.

The following conclusions appeared to be justified :—(1) The Punjab and Rajah ploughs by inverting the soil and going deeper in, increase the yield while reducing the cost of cultivation; (2) Green manuring with *dhatncha* increases the outturn of wheat, barley, mustard and both fine and coarse varieties of paddy. Green manuring with sun-hemp also increases the yield of paddy; (3) Pusa wheat Nos. 7, 8 and 12 give a better outturn than the local variety; (4) Ensilage can be prepared from *Jowar* in 10 feet deep pits during the monsoon season for consumption in spring when fodder is scarce.

APPENDIX II.

Agricultural Shows and Fairs.

Serial No.	Names of Fairs.	Officers of the Department who attended the Agricultural Show.	Demonstrations held by the Department.	Remarks.
1	2	3	4	5
1	Bihar Industrial and Agricultural Exhibition, Bankipore. Grant-in-aid, Rs. 1,000.	Messrs. Heycock, Sherrard, Woodhouse, Southwell, Dutt and Babus A. P. Choudhuri and K. M. Ghosh.	A departmental circle exhibit was sent to the exhibition. The use of chaff-cutter, maize-sheller, sugarcane crushing mill, chain-pump, the process of <i>gur</i> -making and the efficiency of the improved ploughs were explained with practical demonstration. The proper method of salting and smoking fish was shown.	This year the exhibition was held on a much larger scale. The duration of the exhibition was 4 days and about 1,500 visitors attended the exhibition each day. Lectures on insect-pests with special reference to the insect-pest of the Mokameh Tal and potato moth illustrated with magic lantern pictures were given by the Assistant Professor of Entomology and the Divisional Inspector gave lectures on general agriculture with magic lantern show. This exhibition is the largest and one of the best in the Province. His Honour the Lieutenant-Governor opened the exhibition. The President of the Exhibition Committee, the Hon'ble Mr. Oldham, takes a keen personal interest in the getting up of the exhibition as also the Secretary, Rai Purnendu Narayan Singh Bahadur.
2	Bihar Agricultural and Industrial and Cattle Show, district Patna. Grant-in-aid Rs. 300.	Babu N. C. Choudhuri	Demonstrations of the working of a number of Agricultural implements were arranged and a practical demonstration of <i>gur</i> -making was shown. The working of the well-boring machine was also explained in detail.	The Agricultural exhibits were 278 against 290 and the Industrial exhibits were 687 against 416 of the last show. The entries of cattle were less than last year owing to bad weather. A sum of Rs. 140 was allotted for Agricultural exhibits. The existence and success of the show is largely due to the efforts of Rai Sahib Debi Lal, the Honorary Secretary. His exertions were recently recognised by Government in the grant of the above Title.
3	Tirhut Exhibition, Muzaffarpur. Grant-in-aid, Rs. 500.	Mr. Heycock and Babus K. M. Ghosh and S. Dutt.	Practical Agricultural demonstrations of improved implements and <i>gur</i> production and samples of improved seeds manures and implements were exhibited by the Pusa Agricultural Institute, Manager of Dholi Factory, Messrs. Arthur Butler and Co. and the Department of Agriculture, Bihar and Orissa.	The exhibition was opened by His Honour the Lieutenant-Governor. The exhibition contained agricultural, bovine, poultry, horticultural, industrial and miscellaneous sections, and all the sections were very well represented. Free tickets were issued to the cultivators and they were encouraged to come and see the practical demonstrations.

APPENDIX II—continued.

Serial No.	Names of Fairs.	Officers of the Department who attended the Agricultural Show.	Demonstrations held by the Department.	Remarks.
1	2	3	4	5
4	Sitambarhi Agricultural and Industrial Exhibition and Cattle Show, district Muzaffarpur. Grant-in-aid Rs. 800.	Mr. Milne and Babus K. M. Ghosh and S. Dutt.	A departmental exhibit was sent and magic lantern lectures on agricultural subjects were given.	The exhibition was held on the 17th and 18th April 1913. The cattle show was held on the first day and the agricultural show on the second. The local exhibits were very poor indeed and the show does not arouse any interest. It has been suggested by the Department that attention be concentrated on the cattle show only, and the departmental grant will be henceforth restricted to that section.
5	Barahpur Agricultural Exhibition and Cattle Show, Shahabad. Grant Rs. 200.	Mr. Milne and Babus A. P. Choudhuri and Suchit Singh.	Departmental exhibits were shown and lectures illustrated with magic lantern slides were given. The Travelling Inspector demonstrated to the people the process of sugar boiling by improved methods, the use of wheel chaff-cutters and chain-pumps.	A sum of Rs. 384 was spent in awarding prizes for cattle, ponies and the agricultural exhibits. Some recommended implements and seeds were sold by the Department. The number of bullocks produced was very disappointing; and those that did come up were not the best in the fair. The local cows from Gaighat on the other hand were excellent. Prizes for ponies should be discontinued, since none are locally bred and the gift of prize-money serves no useful end.
6	Singheswar Agricultural and Industrial Exhibition, Bhagalpur. Grant-in-aid, Rs. 800.	Mr. Edmunds and Babu K. M. Ghosh.	A departmental exhibit was sent and magic lantern demonstrations were given which were well attended. The process of <i>gur</i> -making and water-pumping was also very carefully explained by actual demonstration.	The agricultural and industrial exhibits were numerous and good. The agricultural section was well represented. The noticeable feature was a number of paddy samples said to be grown by improved methods. Special prizes were awarded for paddy. A ploughing match with the Meston plough was arranged at which the prizes consisted of 3 Meston ploughs and a sum of Rs. 25. Mr. Dixon, the Collector of Bhagalpur, made a gift of Rs. 50 for prizes for agricultural exhibits. A large number of cultivators came to see the show.
7	Bausi Exhibition Bhagalpur. Grant-in-aid, Rs. 100.	Ditto ditto ...	A departmental exhibit was sent and magic lantern demonstrations were given.	The Agricultural exhibits formed the most important feature of the exhibition. These consisted of a number of items of fine paddy and scented paddy, Khari, sugarcane and crops grown by improved methods or with pure seeds. Six Meston ploughs were distributed as rewards as well as some pure seeds recommended by the department in addition to money-prizes and medals.
8	Purnea City Mela, Purnea. Grant-in-aid, Rs. 50.	Mr. Edmunds, Babu K. M. Ghosh and Babu N. C. Choudhuri.	Exhibition of departmental exhibits and the demonstrations by magic lantern lectures.	The encouraging feature of the show was the exhibition of the varieties of paddy recommended by the Department. The samples of jute, <i>gur</i> and vegetables were remarkably good. The prizes given away were encouraging.
9	Khagra Agricultural and Industrial and Cattle Show, District Purnea Grant-in-aid, Rs. 800.	Messrs. Milne and Edmunds and Babus K. M. Ghosh and P. N. Das.	A departmental exhibit was sent and lantern lectures were given which were very well attended.	Besides the usual demonstrations by the Agricultural Department a ploughing match was arranged and two Meston ploughs and a sum of Rs. 15 in cash were given away in prizes. The number of local exhibits in both Agricultural and Industrial sections were reported to be much less than last year.

construction of a brick floor to the Dairy shed. The total receipts amounted to Rs. 1,188-2-6. The cattle are Montgomeries obtained from the Pusa herd and some of them are really good milkers. The strain is being kept pure and the herd will be gradually increased to meet the growing requirements of the staff and the hostel.

Miscellaneous improvements comprised (a) the erection of a sluice gate, (b) the consolidation of the Western Road, (c) the strengthening of the tank *bandhs* and (d) the construction of the stone floor to the Dairy shed.

The total cost of the farm for the financial year was Rs. 13,902-3-5 and the receipts amounted to Rs. 3,645-9-6. This latter figure does not set forth the receipts correctly as produce to the value of Rs. 5,000 has been kept in stock this season as a beginning, for a Provincial Seed Store.

The following conclusions appeared to be justified :—(1) The Punjab and Rajah ploughs by inverting the soil and going deeper in, increase the yield while reducing the cost of cultivation; (2) Green manuring with *dhaincha* increases the outturn of wheat, barley, mustard and both fine and coarse varieties of paddy. Green manuring with sun-hemp also increases the yield of paddy; (3) Pusa wheat Nos. 7, 8 and 12 give a better outturn than the local variety; (4) Ensilage can be prepared from *Jowar* in 10 feet deep pits during the monsoon season for consumption in spring when fodder is scarce.

APPENDIX II.

Agricultural Shows and Fairs.

Serial No.	Names of Fairs.	Officers of the Department who attended the Agricultural Show.	Demonstrations held by the Department.	Remarks.
1	2	3	4	5
1	Bihar Industrial and Agricultural Exhibition, Bankipore. Grant-in-aid, Rs. 1,000.	Messrs. Heycock, Sherrard, Woodhouse, Southwell, Dutt and Babus A. P. Choudhuri and K. M. Ghosh.	A departmental circle exhibit was sent to the exhibition. The use of chaff-cutter, maize-sheller, sugarcane crushing mill, chain-pump, the process of <i>gur</i> -making and the efficiency of the improved ploughs were explained with practical demonstration. The proper method of salting and smoking fish was shown.	This year the exhibition was held on a much larger scale. The duration of the exhibition was 4 days and about 1,500 visitors attended the exhibition each day. Lectures on insect-pests with special reference to the insect-pest of the Mokameh Tal and potato moth illustrated with magic lantern pictures were given by the Assistant Professor of Entomology and the Divisional Inspector gave lectures on general agriculture with magic lantern show. This exhibition is the largest and one of the best in the Province. His Honour the Lieutenant-Governor opened the exhibition. The President of the Exhibition Committee, the Hon'ble Mr. Oldham, takes a keen personal interest in the getting up of the exhibition as also the Secretary, Rai Purnendu Narayan Singh Bahadur.
2	Bihar Agricultural and Industrial Show, district Patna. Grant-in-aid Rs. 300.	Babu N. C. Choudhuri	Demonstrations of the working of a number of Agricultural implements were arranged and a practical demonstration of <i>gur</i> -making was shown. The working of the well-boring machine was also explained in detail.	The Agricultural exhibits were 278 against 290 and the Industrial exhibits were 687 against 415 of the last show. The entries of cattle were less than last year owing to bad weather. A sum of Rs. 140 was allotted for Agricultural exhibits. The existence and success of the show is largely due to the efforts of Rai Sahib Debi Lal, the Honorary Secretary. His exertions were recently recognised by Government in the grant of the above Title.
3	Tirhut Exhibition, Muzaffarpur. Grant-in-aid, Rs. 500.	Mr. Heycock and Babus K. M. Ghosh and S. Dutt.	Practical Agricultural demonstrations of improved implements and <i>gur</i> production and samples of improved seeds manures and implements were exhibited by the Pusa Agricultural Institute, Manager of Dholi Factory, Messrs. Arthur Butler and Co. and the Department of Agriculture, Bihar and Orissa.	The exhibition was opened by His Honour the Lieutenant-Governor. The exhibition contained agricultural, bovine, poultry, horticultural, industrial and miscellaneous sections, and all the sections were very well represented. Free tickets were issued to the cultivators and they were encouraged to come and see the practical demonstrations.

APPENDIX II—continued.

Serial No.	Names of Fairs.	Officers of the Department who attended the Agricultural Show.	Demonstrations held by the Department.	Remarks.
1	2	3	4	5
4	Sitamahi Agricultural and Industrial Exhibition and Cattle Show, district Muzaffarpur. Grant-in-aid Rs. 300.	Mr. Milne and Babus K. M. Ghosh and S. Dutt.	A departmental exhibit was sent and magic lantern lectures on agricultural subjects were given.	The exhibition was held on the 17th and 18th April 1913. The cattle show was held on the first day and the agricultural show on the second. The local exhibits were very poor indeed and the show does not arouse any interest. It has been suggested by the Department that attention be concentrated on the cattle show only, and the departmental grant will be henceforth restricted to that section.
5	Barahpur Agricultural Exhibition and Cattle Show, Shahabad. Grant Rs. 200.	Mr. Milne and Babus A. P. Choudhuri and Suchit Singh.	Departmental exhibits were shown and lectures illustrated with magic lantern slides were given. The Travelling Inspector demonstrated to the people the process of sugar boiling by improved methods, the use of wheel chaff-cutters and chain-pumps.	A sum of Rs. 384 was spent in awarding prizes for cattle, ponies and the agricultural exhibits. Some recommended implements and seeds were sold by the Department. The number of bullocks produced was very disappointing; and those that did come up were not the best in the fair. The local cows from Gaighat on the other hand were excellent. Prizes for ponies should be discontinued, since none are locally bred and the gift of prize-money serves no useful end.
6	Singheswar Agricultural and Industrial Exhibition, Bhagalpur. Grant-in-aid, Rs. 300.	Mr. Edmunds and Babu K. M. Ghosh.	A departmental exhibit was sent and magic lantern demonstrations were given which were well attended. The process of <i>gur</i> -making and water-pumping was also very carefully explained by actual demonstration.	The agricultural and industrial exhibits were numerous and good. The agricultural section was well represented. The noticeable feature was a number of paddy samples said to be grown by improved methods. Special prizes were awarded for paddy. A ploughing match with the Meston plough was arranged at which the prizes consisted of 8 Meston ploughs and a sum of Rs. 25. Mr. Dixon, the Collector of Bhagalpur, made a gift of Rs. 50 for prizes for agricultural exhibits. A large number of cultivators came to see the show.
7	Bansi Exhibition Bhagalpur. Grant-in-aid, Rs. 100.	Ditto ditto ...	A departmental exhibit was sent and magic lantern demonstrations were given.	The Agricultural exhibits formed the most important feature of the exhibition. These consisted of a number of items of fine paddy and scented paddy, Khari, sugarcane and crops grown by improved methods or with pure seeds. Six Meston ploughs were distributed as rewards as well as some pure seeds recommended by the department in addition to money-prizes and medals.
8	Purnea City Mela, Purnea. Grant-in-aid, Rs. 50.	Mr. Edmunds, Babu K. M. Ghosh and Babu N. C. Choudhuri.	Exhibition of departmental exhibits and the demonstrations by magic lantern lectures.	The encouraging feature of the show was the exhibition of the varieties of paddy recommended by the Department. The samples of jute, <i>gur</i> and vegetables were remarkably good. The prizes given away were encouraging.
9	Khagra Agricultural and Industrial and Cattle Show, District Purnea. Grant-in-aid, Rs. 300.	Messrs. Milne and Edmunds and Babus K. M. Ghosh and P. N. Das.	A departmental exhibit was sent and lantern lectures were given which were very well attended.	Besides the usual demonstrations by the Agricultural Department a ploughing match was arranged and two Meston ploughs and a sum of Rs. 15 in cash were given away in prizes. The number of local exhibits in both Agricultural and Industrial sections were reported to be much less than last year.

APPENDIX II—concluded.

Serial No.	Names of Fairs.	Officers of the Department who attended the Agricultural Show.	Demonstrations held by the Department.	Remarks.
1	2	3	4	5
10	Dumka Agricultural Exhibition, Santal Parganas. Grant-in-aid, Rs. 300.	Mr. Edmunds	A departmental exhibit was sent. Practical demonstrations with all the improved agricultural implements were given, <i>Gur</i> -making was also shown. Magic lantern lectures were given which were very well attended.	This is one of the most useful exhibitions in the Bhagalpur Division and it is the only one held in the Santal Parganas. The exhibits were first rate samples. Marked improvement is observed in the cultivation of <i>Burki</i> cotton. Several orders for implements and seeds were booked by the department.
11	Sambalpur Agricultural and Industrial Exhibition, Sambalpur. Grant-in-aid, Rs. 300.	Messrs. Southwell, Rout and Babu N. C. Choudhuri.	A departmental exhibit was sent. The workings of a number of agricultural implements, including the method of <i>gur</i> -making were explained. Actual demonstration regarding the preservation of fish by smoking was given.	The agriculture exhibits comprised all the varieties of agricultural products available in the district. It is reported that the agricultural section was most attractive of all the sections. Under paddy there were five varieties introduced of Badshahbhog, Dedkhami, Samudrabali and C. P. Ana. Among oilseeds the groundnut, the cultivation of which is being strenuously extended in the district through the members of the District Agricultural Association, formed a good collection. The vegetable section showed a decided improvement.
12	Hazaribagh Agricultural and Cattle Show, Hazaribagh. Grant-in-aid, Rs. 600.	Mr. Heycock and Babus P. C. Mustafa and N. C. Choudhuri.	Demonstrations with agricultural implements were carried out and improved process of manufacturing <i>gur</i> from canes was also shown. The demonstrations attracted attention of all the cultivators.	The show was a great advance on its predecessors and is growing in popularity. There was a great increase in all branches of exhibits. The specimens of agricultural produce, garden vegetables, etc., were good. There was an increase in the number of prizes. The Secretary, Babu D. N. Mukerji, the Jail and Reformatory authorities and Major Stevens rendered valuable service during the exhibition.
13	Chaibassa Agricultural and Industrial Exhibition, Singhbhum. Grant-in-aid, Rs. 250.	Messrs. Heycock, Milne, and Babus N. C. Choudhuri and P. C. Mustafa.	A departmental exhibit was sent and a lantern lecture was given.	A large number of exhibits mostly agricultural, such as paddy, rice and other kinds of grain, etc., arrived this year. The exhibition was attended by a very large number of persons from different parts of the district. It is reported that the exhibition is growing in popularity. It wants, however, a great deal of attention to make it really useful; the cattle were exceedingly poor and few in number.
14	Ranchi Agricultural and Industrial Exhibition and Cattle Show, Ranchi. Grant-in-aid, Rs. 600.	Messrs. Heycock, Sherrard and Babus N. C. Choudhuri and P. C. Mustafa.	Exhibition of the departmental exhibit, <i>gur</i> -making and some practical demonstrations of agricultural implements were given which were largely attended by the cultivators.	This exhibition was held under the auspices of the District Agricultural Association. The exhibits received in some classes were not so numerous as in the previous year. Among grains, varieties of fine rice and paddy were exhibited. The collection of maize, <i>wrid kurthi</i> and <i>gundli</i> were good. The potatoes, both English and country, were very fine and exhibited in large quantities, showing marked improvement in the cultivation of the crop. Some special prizes were awarded to encourage the cultivators.

APPENDIX III.

*A list of Agricultural Implements and Machines tested in-Bihar and Orissa,
to have met*

No.	Designation of implements.	Use.	Special Advantage	Price.
1	2	3	4	5
				Rs. as.
1	Chaff-cutting machine ...	Chaffing fodder ...	Much superior to the local <i>garasi</i> .	75 0
2	Steam Chaff-cutting machine	Ditto ...	Cuts fodder fine and of even length.	300 0
3	Bannerjee's sugarcane crushing mill.	Pressing juice from sugarcane.	Effective. Juice can be extracted in a short time with less labour and expense.	65 0 to 75 0
4	Behia sugarcane mill ...	Crushing sugarcane ...	Only one crushing of cane is necessary.	90 0 to 200 0
5	Sugarcane boiling iron pan ...	Manufacturing molasses ...	A large quantity of juice can be boiled at one time and scum removed easily.	90 0
6	Hindustan plough ...	Ploughing ...	More effective than country plough.	10 0 to 14 0
7	Meston plough ...	Do. ...	Ditto ditto ...	4 8 to 6 12
8	Pallian ...	For pulverizing subsoil ...	Breaks subsoil where it is left untouched by <i>dehadi</i> plough.	10 0
9	Planet junior Hand Hoe ...	Hoeing ...	Useful in making ridges ...	15 8 to 40 11
10	Maize Huller ...	Separating grain from cobs	Saves a good deal of manual labour.	4 8 to 25 0
11	Chain-pump ...	Lifting water ...	It has a lift of 15 feet ...	60 0
12	Centrifugal pump ...	Ditto ...	.....	Not known
13	Winnowing machine (Cabbet's patent).	Separating dust and small chaff from grain.	Very useful machine in absence of wind.	125 0
14	Steam thresher ..	Threshing wheat, oats, etc.	Very efficient in threshing and cleaning.	3,200 0

DIX III.

during the year ending 30th June 1913, and of those in use which are reported with success.

Where procurable.	Name and designation of reporting officers.	Opinion.	Extent to which used by cultivators.
6	7	8	9
Messrs. T. E. Thomson & Co., Calcutta.	Superintendent, Dumraon Farm; Subdivisional Officer, Madhipura.	Useful and effective ...	.....
Ditto ditto ...	Superintendent, Siripur Farm, Hathwa Raj.	Most suitable machine for large agricultural and cattle farms.	Not used by cultivators.
Babu Ram Narayan Banerjee, Howrah.	Superintendent, Dumraon Farm, and Secretary, District Agricultural Association, Sambalpur.	Worked by bullock power and is strong and durable.	Used by several members of the District Agricultural Association, Sambalpur.
Messrs. Thomson and Mylne, Behia, Shahabad.	Superintendent, Siripur Farm, Deputy Commissioner of Angul and Subdivisional Officer, Khurda.	Very useful and appreciated by cultivators.	Largely used by cultivators.
Ditto ditto ...	Ditto ditto ...	Ditto ditto ...	.....
Messrs. W. Leslie & Co., Calcutta.	Superintendent, Dumraon Farm; Manager, Bettiah Raj; Manager, Mujhoul Concern; Deputy Commissioner, Santal Parganas and Angul; Secretary, District Agricultural Association, Sambalpur.	It is a very strong and durable plough and can be used for deep and shallow ploughing in all kinds of soil. Broad and deep furrows are made by this plough.	Used in places in the district of Shahabad and Sambalpur.
Messrs. T. Thomson & Co., and W. Leslie & Co., Calcutta, Messrs. Burn & Co., Howrah, Subdivisional Officer, Madhipura; Tahsildar, Khurda.	Superintendent, Dumraon Farm; Manager, Bettiah Raj; Manager, Sursand Estate; Subdivisional Officers of Kendrapara, Jajpur, and Banki.	It is a very light and handy plough and can be used in all soils except in heavy clay loam. It has a mould board, which turns a good deal of earth upside down, making the field easy after two or three ploughings.	Appreciated by cultivators as well as by members of Agricultural Associations.
Superintendent, Siripur Farm, Hathwa Raj.	Superintendent, Siripur Farm, Hathwa Raj.	Strong and useful ...	Not used by native cultivators.
Messrs. T. E. Thomson & Co., Calcutta.	Superintendent, Dumraon Farm, and Deputy Commissioner of Angul.	Useful and effective ...	Used in the Demonstration Farms of Dumraon and Angul.
Superintendent, Seed Store, Bengal, Sibpur, Howrah.	Superintendent, Subdivisional Officer, Madhipura; Zamindar, Barasambhar Estate, Sambalpur.	Very strong and durable and can be worked for many years if properly used. Should be useful in tobacco lands in Darbhanga.	Used by farmers in places in Sambalpur and on the College farm for garden plots.
Messrs. Burn & Co. ...	Superintendent, Dumraon Farm; Subdivisional Officer, Madhipura; Deputy Commissioner, Santal Parganas.	One-fifth of an acre of land can be irrigated in a day by two men.	.....
Messrs. Jossop & Co. ...	Superintendent, Siripur Farm, Hathwa Raj.	Can lift water for about 10 acres of land in a day.	Rarely used by native cultivators.
Ditto ditto ...	Ditto ditto ...	An efficient and strong machine, cleans 200 maunds of grain in 8 hours.	Ditto ditto.
Messrs. Ben Reid & Co., Aberdeen.	Ditto ditto ...	Can be well recommended for a large farm.	Not used by native cultivators.

*A list of Agricultural Implements and Machines tested in Bihar and Orissa,
to have met*

No.	Designation of implements.	Use.	Special Advantages.	Price.
1	2	3	4	5
16	Albion Reaping Machine ...	For cutting out wheat and barley.	Chief advantage is cheapness and rapidity in cutting.	Ra. rs. 450 0
16	Corn crusher ...	Crushing grain for feed ...	Economical and labour-saving machine.	126 0
17	Donaldson's Oil Mill ...	Crushing mustard ...	Gives 5 per cent. more oil than that obtained from wooden <i>kaihu</i> .	120 0
18	Oil-cake crusher ...	Crushing oil-cake for feed : can be worked by hand or steam power.	Very useful in crushing cake into small fragments. The advantage is cheapness and rapidity in crushing.	90 0
19	Eclair Vaporizer ...	Spraying insecticides ...	.....	75 0
20	Straw baling press ...	Baling straw ...	Saving in storage room and railway freight.	2,000 0

DIX III—concluded.

during the year ending 30th June 1913, and of those in use which are reported with success.

Where procurable.	Name and designation of reporting officer.	Opinion.	Extent to which used by cultivators.
6	7	8	9
Messrs. Marshall & Sons, Calcutta.	Superintendent, Siripur Farm, Hathwa Raj.	Cuts about 10 acres of land in a day. A large farm should not be without it. Two pairs of bullocks and three men are required at one time to manage the implement.	Not used by native cultivators.
Messrs. Jessop & Co., Calcutta.	Ditto ditto ...	Very useful and suitable machine.	Ditto ditto.
Ditto ditto ...	Ditto ditto ...	Cannot be recommended for local oil men, being expensive and too heavy for hand power.	Ditto ditto.
Messrs. T. E. Thomson & Co., Calcutta.	Ditto ditto ...	A cattle-breeding and agricultural farm where a large number of animals are kept should not be without it.	.....
Ditto ditto ...	Ditto ditto ...	Very useful machine for applying solution to diseased plants.	Not used by native cultivators.
Messrs. Marshall & Sons, Calcutta.	Superintendent and Manager, Metibari Concern.	The machine has certain advantages, but it must be worked on a big scale to get full benefit and advantages.	Used in factories in Bihar.

33—R.T.
No. _____
I-A—189

GOVERNMENT OF BIHAR AND ORISSA
REVENUE DEPARTMENT.
RESOLUTION.

Dated Ranchi, the 4th December 1913.

READ—

The report on the working of the Agricultural Department in Bihar and Orissa for the year ending the 30th June 1913, by the Director of Agriculture.

The report was received more than six weeks after the due date. Care should be taken to submit it punctually in future years.

2. *Administration and Staff.*—Mr. W. B. Heycock was in charge of the Department till the 1st of April 1913, when he availed himself of combined leave for 7 months and a half, being succeeded by Mr. G. Milne by whom the present report has been submitted. Mr. C. S. Taylor, Agricultural Chemist, acted as Principal of the Agricultural College for six months during the absence on leave of the permanent incumbent, Mr. E. J. Woodhouse, who returned to duty on the 31st September 1912. Mr. G. C. Sherrard held charge of the office of Deputy Director throughout the year and directed the agricultural work of the five Divisions, including the several experimental stations of the province, a task which has proved beyond the powers of a single officer to perform satisfactorily. A scheme for the reorganisation of the Department, which involves among other features the much needed strengthening of the staff by the addition of two more Deputy Directors and an Assistant Director, has been engaging the attention of the Local Government since the constitution of the province and is now ready for submission to the Government of India.

3. *Agricultural Stations.*—No new station was opened during the year. Arrangements have, however, been made to open an experimental farm at Ranchi for the study of the agricultural problems of the Chota Nagpur Division, and steps have already been taken to acquire the requisite site and to construct the necessary buildings. Proposals for the establishment of a Sugarcane selecting station combined with a Cattle-breeding farm at Sipaya in North Bihar are also under the consideration of Government, and negotiations have been concluded for the leasing of the selected land. The whole scheme, in the elaboration of which the Lieutenant-Governor in Council desires gratefully to acknowledge the help which he has received from the Agricultural Adviser to the Government of India, has already been placed before the Imperial Government. Experimental work in the existing stations was continued during the year with varying success. The inadequacy of the existing agency for supervising the scattered farms has militated against their efficiency as educative media, though some useful work in the demonstration of improved methods of agriculture has, it is believed, been accomplished.

4. *Agricultural Education.*—The curriculum of the Agricultural College at Sabaur has received much attention during the year and the local Government are also much indebted for the advice of the committee, presided over by Mr. R. Nathan, C.S.I., C.I.E., which considered the subject in connection with the suggested affiliation of the college with the new Patna University. It was decided that the question of affiliation must be dropped for the present and that action on the further recommendations of the Committee should be postponed till the whole subject of agricultural education has been considered in all its aspects by the Board of Agriculture which meets at Coimbatore this month.

The diminishing number of admissions to the college is a matter which is receiving careful attention. At the inauguration of the diploma course a considerable amount of misapprehension existed in the minds of the public with regard to the objects and aims of the training, and His Honour in Council found

it necessary to repeat the pronouncement made by Sir Andrew Fraser at the opening of the college that the attainment of a diploma was not to be regarded as a passport to employment in Government service. It is too early to say what effect the reorganisation of the Agricultural Department and the changes that are under contemplation in the educational work of the college may have on its popularity.

A short six-monthly course in practical Agriculture for the training of the sons of land-owners and cultivators, which was opened during the year, was joined by only 11 students. The Director of Agriculture is of opinion that further attractions should be offered to cultivators by defraying the cost of their journeys to and from Sabaur and allowing them compensation for loss of wages during the period of training. The point will be considered when the general working of the college is reviewed in the light of the conclusions reached at Coimbatore.

5. *Research and Experiments.*—A considerable amount of investigation and experiment was done in the departments of Chemistry, Botany, Entomology, and Mycology, and some useful results were obtained. His Honour in Council attaches particular importance to the investigation which is being carried on with regard to the cultivation of sugarcane, for which, it is believed, the northern districts of the province present great natural facilities and which may to a large extent take the place formerly occupied by the cultivation of indigo.

The indigo research station which was established in 1904 and was conducted under the direction of Mr. C. J. Bergthell and Mr. F. R. Parnell was finally closed during the year owing to the inability of the Planters' Association to continue their contribution towards its upkeep, and the research work was transferred, with the concurrence of the Government of India, to Pusa where it has been placed under the direction of Mr. A. Howard, the Imperial Economic Botanist. The agreement made by the Bihar Planters' Association with the Belgium flax expert, Mr. Vanderkerkhove, expired during the year and Government await the receipt of his report on the result of his work. The most fruitful results in the Entomological branch were obtained by Mr. E. J. Woodhouse and his assistants, whose campaign against the *Agrotis* moth on the Mokameh *Tal* lands advanced a further stage. Considerable praise is due to Mr. Woodhouse for the systematic and careful way in which this work has been conducted. The value of the crop saved by these operations is estimated at nearly 3½ lakhs of rupees.

6. *Fisheries.*—Fishery operations continue to be carried on jointly with those of the Government of Bengal under the supervision of the Deputy Director of Fisheries, Mr. T. Southwell. The work of this branch consisted mainly in the study of carp and *hilsa* culture and led to the collection of some useful information. It is expected that results of increasing importance will be obtained when the survey of the Ganges and other large rivers which is now in progress with a view to ascertaining the distribution of *hilsa* is completed. Preliminary reports received regarding the possibilities of developing an export trade in fresh fish from the Chilka Lake give rise to the belief that there may be a considerable future for such an industry, and the Lieutenant-Governor in Council awaits with interest the result of further investigations.

7. *Agricultural Associations, Fairs, and Shows.*—The working of the Divisional and District Associations throughout the province came under investigation during the year in connection with the enquiry made into the necessity for increasing the existing staff of the Department. The result was to show that, while the Divisional Associations served no useful purpose the District Associations suffered from inadequate professional supervision. Under the new scheme of reorganization the former will cease to exist and an Inspector will be attached to each of the latter. The District Association will work under the control of a Deputy Director of Agriculture and at the head of these unofficial bodies will be the Provincial Association which was constituted in September 1912 and inaugurated at a meeting held at Bankipore on the 10th February 1913.

Mr. G. C. Sherrard was in charge of exhibitions and fairs. Fourteen Agricultural and Cattle shows were held in different parts of the province during the year under review, receiving grants from Government aggregating Rs. 5,000. The Bihar Industrial and Agricultural Exhibition was held at Bankipore on a larger scale than in former years and was aided by a Government grant of Rs. 1,000.

8. *Agricultural Engineering and Well-boring.*—Well-boring operations were under the general control of Mr. C. S. Taylor. Altogether 132 borings were made during the year against 64 in the previous year. The results obtained in the limited areas over which the work was carried on were distinctly satisfactory. The work has now successfully passed the experimental stage and the question of its prosecution by local bodies in all parts of the province is being considered by Government.

9. *Publication of Agricultural information.*—As in the previous year, the Agricultural Department published a number of reports and notes and gave wide publication to leaflets in English and the vernacular languages.

10. *Miscellaneous.*—Arboriculture under District Boards continued to receive attention, and proposals made by the Director of Agriculture to fix a minimum of expenditure to be incurred by each District Board on planting and maintaining road-side trees have been approved by Government.

11. The Lieutenant-Governor in Council desires to acknowledge the good work that has been done by Messrs. Heycock and Milne in the administration of the Department as now constituted and the services of the official and non-official gentlemen whose work has received commendation in paragraphs 64 and 50 of the Director's report. He is convinced, however, that the constitution of the Department is seriously defective, and that it can never hope to attain the objects of its existence until it has been materially strengthened both in its superior and its subordinate branches. The progress of research and experiment which must be conducted by the professional experts of the Department, and from which alone can be worked out the improved methods to be communicated to the cultivating classes, is hampered by the employment of the same experts on administrative duties; and at the same time the channel of communication with the public is so restricted that the Department is unable to get into touch with the agricultural community. With an increased staff these difficulties will be diminished, and the Lieutenant-Governor in Council hopes that the Department will be able to work in unison with the Co-operative Department for their common object, the uplifting of the agricultural masses.

ORDER.—Ordered that this Resolution be published in the *Bihar and Orissa Gazette*, and that a copy of it, with a copy of the report, be submitted to the Government of India.

By order of the Lieutenant-Governor of Bihar and Orissa in Council,

H. McPHERSON,

Secretary to Government.

34—R.T.

MEMO. No. _____

I-A—189

Dated Ranchi, the 4th December 1913.

Copy forwarded to the Director of Agriculture, Bihar and Orissa, for information.

By order of the Lieutenant-Governor of Bihar and Orissa in Council,

J. C. B. DRAKE,

Under-Secretary.

4

MEMO. No. 35—R.T.
I-A—189

Dated Ranchi, the 4th December 1913.

Copy, with a copy of the report, forwarded to the ^{Appointment} Education Department
or information. _{Municipal}

By order of the Lieutenant-Governor of Bihar and Orissa in Council,

J. C. B. DRAKE,
Under-Secretary.

[The maximum limit of the body of the Report is 12 pages.]

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From T. LISTER, Esq., I.C.S., Secretary to the Development Commissioner, Burma, to the Revenue Secretary to the Government of Burma,—No. 184—8R.—18, dated the 18th October 1921.

I am directed to submit the Annual Report on the working of the Department of Agriculture, Burma, for the year ending the 30th June 1921.

2. The operations of the Department have again been limited by the shortage of officers, the absence of officers on leave, the transfer of Mr. Warth to Pusa, and the resignation of Mr. Thompstone, who severed his connection with the department after having served in it for 14 years. A year ago it was hoped that four Deputy Directors and two professors would be recruited in the year under report, but actually only two Deputy Directors have been recruited. There are, however, grounds for believing that a large number of superior officers will be recruited this year, and that the stultifying effect of an inadequate number of officers to cope with the many and varied agricultural problems which require investigation will be removed.

3. The sanction of the Secretary of State to the reorganisation of the Agricultural Department was received in the year under report. The scheme contemplates the division of the province into 11 agricultural circles and 44 agricultural districts. A member of the Imperial Agricultural Service will be in charge of each circle and a member of the Provincial Agricultural Service will assist him generally. An experimental and demonstration farm will be located at or near the headquarters of each circle, and one or more seed farms in each agricultural district. Members of the Upper Division of the Subordinate Agricultural Service will be in charge of these farms. They will be assisted by two members of the Subordinate Agricultural Service, Lower Division, and two fieldmen.

For the College there will be a staff of six Imperial officers, eight Provincial officers, and 23 members of the Subordinate Agricultural Service.

Time will be required to recruit all these officers. At present it is necessary to depute candidates for the Upper Subordinate Agricultural Service to Poona for training. This procedure will not be necessary when the College is opened at Mandalay, and it will be possible to accelerate the rate of recruitment.

4. Substantial progress has been made in the building of the College. Many necessary ancillary buildings have been completed, and, since the termination of the year under Report, the foundation stone of the main College building has been laid by His Honour the Lieutenant-Governor.

5. Valuable work has been done in the investigation of the Prussic Acid content of Burma beans. The enquiry was instituted as the beans generally were earning an undesirable reputation for a high percentage of this dangerous substance, and the prospects of extending the demand for this possibly important and profitable crop were being jeopardised. The experiments have been directed to the selection of types containing a low Prussic Acid content, and to the investigation of the changes which occur in that content consequent on storage. As regards the first line of investigation useful results have been achieved, though, as with paddy, the evolution of pure strains will prove a slow and tedious process. In view of the slowness of the process, the uncertainty as to whether it will be possible to fix permanently a strain of beans free from Prussic Acid and the dangers of reversion to type when the improved crop is extensively cultivated, the Development Commissioner inclines to the view that the efforts of the department might perhaps be more profitably employed in looking for a bean free from suspicion to take the place commercially of *Pebyugale*.

6. During the year an organised campaign has been started with a view to dealing with the problem of the extermination or control of the *Bedabin* or water-hyacinth. The operations are of two kinds. The first, which may be called mechanical, are directed to the control of the pest by the booming of rivers and creeks so as to collect the weed in large masses and dispose of it by getting it

into the stream by which channel it drifts to the sea. The second line of attack, which may be called scientific, consists in an attempt to discover a non-poisonous spray which can be economically used and which will kill the plant. Incidentally the theory that the water-hyacinth dies when it reaches salt water is being investigated and the degree of salinity necessary to effect this result is being examined. Little is known as to the way in which the plant is reproduced and the attention of the Botanist is being directed to its life history and method of propagation. In Mr. MacKenna's opinion this is one of the most serious problems which affect the economic development of the country and it is hoped that some method of dealing with the difficulty may result from the experiments now being carried on.

7. The Development Commissioner regrets that owing to the scarcity of officers and the impossibility of getting from elsewhere a suitable man at a suitable fee it has been found necessary to postpone the survey of the areas suitable for cocoanut plantations. As soon, however, as it is possible to post a Deputy Director to the Arakan Division he will be specially directed to take up this problem and, if necessary, proposals will be submitted for the deputation of this officer to visit Madras and Ceylon where much work on the crop has been done. Mr. MacKenna adheres to the view that as a commercial proposition the crop must be taken up on capitalistic lines although, no doubt, as in the past, it will continue also to be dealt with in small gardens or plantations. The establishment of capitalistic concerns with machinery to deal with the crop will give the small grower an outlet for his produce for which at present it is sometimes difficult to get a satisfactory market.

8. A Provincial Cotton Committee has been created, the functions of which are to advise the Local Government on any particular questions of cotton policy which are referred to it; to recommend such measures as may appear suitable for safeguarding the existing areas of long staple cotton; to watch the trend of cotton development; to advise on legislation; to assist in trade classification; to collect reliable statistics and to disseminate information regarding cotton matters.

9. Interest in sugar cane has continued during the year both amongst capitalists and amongst small holders. For the latter the jaggery market provides a suitable and profitable outlet and the attention of the Department has been devoted to the evolution and distribution of improved crushers and boilers. With the capitalist the manufacture of white sugar is the main object and, if the schemes at present under consideration materialise, the Province should be in a very satisfactory position as regards the manufacture of this necessary article of diet. The report of the Indian Sugar Committee, which has just been published, contains specific recommendations with reference to Burma which will be carefully examined and necessary action taken.

10. Mr. MacKenna has read with particular interest Chapter IV of this report. The idea of homestead farms put forward in paragraph 29 is attractive and, if successful, would completely alter the face of the country. In general the Development Commissioner would remark that with the prospect of an early increase in staff a fixed policy of concentration should be adopted. The insistent demands of district officers, keen on agriculture and desirous that the problems of their districts should be investigated, imposed a strain upon the small band of workers which was almost overwhelming and a temptation to comply with local wishes which, it is to be feared, has led to considerable dissipation of energy. With the division of the Province into definite agricultural circles and the early prospect of an adequate staff of workers it is desirable that efforts should be more concentrated and limited to more circumscribed areas. In Mr. MacKenna's opinion the process should be—

- (a) the evolution of an improved type in the experimental area of the Central Farm;
- (b) the production of seed of the improved type in bulk on the outside areas of the Farm; and
- (c) a series of seed farms radiating out from the Central Farm the produce of which should be sold to cultivators in the area and the annual seed supply for these seed farms provided from the Central Farm.

In this way an improved strain will be established over a composite area in a very short space of time. The Development Commissioner does not desire to belittle the efforts which have been made in the past by Co-operative Societies or by selected cultivators who have grown the seed recommended and supplied by the Department but a great deal of the effect has been lost by the fact that these societies and cultivators have been scattered and have not been able to cover any considerable area. With the concentration, which it is hoped is now possible, we should within a few years have complete subdivisions or districts, all under one improved type of paddy or other crop, and in a very short space of time the whole standard of the Province should be improved.

11. During the course of the year the Department has lost the services of its two Senior officers—Mr. Thompstone who resigned Government service to take up private employment and Mr. Warth who has been transferred to Pusa as Imperial Physiological Chemist. Mr. MacKenna desires to express his appreciation of the hard and conscientious work performed by these officers in the early days of the department's history frequently under conditions of much discouragement.

In conclusion the Development Commissioner would thank Mr. Clague for his interesting report and Mr. McKerral and other members of the staff for the good work which they have done during the year under report. Mr. McKerral has now been transferred from Hmawbi to Mandalay and Mr. MacKenna is confident that in the new areas over which he is in charge, he will continue to apply those sound principles of experiment and organisation which have characterised his work in Lower Burma.

RESOLUTION
ON THE
REPORT OF THE DEPARTMENT OF AGRICULTURE, BURMA
For the year which ended on the 30th June 1921.

Extract from the Proceedings of the Government of Burma in the Agricultural Department,
No. 1400, dated the 26th May 1921.

READ—

- (i) Report on the operations of the Department of Agriculture for the year which ended on the 30th June 1921.
- (ii) Letter No. 184-8R-18, dated the 18th October 1921, from the Secretary to the Development Commissioner, Burma, forwarding the report.

RESOLUTION.—Ever since its formation in 1906, the Agricultural Department of Burma has been handicapped by lack of staff, and in 1920-21 it was unfortunate in losing two senior officers, namely, Mr. Thompstone, who after fourteen years in the Department resigned to take up private employment, and Mr. Warth, the Agricultural Chemist, who was transferred to Pusa as Imperial Physiological Chemist. In last year's Resolution the public were cautioned against impatience in expecting speedy results from the work of the Agricultural Department; but the way is being got ready for much greater results in the future, and the preparatory work and patient investigation now in progress will bear fruit before many years are over. Two of the seven Deputy Directors sanctioned by the Secretary of State arrived during the year and were placed under training. The appointment of Assistant Entomologist, which had been vacant since December 1919, was filled in October 1920, and it is hoped that a larger number of superior officers will be recruited during the current year. Good progress was made with the College buildings at Mandalay, and the Lieutenant-Governor trusts that no unforeseen hitch will delay their completion, as only with the opening of the College will it be possible to accelerate the rate of recruitment of qualified subordinates.

2. Notwithstanding the lack of superior officers and paucity of subordinate staff much useful work was done. Rice being the principal crop of the country, the Department continued to devote a large share of its attention to its improvement. Sixty varieties of paddy were under observation at the Hmawbi farm, and a good deal of success has attended the obtaining of selected strains giving improved out-turns. A short-lived type of Japanese rice has been introduced in two dry zone districts. Over 8,600 baskets of selected paddy seed were distributed. The Lieutenant-Governor shares the Development Commissioner's views as to the desirability of endeavouring to improve the type of paddy or other crop, as the case may be, throughout concentrated areas, but until the expansion of the department's operations with additional staff makes this possible, and until cultivators learn to retain a sufficiency of the produce from selected strains for seed instead of being tempted by higher prices to sell the whole of it for milling, the Department has to bear the burden of meeting the demand made

on it for pure seed. It appears that hitherto arrangements have not existed for ascertaining the effect of the distribution of selected seeds and new varieties. It is essential to maintain records showing the areas under improved strains or new crops, the results in the way of disposal of seed, expansion or decrease, and success or failure, and His Honour is glad to see that it has been decided to remedy this omission.

3. The investigation of the prussic acid constituent in Burma beans was continued during the year. The experiments have been directed to the selection of types containing a low prussic acid content, and to the investigation of the changes which occur in that content consequent on storage. Certain selected strains have been obtained, but Sir Reginald Craddock is disposed to agree with the view of the Development Commissioner, that in view of the delay and uncertainty in evolving pure strains, and the danger of reversion to type, the Department might profitably endeavour to find a variety free from suspicion which can replace Burma beans in the market.

4. At present the cultivation of cotton is mostly confined to four districts in Upper Burma. A Provincial Cotton Committee with the Director of Agriculture as President has been formed to advise the Local Government on questions of cotton policy and to disseminate information regarding cotton matters. Active and successful work has been done by the Department in obtaining and distributing improved strains, and the completion of the Mahlaing farm ought greatly to facilitate this work.

5. The cultivation of sugar-cane both on a large and small scale is rapidly extending in the Province. The manufacture of white sugar is the object of the larger workers while the small cultivator confines himself to the manufacture of jaggery, for which he obtains a good price. The Department has done a good deal of work on sugar-cane, the popularity of which among the cultivators is largely due to the Department's help and demonstration, but shortness of staff has hampered the work and the Department is hard put to it to supply all the demands made on it for "sets." There is also much still remaining to be done in the improvement of the varieties cultivated. The Department's attention has been directed to the provision of suitable plant for the small grower. The Report of the Indian Sugar Committee, which was received after the close of the year, is under consideration.

6. Great interest is also being taken in cocoanut planting, and endeavours were made without success to obtain at a reasonable cost the services of an expert to investigate and report on the possibilities of developing the cocoanut industry in the Province. The matter is to be taken up by the Department as soon as an officer can be spared for it.

7. In 1917 it was decided to investigate the possibilities of jute cultivation in Burma and the services of a demonstrator and two skilled labourers were obtained from the Government of Bengal to carry out experiments. The experiments show that jute of a good quality can be grown in this country but difficulties about marketing the produce and also in respect of labour at present militate against its cultivation. Further experiments have been stopped for the present and His Honour is inclined to agree with the Director of Agriculture that

extension of cultivation is likely to come only gradually from imitation of Indians who may take up this crop and by the provision locally of facilities for manufacture.

8. The *bedabin* or water hyacinth, which has caused a good deal of harm to waterways in different parts of the world, is giving trouble in the rich paddy-producing districts of the Delta, where waterways are the highways. The plant had become sufficiently widespread in the cold weather of 1912-13 to cause inconvenience and since then endeavours have been made to cope with it, but not on a sufficiently great or systematic scale to prevent the pest from extending. The problem, as to the seriousness of which the Lieutenant-Governor is in full agreement with the Development Commissioner, is now being carefully examined by the Department, in concert with the district officers, and no effort will be spared to discover some method of effectually keeping down, if not eradicating, the plant.

9. The Lieutenant-Governor is glad to learn that the new officers have taken up their duties with keenness, and that District Officers have co-operated helpfully with the Department. There is no activity of Government in which the value of co-operation is so great, and the benevolence of its motives so free from suspicion. Upon the prosperity of the agricultural classes depends the market also for the industrial products of the country. His Honour is a thorough believer in the future of the Agricultural Department in Burma; hitherto and for some years to come the results to the public may seem small, and its light to be hidden under a bushel, but once a certain point has been reached in experiment and demonstration, progress thereafter will rapidly increase. The Lieutenant-Governor feels after his tour in the Delta, that the Department ought to devote attention to the introduction of double cropping in that area, and the extension of garden cultivation. Apart from the extra food supply thereby secured, the growth of leguminous crops would benefit the soil, and the additional occupation provided would help to reduce the disadvantages which arise in one-crop areas from the fact that the agricultural population are idle for several months in each year.

10. His Honour regrets that the services of Messrs. Warth and Thompstone have been lost to Burma and he joins the Development Commissioner in expressing his appreciation of their work in the early days of the Department when conditions were less encouraging than they are now. His Honour congratulates the Department on a successful year's work, and trusts that with an increased staff there will be a rapid expansion of its activities in a manner more commensurate with the importance of agriculture to the economic welfare of the province. Finally, the Lieutenant-Governor desires to record his appreciation of Mr. Clague's administration of the Department, under the guidance of Mr. MacKenna, and of his interesting report, which is a suggestive record not merely of work accomplished or in process of accomplishment but also of extensive developments to come.

By order of the Lieutenant-Governor of Burma,

W. BOOTH-GRAVELY,
Revenue Secretary to the Govt. of Burma.

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, BURMA

For the year ended the 30th June 1921.

CHAPTER I.

ADMINISTRATION.

1. Mr. C. R. P. Cooper was in charge of the Department, in addition to his own duties as Registrar, Co-operative Societies, from the beginning of the year till 28th September 1920, when he proceeded on leave. Mr. Saunders, Registrar, Co-operative Societies, held charge of the Department from that date till 12th November 1920 when I took over from him and held charge till the end of the year.

2. Mr. Cooper spent 51 days and Mr. Saunders 10 days on tour. I was on tour for 163 days between November 12th and 30th June and visited all the farms except Yawnghwe and Thilawa, and all districts which have district agriculturists, except Mōnywa.

3. Mr. Thompstone spent 66 days on tour before resigning his appointment as Deputy Director on 1st January 1921. The resignation of Mr. Thompstone and the fact that only two new Deputy Directors were recruited during the year by the Secretary of State instead of the four expected and that neither a Professor of Agriculture nor a Professor of Mycology have yet been recruited has disappointed the hopes entertained last year of a large increase in the superior staff to meet the proposals for gradual expansion.

Mr. Warth, Agricultural Chemist, was, in addition to his own duties, placed in charge of the Southern Circle from the beginning of the year in place of Mr. McKerral, who had proceeded on leave, till January 1921 when he was transferred to the Agricultural Research Institute, Pusa, as Imperial Agricultural Chemist. He was relieved of the duties of the Deputy Director of Agriculture, Southern Circle, by Mr. Beale on the 17th January 1921.

Mr. Stock, Economic Botanist, was in charge of a portion of the Southern Circle (*i.e.*, Tatkōn Farm) from the beginning of the year till March, when he made it over to Mr. McKerral. Mr. Stock was also in charge of Mahlaing Farm and worked in Myingyan and Pakōkku throughout the year and is being posted to Myingyan to organize the new Myingyan Circle which is being constituted. He spent 169 days on tour.

Mr. McKerral on return from leave took over charge of the Northern Circle in March from Mr. Sawyer who reverted to his substantive appointment. Tatkōn Farm which was formerly in the Southern Circle was also placed under his control. He spent 56 days on tour.

Mr. Lord rejoined the Department as Deputy Director in December 1920 and was posted to Mandalay for training. He accompanied me on tour for a month in February and also toured with Mr. McKerral.

Mr. Charlton, on arrival in Burma, assumed charge of the duties of the Agricultural Chemist in February 1921. He spent 28 days on tour.

Mr. Hendry arrived in Burma in February 1921 and was posted to Mandalay for training.

By the kindness of the Settlement Commissioner and the Settlement Officers of No. 3 and No. 5 Parties, Mr. Lord and Mr. Hendry spent some most valuable weeks with Mr. J. A. Stewart in Kyaukse and Mr. A. Williamson in Shwebo as part of their training with a view to learning the organization of Land Records and understanding the Land Revenue system.

Maung Ba Gyaw, Agricultural Engineer, was on tour in connection with Farm buildings and experiments for 199 days.

The appointment of Assistant Entomologist, which owing to the resignation of Mr. K. D. Shroff had been vacant since December 1919 was filled up by the appointment of Mr. C. C. Ghosh, who arrived at Mandalay in October 1920. He was on tour for 91 days.

Mr. Sawyer, Assistant Botanist, who had resigned his appointment last year, rejoined the Department in December 1920 and was promoted to the Burma Agricultural Service. He held charge of the Northern Circle from the date of Mr. Thompstone's resignation till he was relieved in March by Mr. McKerral.

Mr. Peale, Assistant Botanist, was promoted to the Burma Agricultural Service in January 1921 and held charge of the Southern Circle with one short interval from January to the end of June.

The following increase of staff has been sanctioned :—

(a) Four additional assistants and one additional fieldman for the Economic Botanist.

(b) Two supervisors, six overseers, one additional draftsman and one additional clerk for the Agricultural Engineer.

(c) One assistant for the Assistant Entomologist.

(d) One horticultural assistant to take charge of a portion of Hmawbi Farm reserved for fruit culture.

CHAPTER II.

AGRICULTURAL EDUCATION.

4. Only one assistant completed his training during the year. Maung Ba Tin was successful in the B. Ag. degree examination at the Poona Agricultural College: he specialized in "Sugar-cane" and stood nineteenth in a class of 38 successful candidates. On return to Burma he was posted to Tatkôn Farm as Superintendent in June.

The Coimbatore Agricultural College was unable to accept students for the Lower Subordinate Service training, but 13 students were selected by a Selection Board for stipends and were sent to Poona Agricultural College in May to take the three years' course and to qualify for the L. Ag. diploma or B. Ag. degree.

5. Only one stipend was given to a co-operator who is now undergoing training at Mahlaing Farm. The Registrar, Co-operative Societies, has been consulted with a view to the scheme for co-operators and keen farmers visiting and studying at the farms being improved. It has to be recognized that farmers cannot leave their farms for long, but on the other hand arrangements could probably be made whereby keen men could attend for nine or ten days a month in the most important months and attend a course of lectures in March when most farm work is in abeyance. A scheme for a course of lectures at Hmawbi in March 1921 was prepared but sanction was accorded too late to allow of its being carried out.

With a view to getting suitable candidates for the Lower Subordinate Agricultural Service, the proposal to award stipends and open a class at Mandalay has been sanctioned.

Of three Anglo-Indian Probationers, Messrs. Minus, O'Donnell and Bodeker, the last two resigned after undergoing training for six and eight months respectively. Mr. D'Silva, a candidate selected by Brother John of St. Paul's, joined in May and is undergoing training at Mandalay. At Yawngwe Farm four students from Karenni completed their training and went back to their respective States and four more students are now in training for Yawngwe and Hopon.

The land required for the establishment of a Vernacular Agricultural School at Pyinmana is being acquired and it is hoped that substantial progress will be made during 1921-22.

The scheme for appointing district agriculturists from selected Settlement Clerks and Revenue Surveyors has been abandoned as it has been found that the men selected had not generally enough education to profit by the training necessary. It is proposed gradually to absorb the district agriculturists in the Lower Subordinate Agricultural Service.

7. Good progress has been made during the year with the buildings at Mandalay. Three quarters for officers of the Indian Agricultural Service and eight quarters for officers of the Burma Agricultural Service have been almost completed and quarters for the Subordinate Service are well in hand. The excavation for the main College building has been finished and work in the foundations is progressing steadily. The plans for a hostel to accommodate 84 students have been completed and numerous other plans such as those for the gas plant building and water tower are being drawn up.

CHAPTER III.

AGRICULTURAL RESEARCH AND EXPERIMENTS.

8. No new stations were opened during the year. The equipment of Mahlaing Farm with the needed buildings, fencing, and well, and the laying out of the whole area for experiments have been pushed on and the farm will be fully worked in 1921-22. Plans for a large extension at Allanmyo with a view to making the farm suitable for a Circle Experimental Farm were prepared and an additional 116 acres are being acquired. A small ginnery, like the Mahlaing ginnery, will be built at Allanmyo next year for the ginning of Cambodia cotton to supply pure seed. At Hmawbi, ten acres of garden land were acquired and cleared for experiments with coconut palms, citrus, cocoa, and especially the growing of vegetables for the supply of good seed. Twenty acres more will be acquired for the necessary extension of this garden work. Acquisition of land for the extension of Tatkôn Farm has been held over pending a decision as to the best centre for the Experimental Farm in the proposed Loungoo-Yamòthin-Thazi Circle; projected irrigation works may largely affect the area in which the present farm lies and it is felt that sugar cane can possibly be best dealt with at Pyinmana or further south.

At Hopin the land not hitherto worked is being cleared for cultivation and the farm will be fully worked next year.

The opening of more stations is worse than useless until a larger and fully trained staff is ready both for demonstration and for supervision, and until this staff is ready the policy will necessarily be one of concentration of energy on limited areas. None of the farms are yet fully equipped: Hmawbi paddy land for instance is unfenced, a serious drawback in the case of many experiments.

9. Paddy outweighs by far all other crops in importance in Burma as will be realized from the fact that of over 14½ million acres sown in 1920-21 over 10½ millions were under paddy. It is therefore on paddy improvement that the energies of the Department are mainly concentrated both at Hmawbi and Mandalay. A collection of Shwebo paddies has been made and pure lines will be selected from them at Mandalay. At Hmawbi work on paddies to suit different localities was continued and some 60 varieties are under closed observation.

A recent selection Letywezin B-107 which matures slightly later than Ngachima or Letywezin B-106 is found to give higher outturn of fine quality rice suitable for parboiling than either of those varieties. The late maturing Ngasein 10 is steadily growing in popularity, and Emata A-34 continues to yield well and is now regularly under selection at Hmawbi for multiplication at Zigôn;

Ngasein 8 however has lately given reduced yields and will be replaced by a new strain. The multiplication of the improved strains selected in previous years was proceeded with at Mandalay, Yawnghwe and Hopin. A short-lived type of Japanese paddy which is expected to be particularly suitable for the dry zone tract has been introduced in Meiktila and Myingyan. At Hmawbi the residual effects of previous manuring were beneficial in the case of cattle and phosphatic manures but chemical nitrogenous manures and potash alone gave marked negative results. Direct manurial experiments with soluble phosphate and bone super resulted in an increase in yield. At Mandalay tests for residual effects of manures indicated that the response of the plots treated with moderate quantities of cattle manure was the most pronounced and that the residual effects of cattle manure are more enduring than those of any of the chemical manures.

At Hmawbi the nursery experiment for seed rate were inconclusive, but at Mandalay they served to emphasize previous experience, *i.e.* that in ordinary seasons light seeding combined with thin planting tends to give higher yields than those obtained by local methods. Planting in doubles which saves 50 per cent. of the seed as compared with local methods, is now the standard practice at the Mandalay Farm.

The results of the transplanting and growth experiments at Mandalay have again shown that, if water is available, the best crops are those that are grown from seedlings about forty days old planted out early in the season. While it is still too early to draw any final deductions from the water measuring experiments the results already recorded show that the best crops were produced on the plots which received a continuous flow of water throughout the season of growth. The experiment has been to some extent remodelled for next year and the Agricultural Engineer will be in direct control.

10. Work on isolation of the various types of sesamum and classification was begun in previous years by Mr McKerral at Tatkon and 73 strains were taken over by the Economic Botanist for cultivation at Mahlaing; 185 types have now been isolated but these types will have to be continued in single line culture before a catalogue of the distinct varieties can be arranged. This will be the basis of the further work on this most important dry zone crop. Selection of the most suitable types for Thayetmyo will be carried on at Allanmyo.

11. A fall in demand for the improved strains of Macaroni wheat (*Triticum durum*) for seed from Padu and Mandalay is said to have been due to the low prices current at sowing time. At Hopin the yield was poor and it would appear that the climatic and other conditions in the Namyin valley are generally unfavourable to wheat.

At Yawnghwe of the improved strains of Shan States wheat (*Triticum vulgare*), 4 gave yields averaging 30 per cent. more than the ordinary mixed variety while the exotic wheats Federation, Pusa 4, Pusa 6, and Pusa 12 have all again given very good results, the yields ranging from 1,230 to 1,370 lbs. per acre on the dry *ya* or upland and from 2,245 to 2,590 lbs. on the moist lowland loams. The method of dual cropping in which wheat follows potatoes in the same year has been demonstrated with success at Taunggyi and farmers are now putting the method into practice.

12. The erect type of groundnut is regarded with great favour in the various tracts where it has been grown and the Spanish nut introduced two years ago from Pakokku into Meiktila is rapidly spreading. At Payitkon farmers were induced to try various types. Pondicherry and Japanese Big were not superior to the ordinary Burmese but Japanese Small give a high yield, was easy to harvest and had a high oil content. The Spanish type was tried on *mogaung* land in Shwebo and suffered owing to drought, but the ease of harvesting makes it popular with the cultivator and its extension is only a matter of time. The Pondicherry and Big Erect types have given exceptional results at Yawnghwe. In Thayetmyo the Spanish and Japanese types are most in favour.

13. There was again a large fall in the area under *Pèbyugale* of 31,000 acres and a rise in the area under *Pègyi* and *Pègya* of 54,000 acres, due to the great fluctuations in prices. The rise in prices towards the end of the year is likely to result in a greater area being sown and the selection and analytical work will continue to be of importance. Mahlaing will now be the centre of selection work on beans.

Before his transfer to Pusa, Mr. Warth continued his experiments on determination of prussic acid in fresh and old seed. Mr. Warth reports—

“For storage experiments large samples of uniform seed were maintained at approximately constant temperature of 30° for over half a year under the following conditions:—

- (1) Moist unventilated.
- (2) Ventilated with moist air.
- (3) Ventilated with dry air.
- (4) Thoroughly dried over H_2SO_4 , no ventilation.

The main results were as follows:—

(1) In keeping wet there was trifling increase in total HCN. In the other cases there was no significant change in amount. This is important.

(2) The enzyme activity of moist seed is high. The HCN contained in it can be almost completely liberated in one hour by soaking. There was little or no difference between moist and dry ventilation after the lapse of six months. The activity was low in both cases.

The dry unventilated seed had lowest activity in every case. With good seed there was distinct evidence of reversal.”

The work on storage will be continued by Mr. Warth at Pusa. Mr. Charlton analysed 131 samples left by Mr. Warth and reports that it is now fairly certain that there is no tendency towards elimination of prussic acid as proved by analysis in three years' successive growth of selected beans. Five distinct strains have been found to be particularly good and multiplication of these will give beans of which bulk samples will be perfectly safe and which will with reasonable care keep below the danger mark for a long period. The amount of prussic acid allowed in beans for importation into Canada is '02 per cent. but none of the analysed samples from the five lines above referred to had a higher HCN content than '0069 per cent. and the great majority had less than '003 per cent. It is estimated that a really satisfactory study of the problem, *i.e.* to evolve known pure lines, will require five years more.

Pèsinngon (Cajanus Indicus), commonly known as “dhal,” is rapidly extending and in the Lower Chindwin District alone over 5,000 acres are now reported to be under this crop. As a result of a meeting at Padu in January 1920 to encourage its cultivation in place of more precarious crops seed for 600 acres was supplied in Sagaing but drought and the unwillingness of farmers to put down a crop of which they know little or nothing resulted in less than a sixth of the expected area maturing. As however cultivation is not difficult, and prices are generally remunerative, its extension is only a matter of time and there is a demand for seed in Mònywa, Kyaukse, Yamèthin and Allanmyo.

In the Southern Shan States *pèbyin* a new selection of *Phaseolus vulgaris* is being tried and the Yawnghwe *Sawbwa* is arranging for a trial shipment of three tons for valuation in Europe.

14. The Mahlaing Farm ginnery gins only the *kapas* from selected strains of cotton grown on fields which have been inspected and “rogued” by trained fieldmen. The cotton growers get an advance of Rs. 20 per 100 viss when they bring the *kapas* to the ginnery, ginning hire at the rates prevalent in the neighbourhood is charged, and the growers are allowed to keep the lint for a limited time in the ginnery godown: the advances and charges are recovered when the lint is sold. This system is working well and this year 33,000 viss of *kapas* were ginned for the cotton growers who grew Tatkôn 4, the white flowered strain of Wagale produced at Tatkôn. For several years it has maintained a ginning percentage of well over 38; the average ginning percentage this year was only 36.2, but it is at present impossible to say whether the fall was due to the exceptionally dry season or to impurity. On the Mahlaing Farm Wagale unselected gave 161 viss and Tatkôn 4, 171 viss to the acre; these high yields in what proved to be a bad season for

cotton-growers indicate what may be achieved by judicious spacing and good cultivation.

Mr. Stock's preliminary statistical study of variations brings out the superiority of Tatkôn 4 in respect of ginning percentage but points to some superiority of yellow-flowered Wagale in length of lint and yield.

Out of the single plant selections made at Mahlaing some plants of Shan cotton with a staple of .81 and a ginning percentage of 33 to 37 and of Wagyi with a staple of .69 to .86 and a ginning percentage of 42 to 47 are very promising.

Mahlaing Farm will in future be the main cotton-breeding centre but as the rainfall is precarious the selected strains will be grown also at Tatkôn, where the rainfall is more certain, to ensure their continuance.

During the year selection work on pure lines and on crosses was continued at Tatkôn; the staples and ginning percentages of the best plants were—

	Ginning percentage.	Length of lint. Inches.
Arvensis No. 4	... 38.05	2 3/4
Broach x Wagyi	... 42.37	2 3/4
"	... 32.23	2 3/4
Wagyi x Wagale	... 45.49	...
Pure Wagyi	... 47.99	...
Shan x Wagale	... 36.51	2 3/4

Seven hundred and eighty viss of *kapas* of Cambodia cotton with a ginning percentage of 40 were obtained from 4 acres on the Allanmyo Farm. Akyozaungs obtained 12,660 viss from 148 acres and from this 5,064 viss of good quality lint was ginned. Owing to the slump in cotton the growers refused to part with it at the prices offered up to the end of the year. It is expected that between 400 and 800 acres will be sown with Cambodia next year and plans are being drawn up for a small ginnery, like that at Mahlaing Farm, to secure good and unmixed seed.

In Mōnywa the success of Cambodia has been very striking. In 1919 only half an acre was grown; cotton-growers were so pleased with the results that 70 acres were sown in 1920; of this 40 acres failed but from the 30 acres which matured 2,580 viss of *kapas* were collected. This was sold at Rs. 35 per 100 viss when ordinary *kapas* was fetching only Rs. 15. The seed has been distributed and it is expected that over 500 acres will be grown next year.

Small quantities of Cambodia have been distributed to farmers in Meiktila and Kyaukse for experiments and further experiments will also be made at Nagu where a few plants gave very high yields.

At Tatkôn Farm the yield of early sown Cambodia was nearly 100 viss but of late sown only 60 viss; most of the bolls were badly attacked by boll-worm.

Utopia was again tried on a small area of upland soil at Padu and although no rain fell for a month after sowing the plants withstood the drought and yielded at the rate of over 200 viss an acre. Trials on a field scale will be carried out with the seed next year.

15. Cultivation of sugar-cane is rapidly extending in the Province and the Department is now unable to meet the demand for "sets." At Hmawbi 5 out of the 12 varieties supplied by the Sugar-cane Expert to the Government of India have proved very successful, the best being Ashy Mauritius, B-147 and J-247. The acquisition of the new garden area will give room for multiplication of these varieties which have hitherto had to be grown on a very small scale. The multiplication of exotic canes was continued at Tatkôn, Singaing, where an extra area has been rented for multiplication, and at Hopin. Gilman and B-147 are in great demand as canes suitable for chewing purposes. In addition to 13 varieties previously under observation at Hopin, Singaing Red cane and "Kaka," a Malabar cane introduced into the neighbourhood by Indians, are being tried.

There is a prospect of white sugar factories being opened in the Insein, Mandalay and Myitkyina Districts and small cultivators particularly in the Yamèthin, Toungoo and Mandalay Districts are turning their attention more and

more to sugar-cane. The provision of suitable plant for the small grower is engaging attention and extensive trials with different kinds of crushers are to be carried out next year.

The Hopin Jaggery Factory was completed in January and worked till the end of March. So much of the area planted in 1919-20 had failed and the demand for "sets" in the neighbourhood was so great that instead of the produce of 50 acres expected to be dealt with the cane from about 10 acres only was received. The cane was crushed and jaggery made for the growers at Rs. 7-8-0 per 100 viss which left them a handsome profit. The local growers show so far no tendency to combine and their lack of response to the efforts made to rouse their interest and encourage combined working and management of the Factory have been discouraging. Next year's working however will be a fairer test of the scheme.

For Thawatti a similar scheme was mooted but the devising of a scheme which will ensure the factory being run on the most economical lines and result in combined and continued effort needs much further investigation. The running up of small factories which will pay only in times of high prices and for which the users have no financial responsibility will hardly lead to any useful development.

16. Although Pusa 28 is being grown on a small scale in Prome and is reported to fetch almost double the price of the ordinary local product the area under the improved seed is small. No real improvement will be possible until a tobacco-curing expert is recruited and it is inadvisable to recruit such an expert until the new Circles are constituted.

Tobacco.

17. The Jute demonstrator and labourers were retained in Myaungmya till the end of January when they went back to Bengal. The Indian farmers in Einmè Township took up jute-growing eagerly and sowed some 60 acres at the beginning of the monsoon. The average outturn was over 300 viss per acre, but no provision was made beforehand to help with the early marketing of the fibre and the greater part is said to have been sold locally early in 1921 at about Rs. 30 a hundred viss. Samples of the fibre were valued in Rangoon at about Rs. 25 per 100 viss and a large sample was sent to England through a Rangoon firm for valuation. The report on this had not been received by the end of the year. If the area sown next year is equally important arrangements will be made to get the growers and buyers into direct touch.

Fibres.

Reports from other districts show that labour difficulties are against expansion of jute and at present, outside the areas where Indian farmers take up the crop and their Burmese neighbours imitate them, jute is not likely to be grown except in small patches for local use.

No tests with other fibres have been made during the year, but a sugar-cane crusher is being lent to the Yamèthin Jail for trials with sisal hemp.

18. Guinea grass is being grown with success at Hmawbi and small quantities have been distributed for multiplication in Bassein. At Mandalay the most promising fodder crops up to the present have been Saccoline (*Sorghum saccharatum*) which was fit to cut for green fodder in about 90 days and yielded at the rate of nearly 11 tons per acre. Guinea grass, irrigated, yielded three cuttings in the year, a total outturn of nearly 10 tons per acre; Cumbu millet (*Pennisetum typhoidem*) yielded 4½ tons of green fodder, Lucerne 4 tons of green fodder in four cuttings, and Sudan grass nearly 4 tons of dry fodder per acre.

Fodder Crops.

19. Great interest is being taken in the question of coconut planting and it is unfortunate that Mr. Sampson, for whose tour in the cold weather arrangements had been made, was unable to come from Madras. Efforts are being made to procure the services of an expert for a cold weather tour in 1921-22 to advise on the suitability of the Arakan and Tenasserim Coasts and the Delta for extensive plantations. A small plantation with selected Burma and Madras nuts is being arranged for at Hmawbi, and through the courtesy of the Director of Agriculture,

Coconuts.

Federated Malay States, a number of dwarf coconuts, which are reputed to bear in the fourth year, have been obtained for experiment. It is unfortunate that coconut palms along the sea-board in Thaton are being ruined by the Rhinoceros beetle which finds ideal breeding places in manure heaps and decaying straw. The Assistant Entomologist visited several areas in Thaton and showed the gardeners large numbers of the beetle in all its stages. Only combined and continuous effort however on the part of people living in and near the coconut gardens can keep under the pest and reduce its ravages.

20. The cultivation of gram on land flooded during the rains in Bassein has grown from a few acres in 1918-19 to over 1,000 acres in 1920-21. Experiments with gram got from Mandalay were not entirely successful, late sowing being followed by rats and other pests; 36 baskets of the Mandalay gram were harvested and sold for seed. At Padu Karachi gram has maintained its reputation for freedom from wilt and resistance to drought and produced crops in many cases where Burmese gram failed; similar results were obtained in the Lower Chindwin. The distribution of Karachi seed will be organized so as to get a compact area sown and thoroughly tested on a large scale next year.

21. The cultivation of the large red onion continues to make progress in the Shwebo Canal area. Rs. 4,368 worth of seed from Bombay was supplied and though the average yield, 800 viss per acre, was low owing to late planting and scarcity of water, the majority of the growers are in favour of continuing onion cultivation.

Linseed was grown from seed given out from Mandalay on about 60 acres in the Mandalay and Lower Chindwin Districts. The yields have been small and linseed cultivation in Burma cannot yet be considered a success.

Cultivation experiments with potatoes at Yawnghwe have again shown that the yield of the crop could be greatly enhanced by green manuring and by drill-planting with unburnt cattle manure applied in the furrows at the time of planting. Yields up to 3,735 lbs. per acre were obtained with the Gwe-nge-pè (*Mucuna edulis*) as the green manure crop, and with unburnt cattle manure the yields were up to 8,000 lbs. per acre against yields of 2,000 lbs. by the local method of planting in mounds after burning the cattle manure. Seven varieties of exotic potatoes were retested at Yawnghwe. "King of potatoes" from Assam proved the best, yielding 4,500 lbs. per acre.

22. The ten acres acquired at Hmawbi have been cleared and after thorough cleaning and cultivation will be utilized next year for gardening and other experiments. Cultivation and selection of indigenous vegetables for the supply of good seed will be an important feature of the garden; a small citrus plantation will be put down for testing the possibility of making citric acid, and the cultivation of cocoa, some seedlings of which have at last been successfully obtained from Ceylon, and experiments with crops for high level lands will be carried out. African palm-oil seeds (*Elaeis Guineensis*) have been obtained from Kuala Lumpur through the Director of Agriculture, Federated Malay States, and in addition to being tested for germination at Hmawbi, small quantities have been distributed to planters in various parts of Lower Burma.

23. As the dairy expert from India Mr. Smith was unable to visit Burma before he went on leave the dairy scheme is for the time in abeyance. As soon as the expert's advice is available the scheme will be proceeded with and an Agricultural Assistant deputed to Pusa for study. Meanwhile the land acquired for the dairy farm is being let to neighbouring farmers.

CHAPTER IV.

DEMONSTRATIONS, AID TO THE PUBLIC, SHOWS, AGRICULTURAL ASSOCIATIONS AND GENERAL PROGRESS.

24. Six thousand four hundred and fifty baskets of selected paddy seed were distributed in the Southern Circle; 2,406 baskets from the produce of the Hmawbi Farm and the rest

Seed Distribution.

from the produce of district farms and the Paungdè Jail. No seed was distributed from Ma-ubin, Henzada or Prome Jail farms owing to accidental mixing of varieties at harvest time.

From the Allanmyo Farm 1,312 viss of Cambodia cotton seed were distributed and also small quantities of sesamum, *pèsinnngôn*, *pèdissein* and groundnut. This is done through selected Akyozaungs who can be expected to carry out distribution of the seed from the crops grown by them. In Myaungmya 481 lbs. of jute seed were taken by 60 farmers. Of the five successful exotic varieties of sugar-cane grown at Hmawbi about 15,000 sets were distributed to the Tatkôn, Zigôn and Yedashe farms for multiplication and to cultivators.

In the Myingyan Circle the small ginnery at Mahlaing dealt with the *kapas* from selected areas and 16,458 viss of pure Pwinbyu seed or almost double the quantity of the previous year were distributed to cotton-growers in Myingyan and Meiktila; 1,164 baskets of groundnut were distributed in Myingyan, Meiktila and Pakôkku, 92 baskets of short-lived type of Japanese paddy in Myingyan and Meiktila, and 450 baskets of paddy from the Minbu Farm in Minbu.

In the Northern Circle 2,217 baskets of selected paddy from the Mandalay Farm were distributed in Mandalay, Kyauksè, Shwebo and Sagaing. Large quantities of sugar-cane "sets" were distributed through Departmental agency to cane-growers in Mandalay, Shwebo and Yamèthin; 135 baskets of the wilt and drought resisting Karachi gram from Padu Farm were distributed in Sagaing and Mònywa. Smaller quantities of groundnut, *pèsinnngôn*, linseed, etc., have been distributed for experiment in several of the districts in the Northern Circle.

Reports from all districts in which pure varieties of paddy are grown indicate that these command a premium of Rs. 5 to Rs. 15 above ordinary prices and are especially liked by small millers. Unfortunately the local farmers do not yet offer bigger premia than the miller and broker and thus the greater part of the improved paddy which should at this stage be used for seed is lost. Yet the demand for pure seed from the farms is great and the supply will have to be organized on a wider basis through Co-operative Societies and individual Akyozaungs. Seed godowns in charge of men experienced in handling seed will also be required at each Central Farm if the best of the produce is to be got hold of and distributed to the best advantage.

25. During the year the district agriculturists have collected seed due from farmers and carried out supply of the seed and implements ordered by farmers. They have done **Demonstration.** propaganda work in many districts and have been particularly successful in Meiktila with Pwinbyu cotton, in Shwebo with onions, and in Allanmyo and Mònywa with Cambodia cotton.

Though the district agriculturists have on the whole done well, some through age, infirmity, or distaste for the work have not given satisfaction. Employment on crop-cutting experiments has hitherto made it impossible for the Deputy Directors to insist on a high standard of definite work in definite areas. This has now been stopped and detailed programmes can be worked up to. In the past the effect of the distribution of selected seeds and new varieties has often not been definitely known, but in future the district agriculturists will keep *maps* maps and registers in which areas under improved strains or new crops will be marked and entered and the results in the way of disposal of the seed, expansion or decrease, and causes of success or failure recorded.

Major Roberts, Deputy Commissioner, Bassein, and Major Sandeman, Deputy Commissioner, Pegu, have made valuable suggestions for utilizing small areas in grazing grounds for the growing of pure seed by Akyozaungs. Proposals will be formulated as soon as the staff for supervision is in sight. In Meiktila an arrangement has been made whereby the Deputy Commissioner will remit the land tax and supply seed free of cost to land-holders who are prepared to try dry crops on paddy lands under the instructions of the Agricultural Department. Four farmers are trying groundnut, *pèsinnngôn*, *pèbinat*, *matpè*, millet and Cambodia cotton under those conditions.

26. In spite of the high prices of all implements and machinery making it hard for farmers to buy freely there has been in places a good demand for ploughs and sugar-cane crushers. In Yamèthin the Cyprus plough has been found useful for earthing up sugar-canes, its use reducing hand labour and halving the costs. Twenty-nine of these ploughs were sold from Tatkôn for Yamèthin, and 226 from Mandalay, mainly for Sagaing. Nineteen sugar-cane crushers were also sold from Tatkôn Farm. Much requires to be done in the way of experiment with implements, but until the Agricultural Engineer has a workshop little progress can be made.

One "Fordson" tractor was bought and will be fully tested during 1921-22 at Mahlaing. Demonstrations on the Mandalay Farm in October were insufficient for a definite decision as to the value of tractors for the farms. The wet and mucky conditions under which farming is carried on in Lower Burma and in Upper Burma the fact that cattle are at once an investment and the source of the manure which is essential for dry land crops, and are handy at all times for carting and other operations make the problem of the relative value of tractors for the small farmer one which will take time to solve. They will probably be found of great value where they can be used for the greater part of the year on large estates if the manuring difficulty is not present or can be easily dealt with, and the results of the working of the tractors which are in use in the Southern Shan States will be awaited with great interest.

27. Sericulture up to the cocoon stage has been allotted to the Agricultural Department and as a result of the Assistant Entomologist's visit to Taunglè (Prome) two expert reelers from Bengal have been engaged and sent to instruct the silk-worm breeders in better methods of mulberry growing and reeling. Two acres in a fenced area at Maymyo have been lent to the Department by the kindness of the Forest Department at Maymyo and it is hoped that disease-free seed from moths examined by the Pasteur method will be available for distribution to silk-worm breeders by the end of 1921. Mr. Ghosh's previous experience of sericulture will be of great value in dealing with this industry which has been steadily decaying mainly on account of the ravages of *pebrine*.

28. The Deputy Commissioner, Yamèthin, organized a Cattle Show at Pyawbwe which was attended by officials of the Department and the Department contributed Rs. 1,000 towards the prize money. If District Agricultural and Co-operative Association hold their conferences in future at or near the experimental farms it will probably be found possible to organize cattle and implement shows in connection with them. Mr. Clerk, Assistant Superintendent, Htagaw, continued his excellent work in the Kachin Hill Tracts until he was transferred. The result of his efforts has been not only to make the experimental garden practically self-supporting but to train Kachins to grow potatoes and sugar-cane with every prospect of these crops being widely extended.

At Meiktila the Juvenile Jail Farm has been well run by the specially trained Jailer in charge and the boys will gain experience in growing dry crops of many kinds, of improved methods, and later in garden work such as the grafting of mangoes.

29. The foundations for future work have been well laid especially by Mr. McKerral at Hmawbi and the future policy will be to concentrate all the energies of officers on limited areas. But the getting into closer touch with the actual farmer and the following up of results are aims that can be achieved only when a fully trained subordinate staff and an adequate supervising staff are available. There is too another aspect of farming in Lower Burma which operates against better farming and the use of better seed and the following description of English cultivation in the 18th century could well be applied with little alteration to many parts of Burma:—

"Such was the appearance of one of the great fields which were commonly owned and commonly farmed. A field might be 400 or 500 acres in extent. It was marked out by innumerable strips of turf which separated the plots of the various cultivators. Roots were unknown in early days. As the houses of the cultivators were grouped together and

the plots lay in different fields the cultivator might have to go considerable distances to work on his plots. When harvest had been got in everybody had a right to graze his cattle over the land. The mingling of the animals caused an extraordinary amount of disease. No man could improve the breed of his stock and keep the land clean, sweet, and productive so long as he was at the mercy of his neighbours. The system bore most hardly on the poor and weak because a richer man with a heavier head of stock tended to crowd out the small men."

So long as lands remain unfenced, so long as cattle disease is rife largely through promiscuous grazing, and so long as the tenant has no security of tenure for more than a year so long will the efforts of the Agricultural Department be shorn of much of their effect. The problem is one of great administrative difficulty owing to the prevalence of crime in Burma. For instance at Hmawbi four co-operators have been induced this year to take up residence for five years at fixed rent on small farms rented from Government, but have been induced to do so only with great difficulty owing to the various risks. Tenant farmers again can hardly settle down to improve land and get the best out of it when security of tenure is practically unknown and so large a percentage cultivate the same land for one or two years only. In 1919-20 the number of tenants in Lower Burma who had rented the same land continuously for five years or more was 25,000 against 165,000 who had rented the same land for under five years and the percentage of land rented in Lower Burma was 33 per cent. of the whole.

CHAPTER V.

AGRICULTURAL ENGINEERING.

30. The Agricultural Engineer has during the year been engaged mainly on the construction of buildings on the Mahlaing Farm. A power sugar-cane and jaggery factory at Hopin, and a cotton godown at Allanmyo were also designed and built by him. He visited several places in connection with schemes for power pump and well irrigation. In accordance with the decision of the Departmental Conference held in April 1920 a well irrigation experiment was sanctioned for Nagu. The scheme did not get further than testing the capacity of the well which proved entirely insufficient for irrigating anything more than a garden plot to the great disappointment of local farmers. A large well has been dug and a windmill erected at Mahlaing Farm and plans and estimates have been drawn up for the further buildings required at Mahlaing, for a ginnery at Allanmyo, and for paddy godowns for combined-sale societies.

Maung Ba Gyaw has found it somewhat hard to recruit a competent staff owing to the prospects of permanent employment being uncertain. Generally the work of the Agricultural Engineer has been devoted to building work rather than to Agricultural Engineering proper, but Departmental building will be stopped as soon as the buildings now in hand are completed; a workshop is being arranged for at Mandalay Farm, and from November next the Agricultural Engineer will be in a position to give his whole time to his proper work. Problems which will be immediately attended to are tests of sugar-cane crushers and furnaces, cost and efficiency of pumping installations, and improvements in indigenous farming implements.

CHAPTER VI.

PUBLICATIONS AND SUPPLY OF INFORMATION.

31. A leaflet on Cambodia cotton was issued during the year and a leaflet on onion cultivation is now in the Press. A bulletin giving a history of the result of the investigations made by the Department into the extent of the damage caused by the parasitic plant known as "Pwinbyu" (*Striga lutea*) is also in the Press. An interesting note written by Mr. Thompstone on Agriculture in the Southern Shan States has been published in the Agricultural Journal of India.

Mr. Chalmers' note on "Coconuts in Madras" has been printed and widely circulated. It has also been translated and published in *Burma's Progress*.

Many of the leaflets and bulletins are out of print and the revision of these will be undertaken in the coming year.

CHAPTER VII.

MISCELLANEOUS.

32. The many changes in the Department during the year and the large extent to which officers took leave make the year one of transition. Mr. Warth was under orders for Pusa and was for months awaiting his relief. Mr. Thompstone resigned at two months' notice and no trained Deputy Director was available to replace him; Mr. McKerral the only Deputy Director with experience of Burma was on leave till the end of February. Mr. Sawyer rejoined only in December and Mr. Ghosh was quite new to Burma when he arrived in October.

33. Mr. Warth was in charge of the Southern Circle in addition to his own duties from July to January and therefore had to spend much time away from Mandalay on tour. He continued the work on the prussic acid content of Burma beans and intends to experiment further with storage problems at Pusa. Mr. Charlton who relieved Mr. Warth has taken up his duties with great keenness and has outlined a scheme for further experiments with Burma beans. He has conducted a detailed investigation at Prome and Rangoon on methods for eliminating the noxious smells from paddy steeped for parboiling. Investigation on spraying solutions for destroying *bedabin* has also been begun. Many analyses of oil cake, soil, and manures have also been carried out and work in connection with the new College laboratory plans has taken up a good deal of time.

34. Mr. Stock, in addition to holding charge of Mahlaing and Tatkôn Farms and the work in Myingyan, Meiktila and Yamèthin, continued his work on the survey of Burmese cottons and sesamum and toured extensively for the purpose of research into the indigenous cottons of Burma. His surveys will be completed in the coming year.

35. Mr. Ghosh took up his duties at Mandalay in October and began the investigation and observation of paddy pests. Investigation and experiment, and formulation of methods for dealing with these pests will take two or three years. He also made enquiries about cotton and sugar-cane pests and investigated the prevalence of the Rhinoceros beetle in coconut gardens in the Thatôn District. Mr. Ghosh has drawn up plans for an Insectory at Mandalay and has demonstrated simple and inexpensive methods of storing paddy in straw granaries and of threshing grain on inclined boards for the purpose of obtaining clean grain and clean unbroken straw. His work in connection with sericulture is mentioned elsewhere.

36. The receipts of the Department amounted to Rs. 20,004 and the expenditure to Rs. 3,77,712, of which Rs. 14,347 was spent for the students under training at Poona, Rs. 13,594 on the Amarapura Weaving Institute, and Rs. 23,318 on contributions to botanical and other public gardens.

37. For the purpose of showing the present Circles, the proposed Circles, and the various farms, a map has been prepared and attached to this Report. A statement printed on the map will show at a glance the occupied area and the area under the principal crop in each district.

An appendix compiled from the Season and Crop Report is attached to show the areas under the principal crops in each district.

38. All the Agricultural Assistants and Overseers have worked well and among the District Agriculturists, those of Shwebo, Meiktila, Thayetmyo, Prome and Amherst deserve special notice.

Conclusion.

District Officers have shown great willingness to help the Department in every possible way and I have to acknowledge the cordial help given by the Director of Industries on every occasion on which he has been consulted.

J. CLAGUE,
Director of Agriculture, Burma.

MAYMYO, 12th September 1921.

APPENDIX I.—*Glossary.*

Vernacular.	English.	Botanical.
Akyozaungs ...	Voluntary helpers in improvement and distribution of the Department's seed.	
Bedabin ...	The Water Hyacinth ...	<i>Eichornia crassipes.</i>
Emata ...	A variety of Kauklat paddy ...	<i>Oryza sativa.</i>
Ŧwengepe ...	Velvet bean ...	<i>Mucuna pruriens</i> var. <i>edulis</i> Wall. D.C.
Kapas ...	Unginned cotton.	
Kwin ...	A complete block of land demarcated separately for survey, to render assessment convenient.	
Letywezin ...	A variety of Kauklat paddy ...	<i>Oryza sativa.</i>
Matpè ...	Black gram ...	<i>Phaseolus mungo</i> , Linn.
Mogaung land ..	Generally precarious paddy land in the dry zone, being entirely dependent on rainfall.	
Ngachima ...	A variety of Kauklat paddy ...	<i>Oryza sativa.</i>
Ngasein ...	A variety of Kaukkyi paddy ...	<i>Oryza sativa.</i>
Pebrine ...	A disease common among silk-worms.	
Pèbyin ...	Kidney, French, or Haricot beans ...	<i>Phaseolus vulgaris.</i>
Pèbyugale ...	Small white bean ...	<i>Phaseolus lunatus</i> , Linn.
Pèdisain ...	Green gram ...	<i>Phaseolus mungo</i> , Linn. var. <i>Radiatus.</i>
Pegya ...	Rangoon red bean "Lima or Duffin bean."	<i>Phaseolus lunatus</i> , Linn.
Pègyi ...	Lablab bean ...	<i>Dolichos lablab.</i>
Pèsinngon ...	Pigeon pea ...	<i>Cajanus Indicus</i> Spreng.
Pwinbyu cotton	A white-flowered cotton of the Wagale variety.	<i>Gossypium neglectum</i> var. <i>Burmanicum.</i>
Pwinbyu pest ..	Witch weed ...	<i>Striga lutea.</i>
Sat ...	Italian millet ...	<i>Setaria Italica.</i>
Wagale ...	Early Burmese cotton ...	<i>Gossypium neglectum</i> var. <i>Burmanicum.</i>
Wagyi ...	Late Burmese cotton ...	<i>Gossypium obtusifolium</i> var. <i>Nanking.</i>
Vias ...	A Burmese measure of weight equivalent to 3.60 lbs.	

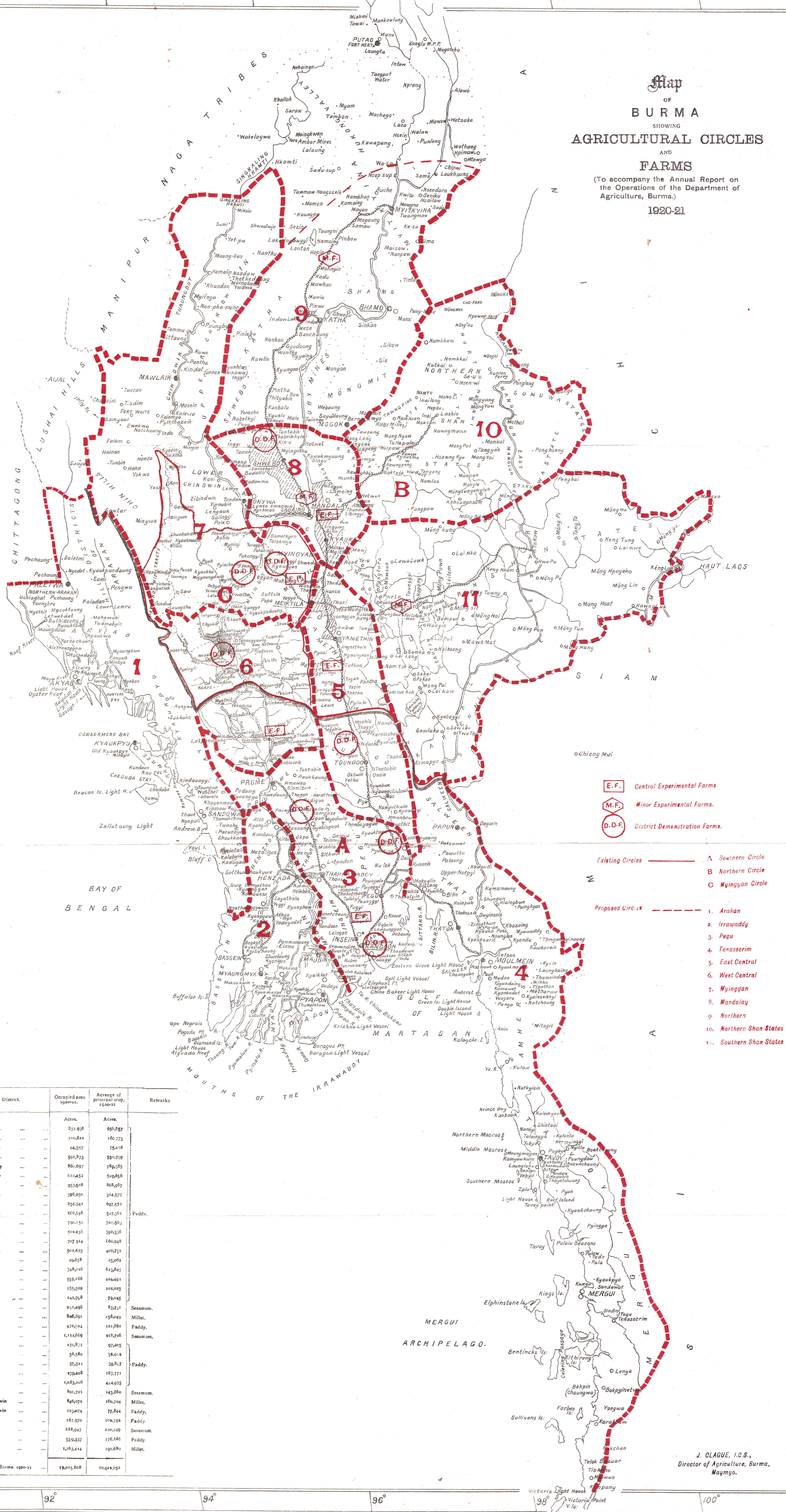
APPENDIX II.—Principal crops in 000 acres (less than 2,500 acres not included), 1920-21.

District.	Nett area sown.	Paddy.	Millet.	Little millet and Italian millet.	Maize.	Gram.	Sesamum.	Chillies.	Sugar-cane.	Cotton.	Tobacco.	Betel-nut.	Pègyi.	Pèbyu-gale.	Pègya.	Other beans.	Plantains.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Akyab ...	707.6	656.7	...	...	...	...	...	10.4	...	...	...	...	...	...	...	...	4.1
Hill District of Arakan ...	12.0	9.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kyaukpju ...	183.8	166.8	...	...	...	...	...	...	...	...	4.9	...	...	...	...	...	...
Sandoway ...	87.7	75.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Insein ...	560.2	510.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8.5
Hanthawaddy ...	833.3	789.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tharrawaddy ...	580.8	529.7	...	...	...	11.9	9.6	...	...	...	5.3	...	8.8	...	...	10.0	4.9
Pegu ...	808.1	869.6	...	...	...	...	8.8	...	...	...	7.1	...	...	...	...	...	2.7
Prome ...	374.7	304.6	...	...	...	...	3.8	...	...	...	8.7	...	9.4	...	...	...	3.6
Bassein ...	702.0	697.6	...	...	...	4.1	...	...	...	...	5.6	...	...	...	...	...	10.6
Hensada ...	640.0	597.4	...	...	6.1	5.5	...	3.9	...	...	10.2	...	9.3	...	...	10.0	14.1
Myaungmya ...	739.1	701.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5.7
Ma-ubin ...	471.0	392.3	...	...	3.0	...	...	6.6	...	...	7.7	...	...	...	...	21.6	6.4
Pyapön ...	674.0	660.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toungco ...	405.5	400.7	...	...	...	...	7.8	...	8.7	...	9.6	9.0	4.1	...	...	8.6	5.9
Salween ...	29.7	25.1	...	...	...	...	...	...	...	...	...	3.7	...	...	...	...	...
Thatön ...	701.1	623.8	...	...	...	...	...	...	7.2	...	...	...	...	...	...	...	3.6
Amherat ...	491.6	424.5	...	...	...	...	2.7	...	...	...	...	3.7	...	...	...	...	2.6
Tavoy ...	145.7	101.0	...	...	...	...	...	...	...	...	...	4.3	...	...	...	...	...
Mergui ...	133.2	79.0	...	...	...	...	...	...	...	...	...	4.1	...	...	...	...	2.7
Thayetmyo ...	193.9	76.4	...	...	10.8	...	83.7	...	...	51.9	10.6	...	...	...	...	2.6	...
Pakékkü ...	543.3	52.4	158.0	...	36.1	4.7	57.8	4.4	...	3.3	6.8	...	6.6	25.3	6.3	36.8	...
Minbu ...	607.7	120.9	21.4	...	24.8	3.6	53.6	4.8	...	...	...	...	7.9	7.6	2.9	15.0	...
Magwe ...	516.3	63.4	39.0	...	34.1	...	217.7	...	...	10.4	...	...	10.3	...	...	35.1	...
Mandalay ...	181.6	97.4	...	45.7	4.1	...	8.3	...	...	...	...	...	6.0	27.8	4.1	11.5	3.8
Bhamo ...	37.2	32.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Myitkyina ...	46.8	39.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Katha ...	191.6	182.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shwebo ...	601.6	445.0	7.0	...	...	...	58.6	...	...	7.7	...	...	2.8	10.4	18.0	10.7	...
Sagaing ...	544.9	29.6	54.8	...	7.7	8.6	143.0	4.1	...	98.3	3.8	...	8.4	63.7	27.6	2.6	...
Lower Chindwin ...	597.4	83.1	160.7	...	4.4	7.1	151.8	...	...	44.2	...	...	5.0	31.9	14.9	33.1	...
Upper Chindwin ...	29.1	77.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kyaukse ...	183.5	108.8	...	...	...	8.5	89.2	12.5	...	8.9	...	...	2.9	13.6	...	8.7	8.5
Meiktila ...	401.8	76.5	61.6	6.1	7.9	4.0	120.8	19.1	...	62.2	...	...	...	51.1	25.4	20.8	...
Yaméthin ...	328.0	176.7	15.7	...	18.4	...	66.0	...	...	2.5	...	...	4.4	8.5	...	38.4	...
Myingyan ...	660.9	31.3	190.7	33.8	6.4	4.0	130.8	6.4	...	71.5	4.3	...	4.2	64.6	35.5	23.8	...
Total, Burma crop, 1920-21*	14,823.9	10,338.9	699.5	89.4	171.5	60.4	1,142.4	27.7	22.7	565.5	100.3	30.0	98.2	308.0	128.7	341.5	108.7
Total, Burma crop, 1900-01*	11,450.4	8,550.1	1,066.9	...	20.7	52.6	808.5	4.5	10.5	154.5	69.9	...	...	...	258.5	...	...

* Includes crops with less than 2,500 acres not shown in the details.

Map
OF
BURMA
SHOWING
AGRICULTURAL CIRCLES
AND
FARMS

(To accompany the Annual Report on
the Operations of the Department of
Agriculture, Burma.)
1920-21



- E.F.** Central Experimental Farms
M.F. Minor Experimental Farms
D.D.F. District Demonstration Farms
- Existing Circles ——— A Southern Circle
B Northern Circle
C Myingyan Circle
- Proposed Circles - - - - 1. Arakan
2. Irrawaddy
3. Pegu
4. Tenasserim
5. East Central
6. West Central
7. Myingyan
8. Mandalay
9. Northern
10. Northern Shan States
11. Southern Shan States

District	Occupied area		Remarks
	1920-21	1910-21	
	Acres.	Acres.	
Akyah	332,936	656,457	
Kyaukpadaung	210,822	166,773	
Sandaway	64,357	75,008	
Insein	591,473	530,759	
Hanthawaddy	866,697	789,385	
Tharrawaddy	617,452	559,456	
Pegu	953,508	868,687	
Prone	398,950	324,577	
Bassein	824,541	697,572	
Herzard	666,256	517,301	Paddy.
Myingyan	796,151	701,503	
Maubin	502,436	392,336	
Pyawb	207,914	166,048	
Toungoo	502,433	402,721	
Salween	29,658	25,062	
Tharén	748,116	613,803	
Amherst	559,108	444,401	
Tavoy	155,009	101,093	
Mergui	147,752	79,045	
Thayemyo	211,498	83,721	Sesamum.
Fakoku	866,391	158,049	Millet.
Minbu	470,204	182,882	Paddy.
Magwe	1,112,656	812,226	Sesamum.
Mandalay	272,721	97,405	
Bhamo	38,586	38,019	
Myitkina	55,321	39,817	Paddy.
Katha	959,408	183,771	
Shwebo	1,483,206	444,675	
Sagaing	801,721	143,866	Sesamum.
Lower Chindwin	846,079	166,704	Millet.
Upper Chindwin	103,474	77,844	Paddy.
Kyaukse	167,970	167,970	Paddy.
Meiktila	688,027	130,249	Sesamum.
Yamethin	530,337	176,686	Paddy.
Nyinyang	1,167,414	196,680	Millet.
Total, Burma 1920-21	19,015,808	10,944,052	

J. CLAGUE, I.C.S.,
Director of Agriculture, Burma,
Maymyo.

[The maximum limit of the body of the Report is 12 pages.]

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Letter No. 303—SA., dated the 9th December 1922, from J. F. SHEEHY, Esq., I.C.S., Secretary to the Development Commissioner, Burma, to the Revenue Secretary to the Government of Burma.

Report on the Operations of the Agricultural Department for the year ending the 30th June 1922.

I am directed to submit the Report on the Operations of the Department of Agriculture, Burma, for the year ending the 30th June 1922.

2. The Report gives evidence of a more hopeful optimism than has been possible in the past. There have been substantial increases to the staff; the foundation stone of the Agricultural College has been laid and good progress has been made with its construction. It is now becoming more possible to concentrate on definite problems in better defined areas; the temptations to dissipation of efforts are disappearing. Mr. MacKenna notes with satisfaction that the Director of Agriculture is alive to the necessity of such concentration.

3. Pending the opening of the Agricultural College the Department is dependent on the good offices of the Poona Agricultural College for the training of agricultural graduates. Some of these students will soon be completing their course. The Development Commissioner agrees that we owe a debt of gratitude to the Bombay Government for their hospitality in this matter. Some difficulty is apparently being experienced in recruiting candidates of a suitable class for Junior Agricultural Assistants. It is to be hoped that these difficulties will disappear when the College is opened. Farmers' "classes" and farmers' "days" should be encouraged; they will do much to awaken an interest and to disseminate the results of the Department's researches. It is probable that better results will be achieved if, instead of separate Farmers' Associations, the existing District Agricultural and Co-operative Associations are made use of.

4. Chapter 3 of the Report gives some idea of the vast number of problems with which the Department is faced. In paddy they are unending. Some superior strains have already been isolated, but work on the line of pure line selection, mass production and distribution will be continuous for years. Paragraph 27 gives some indication of what has been achieved in the way of distribution. As it becomes possible to divide up the Province into smaller tracts by the opening of new Agricultural Circles, concentration on particular crops in particular areas will follow and more obvious results will be obtained. Chapter 3 indicates that there is no lack of problems; the agency for grappling with them is being rapidly recruited.

5. The Development Commissioner trusts that paragraph 14 will reassure the commercial community that the Department realises the seriousness of the "Burma bean" question. Mr. MacKenna only wishes the public to realise that the fixation of an immune variety bids fair to be a very long and tedious matter and that therefore it is desirable to attempt simultaneously to find substitutes if such substitutes exist.

6. With the opening of farms at Mahlaing and Allanmyo concentrated and continuous work will be possible on cotton. Paragraph 15 of the Report indicates the lines of work which are being followed. The results with Wagyi 800 are promising, but it is perhaps too early as yet to pass a final opinion on the suitability of Cambodia cotton for Burma. The strength of the fibre and the ginning percentage will be amongst the determining factors.

The farm at Pyinmana will enable the Department to attack the problems of sugar cane; while in Akyab Mr. Watson will tackle the question of cocoanuts. As noted by the Director, however, the main problems in connection with cocoanuts are entomological and it is only by drastic measures which must have the loyal co-operation of the cultivators that these insect dangers can be controlled. The Development Commissioner considers this the most difficult aspect of the case.

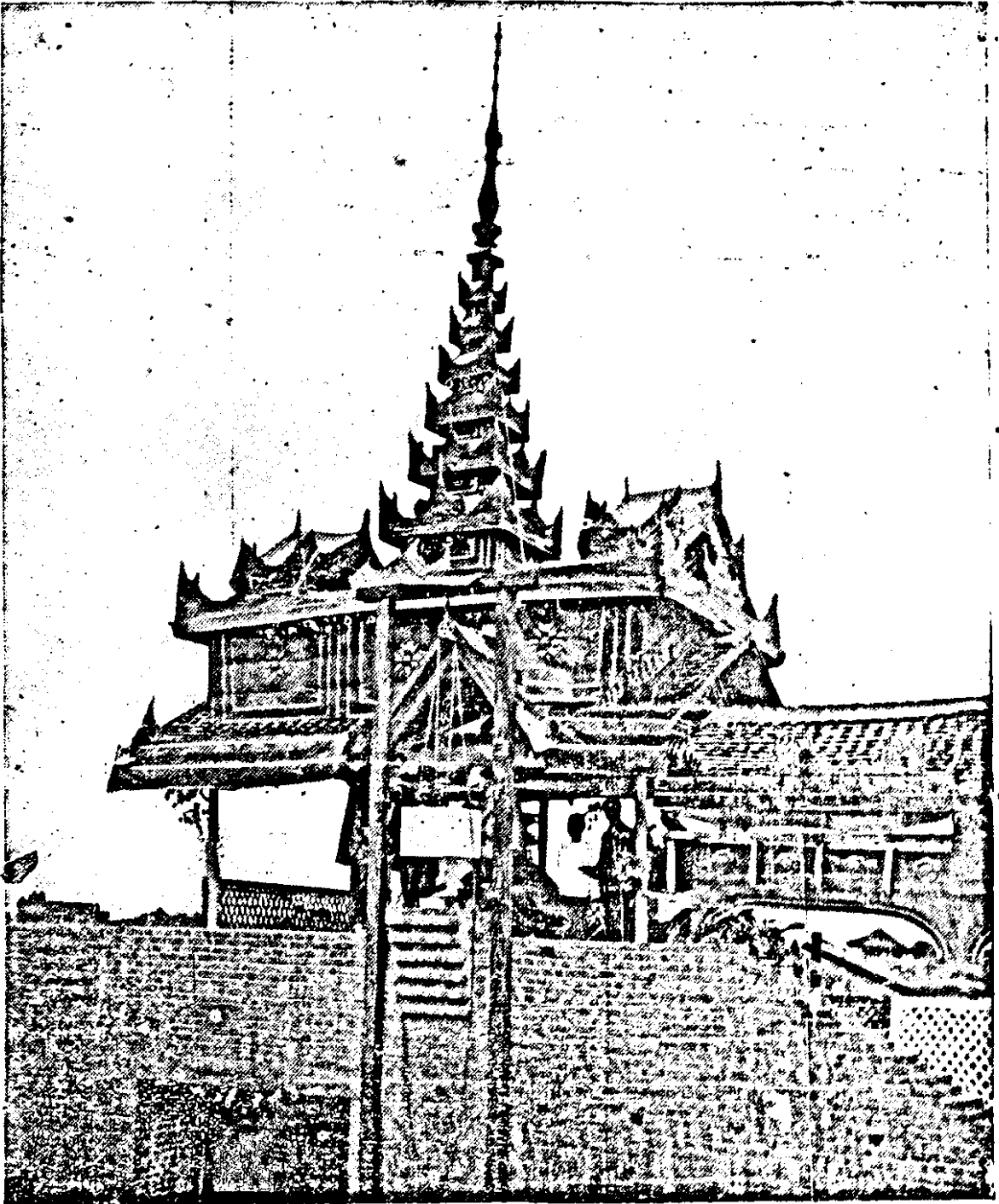
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7. The Report sets out fully the numerous activities of the Department and the Development Commissioner does not propose to refer to them in further detail. Stock-breeding has now been transferred to the Agricultural Department, the scheme for dairying is well advanced and some cattle have been imported from India.

8. It has been accepted that the Beda-bin problem must be regarded rather as one of control than eradication and proposals have been made that the work should be entrusted to the Public Works Department.

9. Good work has been done by the Agricultural Chemist Mr. Charlton who is proving himself a sound scientific worker with a strong appreciation of the commercial and practical aspects of his work. The Agricultural Engineer put in much useful work. Mr. Ghosh's work on Sericulture is of great importance and may prove of much value to the small section of the community who still follow this occupation.

10. The Development Commissioner desires to acknowledge the good work done during the year by the staff and would specially mention Mr. McKerral whose past services have been recognised by his promotion to the selection grade. His thanks are also due to Mr. Clague for his efficient administration of the Department and for a full and interesting Report.



**"The foundation stone of an institution which I hope will prove of incalculable benefit to Burma"—
His Honour Sir Reginald Craddock, K.C.S.I., at the laying of the foundation stone of the Agricultural
College at Mandalay on 29th August 1921.**

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, BURMA

For the year ended the 30th June 1922.

CHAPTER I.

ADMINISTRATION.

1. Mr. McKerral was in charge of the Northern Circle throughout the year. Mr. Stock took over the new Myingyan Circle with headquarters at Myingyan and Mr. Hendry was posted to the Southern Circle in July, 1921. Mr. Lord took charge of the West Central Circle which was formed in December 1921 with headquarters at Thayetmyo.

Four new Deputy Directors appointed by the Secretary of State, Messrs. McLean, Henry, Robertson, and Watson, arrived in Burma in December 1921. All four as part of their training spent a month or more with a Settlement Party in the field and the Department owes many thanks to the Settlement Commissioner and to the Settlement Officers, Kyauksè, Shwebo and Pyapôn, for their help and interest. Mr. Henry, who had taken up his work with great keenness, died in Maymyo Hospital in April 1922 to the great regret of all who knew him. New circles are being constituted with headquarters at Pyinmana, Myaungmya, and Akyab to which the new Deputy Directors will be posted in July 1922.

Maung Maung, Senior Agricultural Assistant, was transferred to the Education Department as Assistant Inspector of School Gardens in April 1922. One Poona student, Maung Chin Khine, finished his course successfully in March 1922 and on return to Burma he was posted to Hmawbi for training.

2. The addition of three new Deputy Directors during the year and the probable recruitment in 1922 of Deputy Directors for the proposed Northern, Tenasserim, and Southern Shan States Circles make it now possible to envisage the future organisation and policy of the Department on the lines worked out by Mr. Chalmers. New Deputy Directors must for some time devote themselves to the training of their assistants and the agricultural survey first of the districts containing the central farms and then of districts further afield in order to appreciate thoroughly and in detail the problems before them. They will carry out the scientific experimental work for the circles on the central farms at first and as the subordinate staff grows will carry the results of the experiments further afield. Concentration of effort is vital: the farmer and the scientific worker will benefit more ultimately if the work is concentrated in a confined area for a few years than if it is spread over several districts.

3. The following details may be of interest as showing the growth of the Department:—

A short Table showing the Progress of Staff in the Agricultural Department.

Year.	Deputy Directors of Agriculture.	Agricultural Chemist.	Economic Botanist.	Mycologist.	Agricultural Engineer.	Provincial Service Assistant Directors.	Senior Agricultural Assistants.	Junior Agricultural Assistants.	Expenditure.
1912	2	1	...	...	...	...	6		Rs. 1,46,000
1919	2	1	...	...	1	...	11	14	3,85,000
1920	2	1	1	...	1	...	15	17	3,11,000
1921	3	1	1	...	1	3	13	17	3,84,000
1922	6	1	1	...	1	4	14	37	5,23,000

CHAPTER II.

AGRICULTURAL EDUCATION.

4. Fourteen second and thirteen first year students were taking the three years' B.Ag. or Diploma Course at Poona during the year. The majority of the students did well in their examinations and took a prominent part in College games. It was for a time doubtful whether the Poona Agricultural College could take more Burma students but fortunately arrangements were made for a further five who were chosen by a Selection Board in April 1922. Burma is under a deep debt to the Bombay Government for the help received in this direction.

Senior Agricultural Assistants. Ten students were selected in October 1921 for training at Mandalay as Junior Agricultural Assistants. Only one of the candidates who appeared had High School Final qualifications, a fact which points either to a distaste on the part of educated boys for the work of the Agricultural Department or to the scale of pay (Rs. 60—5—150 on confirmation) being too low to attract them. Boys with inferior educational qualifications are not likely to benefit by the training and become of real value as Junior Agricultural Assistants. The former District Agriculturists have been absorbed in the Junior Agricultural Assistant cadre and where necessary transferred to centres where definite work can be assigned to them and strict control exercised.

5. At Hmawbi two classes were held for farmers in March and April. Fifteen young men attended for ten to fourteen days: they lived on the Farm and were paid enough to cover travelling expenses and subsistence. They displayed keen interest in the lectures and demonstrations and should in turn be able to spread a knowledge of the work of the Agricultural Department.

Co-operators and others. At Mahlaing also twelve farmers attended courses for various periods arranged to suit their individual requirements. These classes will be gradually extended and modified to suit the needs of different districts. At Mahlaing a day has now been set apart each month for farmers to visit the farms, see what is going on, and talk over their problems with the Circle staff. Although these farmers may not learn much of value from their visits, especially where scientific research and not demonstration is the main work of the Farm, the meetings with the officers of the Department and the realisation that the work on the Farms is being directed to the solution of farmers' problems can hardly fail to be helpful to both.

6. At Chaung-u (Sagaing) the Mechanical Overseer in charge of an irrigation experiment with a small oil engine taught a class of ten boys the rudiments of combustion engines. With a view to training local Burmans a scheme for engine-driver apprentices at Mahlaing and Allanmyo has been sanctioned: if successful the scheme can be extended.

7. The acquisition of the land for the American Baptist Mission Agricultural School at Pyinmana was delayed for some time and only completed in June 1922. Building has now begun and Mr. Case hopes to begin teaching in 1923.

8. The great event of the year was the laying of the foundation stone of the Agricultural College at Mandalay on August 29th, 1921, by His Honour the Lieutenant-Governor; a photograph of the ceremony is reproduced at the beginning of this report. This event marks a very definite step in the progress of the great scheme which is the outcome of His Honour's enthusiasm for agricultural education and advancement. In his speech Sir Reginald Craddock said: "I am laying the foundation stone of an institution which I hope will prove of incalculable benefit to Burma. We feel that the Agricultural Department in Burma will never progress as satisfactorily as it should until we have our own institution

here at which we can train our own men *in situ* and while teaching them as good general science as they can learn in any institution in India also acquaint them from the very first with the local problems which we have to face here in Burma.

"It is my firm belief that the Institution of which I am laying the foundation stone to-day will itself be the foundation of a large and most efficient Agricultural Department from the labours of which the land of Burma will bring forth her increase."

Good progress has been made with the College though non-arrival of girders caused some delay and it can now be definitely stated that the College can be ready with all fittings complete early in 1924. Eight quarters for Upper Subordinate and seven for Lower Subordinate officers have been completed as well as a number of quarters for menials, and the building of the hostel which is to accommodate 84 students has begun.

CHAPTER III.

AGRICULTURAL RESEARCH.

9. No new stations were opened during the year. The necessary buildings at Mahlaing Farm are now almost complete, clearing was finished, and the whole farm was worked during the year. Laying out the experimental areas in small plots has involved heavy work.

Allanmyo Farm was extended by 116 acres, a small four-gin ginnery and a godown completed, and a tube-well which struck good water at 120 feet sunk. Plans for the buildings have been drawn up and work on these will begin soon.

At Hmawbi acquisition of the additional twenty acres for the garden area though notified in March has not yet been carried out by the Collector. It has been decided to acquire 12 acres more for Tatkôn Farm, which may have to be still further extended to duplicate the cotton experiments at Mahlaing where risk from drought is extreme. At Mandalay 38 acres have been acquired between the old and new canal distributaries to round off the farm area. The extension of Padu Farm is badly needed for wheat and gram experiments but this depends on good water being found and a scheme for sinking a tube-well is in hand. Mr. McKerral and I in consultation with district officials have chosen sites for central farms at Akyab and for a sugarcane farm at Pyinmana and with the posting of Deputy Directors to the Arakan and East Central Circles in July 1922 a start will be made with these farms in 1923. For the Irrawaddy Circle selection of a central farm in Myaungmya will be deferred until the Deputy Director has some experience of the area. For the time being experiments can be carried on at the Myaungmya Jail Farm.

The prospect of experiments and mass production on jail farms opens up great possibilities. With ample labour well controlled at convenient centres, e.g. Tharrawaddy and Pegu, it should be possible to make district jails important centres for production and distribution of improved seed.

10. Work on paddy has naturally taken up most of the energies of the Department in the Northern and Southern Circles during the year. Only the broad outlines of the work can be summarized here and the Station Reports may be consulted for detailed information.

The main feature of the year's work on paddy at Mandalay was the reinstatement of plant breeding and selection which, Mr. McKerral writes, "for some unaccountable reason had been discontinued for several years." In yield tests of Mandalay *ngasein* (2104) and Hmawbi *ngasein* (10), the Hmawbi variety gave much better yields but this type of rice does not find favour with Mandalay millers. Farmers recognize the decided superiority of *ngasein* (2104) known as "*theikban*" *ngasein* over local unselected varieties and the problem is now one of mass production and distribution. The superiority of *taungdeikpan* is not so evident and reselection will be needed. Twenty acres of Japanese

'Hoito' short-lived paddy are being grown at Mandalay to form a stock for distribution. The attempt to secure Japanese paddy grown at Hlaingdet for distribution failed as the growers had mixed it with other paddy.

At Hmawbi fifty-six strains were selected from twenty-five new varieties received from various districts for examination and are being put down for second-year selection. Twenty-nine second-year selections were grown in lines for observation and to establish their purity in the third year or increase plots thirteen pure strains were grown. These include the strains at present being distributed direct from Hmawbi. Difficulties met with may be illustrated by the fact that a promising strain, *ngasein C277*, which after several years selection was, this year, grown on twenty acres for distribution unexpectedly developed *awns* of which there had been no previous indication. This paddy was therefore useless for distribution. Yield tests were carried out with three varieties of paddy comprising in all sixteen strains. The first included nine strains of the *byat* paddies grown in Amherst District, the second two strains of *ngasein* from Pegu District, and the third five strains of *ngasein* from Nyaunglebin and Insein. Three strains of the *byat* paddies were outstanding and have been retained for further trials, and one of the Pegu *ngasein* paddies showed marked immunity from the attack of case worms.

At Pwinbyu (Minbu District) selected varieties *ngasein 10* and *byatthidat* are being multiplied for distribution.

Several varieties of Akyab paddies have been put down for selection at Hmawbi where the new Deputy Director of Agriculture, Arakan Circle, will study the technique of paddy selection.

A series of sixteen manurial experiments was begun by Mr. McKerral at Hmawbi in 1912. For five seasons, 1912-1917, the plots were treated each year with the same manures. Since 1918 no manure has been applied to these plots but they have been cropped in the usual way each year to determine the effects of the original five years' manuring. Cattle manure alone, cotton cake, and cattle manure combined with potassic and phosphatic fertilisers still exhibit beneficial effects while the harmful effect of sodium nitrate still persists.

Figures for a bone meal test on a small scale show that with bone meal costing Rs. 90 a ton two hundredweights valued at Rs. 10 applied to an acre would in two years produce 3,725 lbs. on land which would normally produce 3,000 lbs. paddy. Bat's guano gave definite increases but *bedabin* (water hyacinth) ash tested as a manure gave no reliable results. Sunn hemp, gram, groundnut, and *pèlun* were tried as green manure on paddy land after harvest. Sunn hemp alone grew fairly well and was ploughed in at the beginning of the 1922 rains. Definite test plots will be put down in 1922-23 to determine the effect produced on the subsequent paddy crop. It may be noted that none of the leguminous plants produced nodules.

Experiments at Hmawbi on manuring of nurseries would, so far as they have gone, appear to show that for any appreciable increase in crop to be secured the seedlings should be transplanted into manured fields.

Experiments for seed rate in nurseries showed that this year a rate of six baskets per acre gave the highest crop yields. The experiments will need to be carried out for several years to enable definite conclusions to be arrived at.

Experiments were again carried on at Mandalay on forty-four plots to find out the optimum duty of water for paddy, the number of inches of irrigation water to be given at a time, and the length of the interval between successive irrigations. The results were conflicting owing probably to the facts that transplanting was late and that from transplanting till flowering there were very heavy showers of rain. A simpler scheme has been designed by Mr. McKerral and the Irrigation Officers for the 1922-23 season.

11. Owing to the failure of the early rains very little progress was made by Mr. Stock with the classification of sesamum varieties at Mahlaing. One hundred and eighty-five strains isolated in 1920 were sown in pure line cultures but germination was poor

and in spite of regular hand waterings, no material became available for a critical study of the crop. Seed of 114 strains was saved with difficulty and with these the work will be continued next year. Yield tests were carried out with three varieties at Tatkôn; owing to uneven rainfall in the early rains the short-lived variety, *tetthun*, was a total failure. *Pyegy* did well and is to be multiplied for seed next year. Where there is an assured rainfall drilled shows a decided superiority over broadcast sesamum and further experiments dealing with this are being carried out at Tatkôn.

12. Burmese wheat varieties have been placed under observation and selection at Mandalay and several Central Provinces selections from Jubbulpore were tried. Unfortunately conditions at Mandalay were unfavourable this year and the work will be transferred to Padu. The local varieties suffered from smut and rust.

In the Shan States work on multiplication of exotic wheats was continued; Federation and Pusa 12 have been found to do best on lowlying areas and Pusa 4 on the uplands, and have continued to give good results. Further experiments with wheat planted in October after a crop of potatoes planted in June and lifted in September show that on manured land twice the yield obtained by Shan farming methods can be got.

13. Experiments at Mahlaing with two spreading varieties of groundnut, Burmese and Pondicherry, and two erect varieties, Spanish and Small Japanese, pointed to the yields of the erect being lower than for the spreading types. While cost of cultivation came to Rs. 19 an acre for erect as against Rs. 15 for the spreading types harvesting cost less than Rs. 10 an acre for erect as against over Rs. 20 for spreading types: this is due to the great ease with which the plants can be pulled. Spanish groundnut has been valued at Rs. 10 to Rs. 15 a hundred baskets more than ordinary groundnut. The skin of the Japanese groundnut is rich, red in colour, and tests will be made to ascertain whether this has any colouring effect on the oil. The correct spacing for the erect types is the next important investigation on groundnuts. In Thayetmyo District Spanish and Japanese groundnuts grown by an *akyosaung* are reported to have yielded 50 and 40 baskets to the acre respectively: on Allanmyo Farm the yields were 23 and 14 respectively. There is now a big demand for the seed. Small quantities of new varieties, Upright American and African, received this year from America, are being multiplied at Tatkôn.

14. The area under *pèbyugale* has again fallen by 39,000 acres but is still greater than that under *pègyi* and *pègya* which has risen by over 25,000 acres. The importance of *Phaseolus lunatus* is due to its being a cold weather crop and a crop which gives fair yields on the upland *ya* and with the very small rainfall of the dry zone. Mr. McKerral writes:—

"The attempt to find a substitute is therefore difficult. The *Phaseolus vulgaris* varieties in general need a cooler climate and a moister atmosphere, so that even if the price of *Phaseolus lunatus* is low it may pay farmers better to grow *pèbyugale* or *pègya* than other prussic acid-free kinds which yield poorly. The riverine alluvial tract, where large quantities of beans are grown, is different."

Work on beans is therefore being continued with a view to—

- (a) finding a prussic acid-free strain of *Phaseolus lunatus* for the upland areas of the dry zone;
- (b) experimenting with possible substitutes for upland areas;
- (c) experimenting with possible substitutes for riverine areas.

Of work on the strains of *pèbyugale* left by Mr. Warth, Mr. Charlton writes:—

"In the year under review the content of prussic acid tended to increase. About four acres of strain K were grown at Tatkôn for multiplication. Over 1,000 single plants, all excellent yielders, were collected separately for analysis. Over 500 plants have been examined with results as follows:—

Maximum per cent. H.C.N. = '0058

Minimum per cent. H.C.N. = '0015

It is proposed to continue selection with the plants representing the minimum. The fact that so far 500 plants have failed to give one free from prussic acid discourages the hope that *Phaseolus lunatus mutatus* as regards the prussic acid factor."

It may be possible, however, to obtain plants which will contain such a small amount of prussic acid as to satisfy any ordinary test. Mr. Charlton has made the important discovery that by adding ordinary brewers' malt to the crushed beans a larger amount of prussic acid was liberated than when ordinary enzyme reaction was employed for liberating the prussic acid. The method is quick and easy to carry out and will much facilitate the work.

Attempts are being made at Mandalay to cross Madagascar beans with *pègya* and *pèbyugale* and the results will be awaited with great interest.

As substitutes for *Phaseolus lunatus* several varieties of Japanese beans and of Shan beans, all of them varieties of *Phaseolus vulgaris*, have been tried at Mandalay. It is proposed to multiply the selected strains for seed production at Tatkôn and Mahlaing. A collection of many varieties has also been made for trial at Mahlaing next year. An attempt to get Tipary beans from Arizona for experiment has not been successful but an application has now been made to the United States Department of Agriculture.

Two and a half tons of a variety of *Phaseolus vulgaris* grown in the Shan States and known there as *pèbyin* were shipped to England as an experiment. The quality of the sample was poor and as the beans realized only £6 a ton there was a heavy loss on the shipment.

Testing of the strains of *Phaseolus calcaratus* at Mandalay has resulted in the retention for seed production of only one strain of common yellow *pèyin* and one of Kachin-*pè* a large seeded variety of the yellow *pèyin*. Out of a large number of soy beans tested three strains have been selected and will be multiplied.

The *pèsingôn* (*Cajanus Indicus*) previously selected at Mandalay was a white-seeded variety and matured late. As district reports indicate that the demand is for an early maturing red-seeded kind, seed of two early-maturing red-seeded varieties from the United Provinces, and other early varieties obtained from the Imperial Economic Botanist will be worked with at Mandalay for isolation of the types desired.

Mr. McKerral is also working at Mandalay on the—

- (a) production of a strain of *matpè* free from *pènauk*, the presence of which lowers the price by a rupee a basket.
- (b) multiplication of a pure line of *pèdisain*, as this seed is usually mixed with that of other small pulses.

15. Mr. Stock, Economic Botanist, made considerable progress during the year with the survey of indigenous cottons. The *wagale* crop has been studied in more detail and these studies show that there are considerable variation both in quality and ginning percentage in the crop from different localities. Samples have been taken from all the principal cotton-growing centres and it remains to be determined from experiments at Mahlaing whether the variation is due to heredity or to the influence of local conditions. In the Shan and Chin cottons the main types have been isolated and self-fertilised seed taken for further study.

As was shown last year yellow-flowered *wagale* tended to be superior to the white-flowered variety in mean yield and length of lint while the latter variety maintained its superiority in respect of ginning percentage.

Though the ginning percentage of selected *wagale*, Tatkôn 4, fell very slightly from 36.2 in 1920-21 to 36.13 this year, for the cotton ginned at the Mahlaing Farm Ginnery, it was much superior to ordinary *wagale* which is said to have yielded only about 30 per cent. of lint this year.

Some of the *wagale* selections made in the previous year gave highly promising results. Seed of C19 was saved for a plot trial while the following reselections were made for continuation in row progeny lines :—

Plant No.	No. of bolls.	Yield of <i>kupas</i> in grammes.	Length of lint in inches.	Ginning percentage.
487-2 ...	109	257.35	.68	34.59
C19-20 ...	99	205.53	.71	35.18
C19-22 ...	146	285.12	.70	40.58
C19-23 ...	63	126.65	.70	37.37
C19-27 ...	67	146.23	.63	36.42
C19-28 ...	74	124.50	.66	36.76

The *wagyi* selections from the previous year were grown at Tatkôn. One of these number 800 proved to possess exceptional merit and the following four reselections will be continued :—

Plant No.	Length of lint (inches).	Ginning percentage.
800-1 ... **	'76	35'07
800-2 ...	'69	41'74
800-3 ...	'81	38'14
800-4 ...	'72	40'83

Of the Shan X *wagale* selections taken in the previous year only three gave uniformly satisfactory results. These hybrid strains produce lint of excellent quality but their yielding powers are considerably lower than those of *wagale* and they also give a lower ginning outturn. Selection is being carried out with a view to isolating a really profitable strain.

During the year 131 crosses were made at Mahlaing but unfortunately many of the cross fertilised bolls dropped as a result of heavy late rains and only 23 sound bolls matured. These will be sown for Mendelian studies and it is hoped that some valuable strains will result. The year was almost disastrous for the selected white-flowered *wagale* crop : over 16,000 viss of pure seed were distributed last year but less than 7,000 viss of *kapas* were brought for ginning to the Mahlaing Farm Ginnery : many cotton growers were unable to plant their seed, most of what was sown failed, and the nature of the season in the Mahlaing area may be judged from the fact that the Farm yielded only about ten viss to the acre.

Kapas from an acre plot of white-flowered Tatkôn 4 grown at Tatkôn when ginned at Mahlaing gave a ginning percentage of only 34·28 though this strain had given 40 per cent. or more for several years. Two acres are to be planted next year for further selection. Selections of Broach-*wagyi* cross, *wagyi*, and Shan-Burmese cross have been made for further tests at Tatkôn.

From 30 acres in 1920-21 the area in Sagaing and Môngywa under Cambodia cotton increased to 468 acres in 1921-22. Owing to severe late rains and boll-worm attacks the yield was poor, only some 20,000 viss. Mr. McKerral met the growers in June and they decided to go on with the crop for another year as it was pointed out that though the average was poor some very good individual results, up to 160 viss per acre, had been got. The price obtained was Rs. 60 when ordinary *wagale* was Rs. 44 per 100 viss. Messrs. Tata & Sons' report on samples submitted for evaluation compared the Môngywa Cambodia to Sind-American but pointed out that the staple was weak and valued the samples at Rs. 490 as against Rs. 500 per 784 lbs. for good staple Sind-American cotton on the same date (July 19th, 1922).

In Thayetmyo District out of over 400 acres sown in 1921-22 only about 167 were harvested, the phenomenally heavy rainfall in November having totally destroyed the crop in many places. The yields reported by farmers varied from 45 to 140 viss *kapas* per acre but on the Allanmyo Farm four acres yielded at the rate of 172 viss per acre. The ginning percentage was 36 and the price realized for the lint was 1½ annas a pound above that current for *wagyi*. A valuation by the Cotton Contracts Board in May gave Rs. 525 to Rs. 540 for Burma Cambodia and Rs. 440 to Rs. 460 for Burma *wagyi*. As *wagyi* has a ginning percentage of 40 extended yield tests will be necessary to decide whether Cambodia or *wagyi* gives better financial results.

The small ginnery of four gins at the Allanmyo Farm was completed during the year at a cost of Rs. 21,500, and 14,476 viss of Cambodia *kapas* were ginned for cotton-growers. The system, which has worked well at Mahlaing, of advancing Rs. 20 per hundred viss of *kapas* to the growers when they bring the *kapas* to the ginnery and recovering the advances and charges when the lint is sold, was successfully followed at Allanmyo.

At Tatkôn Cambodia did not do well and the bolls formed were badly attacked by boll-worms. Its cultivation at Tatkôn has therefore been discontinued.

16. Lack of staff has hindered extensive work in connection with sugarcane but with the opening of the East Central Circle and the proposed sugarcane farm at Pyinmana the

Sugarcane.

Department will be in a position to carry out some at least of the recommendations of the Indian Sugar Committee.

At Tatkôn eight exotic and two indigenous varieties of sugarcane were under observation. Java Hebbal, a medium-sized reddish yellow cane which resists drought well, J213, a good tillering purple cane, and Ashy Mauritius, a thick cane which stands drought and never lodges, have all done well. Small tests on the Tatkôn Farm showed that Ashy Mauritius gave 12 per cent. of jaggery to weight of cane. At Hmawbi thirteen exotic and two Burmese varieties were grown without irrigation on two and a half acres of the new garden area. Ashy Mauritius was the most successful and all available cane were sold for "setts." Sugarcane has also been introduced by the Department to farmers in Shwebo, Sagaing, and Mandalay and prospects for future extension are good.

The Jaggery Factory near Hopin (Myitkyina) after being worked for a month in 1922 was closed as the cane supply gave out. The experiment failed because the local farmers were not really keen on growing cane and because the locality was hardly favourable for such an enterprise. Cane had promised well at Hopin Farm but lack of drainage and insufficient cultivation resulted in the outside area falling from an estimated 90 to under 20 acres matured. The factory was dismantled at the close of the year and it is hoped to find a more promising centre for future experiment either in Yamèthin or Toungoo. So far attempts to induce cane-growers to combine for power-crushing have resulted only in extravagant requests for additional machinery, such as a small rice mill, to be run in conjunction with the power-crusher.

17. From Prome it is reported that only 500 viss of well cured Pusa 28 was harvested this year as the nurseries were badly washed out by heavy showers in November. This tobacco is reported to be gradually increasing in favour. In Thayetmyo Mr. Lord made a study of the methods of cultivation, curing, and marketing and it is hoped to begin work on this crop in 1924 in the West Central Circle.

Tobacco.

18. No work has been done on jute during the year but experiments will be made by the Deputy Director of Agriculture, Irrawaddy Circle, as part of the work of the new Circle at Myaungmya.

Fibres.

19. At Hmawbi guinea grass and millet were grown with success. Ten tons of guinea grass were got in June from a one-acre plot which had been cut close to the ground in the hot weather. It will not give large cuttings throughout the year however unless it is grown on good soil or is well manured and receives an ample supply of water. An acre of millet sown broadcast in June yielded seven and a half tons of fodder in October.

Fodder Crops.

Experiments with fodder crops, lucerne, teosinte, oats, Egyptian clover, maize, and guinea grass, at Mandalay with a view to testing the capabilities of the Mandalay soil for growing green fodder under irrigation for the proposed dairy farm proved that a continuous supply of green fodder can be got if water is available. The most important result was the discovery that Berseem or Egyptian clover can be grown by sowing the seed in the wet mud just before paddy is reaped with subsequent irrigation. Although the Dodder parasite attacked the crop and large patches had to be cut out and burnt the average outturn per acre of green forage was nearly two tons. Dodder-free seed is being got from North-West India for trial next year. Saccoline (*Sorghum saccharatum*) and fodder maize from Bombay did well but lucerne was not a decided success. The highest yields were from maize $9\frac{1}{2}$ tons, oats 7 tons, and guinea grass $6\frac{1}{2}$ tons to the acre.

The saccoline introduced from New South Wales is likely to prove of great value. It yields much better than teosinte, Sudan grass, American sorghum, or local millet (*Andropogon sorghum*). It has withstood drought well and as it matures almost a month earlier than local millet it is most valuable in September when fodder is often scarce. It has done well at Tatkôn, Mahlaing, and Allanmyo and is being taken up by local farmers.

20. As it proved impossible to obtain the services of an expert at reasonable rates to report on coconut planting in Burma, Mr. Watson, who is being posted to the Arakan Circle in July 1922, will tour in Southern India in October 1922 to learn the methods and the requirements of successful coconut plantations. On return he will begin work on coconuts in Akyab.

Coconuts.

At Hmawbi the percentage of germination of dwarf coconuts from the Malay States was 67 : these have been planted out at the rate of 90 to the acre on two and a half acres, appear to be doing well, and should come into bearing in 1925. A small number of these have been sold to growers and their behaviour under different climatic and soil conditions will be compared with those at Hmawbi.

Over 90 per cent. of the Madras nuts received in 1921 germinated and are doing well : they will be planted out on two acres shortly.

The problem with coconuts, which under good conditions give so excellent a return to the grower, would now appear to be entomological rather than agricultural. Most palm-growing areas in Burma seem to be infected with rhinoceros beetles and palm weevils and breeding-places are so numerous—hundreds of beetles have been found in a small dung heap—that either every householder in a coconut palm area will have to take precautions or drastic legislation will have to be resorted to.

21. Gram is grown regularly in rotation with wheat in several dry-zone districts. Burmese gram has, however, been for years subject to attacks by a soil fungus, identified at Pusa as *Fusarium udum*, and average crops have yielded not more than four or five baskets an acre. Karachi gram has proved to be at least temporarily immune and a remarkable demonstration was given at Padu Farm, which is in the centre of the gram tract, this year. Karachi and Burmese gram were grown in alternate plots, five of each ; the Burmese gram failed on all five plots, while Karachi gram yielded at the rate of 1,400 lbs. an acre. At Chaung-u (Sagaing) adjacent plots grown by a farmer gave like results. Mr. McKerral writes :—

Gram.

"The figures clearly prove that the wilt disease of gram has taken for an indefinite number of years a toll of six lakhs of rupees a year from the Sagaing and Meiktila Divisions alone. Last season seed of Karachi gram was eagerly sought for and over 2,000 acres are reported to have been under the new variety in Sagaing District."

Various gram varieties from India are being tested at Padu where the aim will be to keep in reserve as many disease-resisting types as possible.

22. Linseed was tried on the flooded land of the Mandalay District but yielded less than 6 baskets an acre from 30 acres. Tests will be made with gram to determine the relative cost of handling and profit on linseed and gram. Safflower has done well at Mandalay, a small plot yielding at the rate of over 1,000 lbs. seed to the acre : the Agricultural Chemist reported the oil content of the seed to be over 24 per cent. indicating that the seed is of fair average quality.

Miscellaneous.

Work has been started on chillies at Mandalay with the sowing of varieties obtained from Mandalay, Kyauksè, Minbu and Myingyan for selection of good strains.

Experiments in Hanthawaddy with *matpè* and *pèdisein* broadcasted in paddy-fields before the paddy was harvested failed as practically the whole of the seed was carried away by field mice and rats.

Twenty baskets of gram were issued free to farmers for experiment on flooded land in the Pegu District and a skilled gram cultivator from Sagaing was employed to demonstrate the best methods of cultivation. The land was not well prepared and the yield was poor.

23. The new garden area at Hmawbi was cleared and was utilized for growing Burmese vegetables for pure seed, sugarcane, and fodder crops in the rains. A limited quantity of vegetable seeds was sold. Part of the area has been planted with dwarf coconuts and citronella and four varieties of cocoa from Ceylon have been put down. Extension of the work, however, will be slow until a good Horticulturist is obtained. The gardener who had agreed to come from Bombay failed to join and a substitute has not yet been found. Only sixteen per cent. of the African oil palm seeds (*Elaeis Guineensis*) received in 1921 germinated and only 11 plants have survived. Reports from people who experimented with seeds in different parts of Burma indicate that the percentage of germination has been small.

24. The Imperial Dairy Expert, Mr. W. Smith, visited Mandalay in January and a scheme for a large dairy farm on modern lines was drawn up. The scheme will involve a capital expenditure of about three and a half lakhs in six years and contemplates building up a large herd of Sindhi and Montgomery cattle for milk supply while experiments are being made with pure Burmese and Burmese crosses. The ultimate object is to produce, if possible, good draught animals as well as good milkers.

Plans for the buildings required were furnished by Mr. Smith and estimates are being drawn up by the Public Works Department. Estimates for the machinery and equipment have already been secured and provision for the scheme will be made in the 1923-24 Budget.

Eight Sindhi cows and a Sindhi bull selected by Mr. Smith were bought in April for the Mandalay Farm and if the large dairy scheme is approved will form the nucleus of the dairy herd. The cows for the short period they have been at Mandalay have averaged nearly 10 lbs. milk each per day.

25. As it has been decided not to proceed with the scheme for a large central stock-breeding farm it is proposed to begin experiments in cattle breeding on the central farms. No strictly pure Burmese breed seems to exist at present but young bulls and heifers from centres where there has been so far very little crossing with Indian cattle are to be bought for the central farms and the progeny observed. The Stock-Breeding Expert, Captain Idle, will co-ordinate the information obtained and selection will ultimately be carried on. It is somewhat curious that opinion at such centres as Mahlaing is in favour of the "Moulmein Chetlon" bullock, reported to be a Burmese-Indian cross.

It must not be forgotten, however, that the problem is largely economic. Better cattle almost necessarily presuppose more care and better feeding and experience of recent droughts points to the prior necessity of an improved fodder supply for the dry-zone cattle-breeding areas. Nor will the Lower Burma farmer get cheaper cattle: care in feeding and breeding must be paid for and there is perhaps a tendency to overlook the fact that while the cattle (bulls and bullocks) and buffalo (bulls, bullocks, and cows) population rose (*vide* Stock-Breeding Committee Report figures) from 2,179,526 in 1903 to 3,225,141 in 1917 the area cropped had in the same time risen only from 11,355,614 to 14,414,526 acres, yet prices of cattle rose almost steadily. What Mr. Grantham in the Myaungmya Settlement Report says of Myaungmya is not inapplicable to many parts of Burma: "It is usual to say that the average area worked per yoke is too large; but that seems to be a proposition requiring considerable qualification in the light of the economics of agriculture."

26. Attention is being paid to the problem of double-cropping in the Delta. Several attempts have been made to grow crops after the paddy has been reaped but the great rapidity with which these soils dry at the end of the rains makes dry-weather cropping very difficult where irrigation is not available. Well irrigation too cannot deal with large areas on an agricultural as opposed to a horticultural scale. Groundnuts, gram, *matpè*, and *pèlun* have all failed as dry-weather field crops after paddy at Hmawbi. Sunn hemp has succeeded to a certain extent

but its value is mainly as a green manure. It may be possible by sowing early-maturing paddies to sow a second crop which will benefit by the remaining moisture and among other experiments early Japanese paddy will be tried this year at Hmawbi. Next year extensive trials will also be possible at Myaungmya and Akyab.

CHAPTER IV.

DEMONSTRATIONS, AID TO THE PUBLIC, SHOWS, AGRICULTURAL ASSOCIATIONS AND GENERAL PROGRESS.

27. Reports from the Southern Circle go to show that Pegu has the greatest area in any Lower Burma District under improved strains, over 8,000 acres under *ngasein* (8), 2,600 acres under *letywezin*, and 590 acres under *ngachima*. It is however impossible to give any accurate figures owing to the difficulty of tracing seed beyond the first year of issue; from Pegu *ngasein* 8 has spread into Hanthawaddy and names such as *mingyisaba* (Pegu) and Dawson's *letywezin* (Ma-ubin) are given to good paddy which can be traced back to the Department's pure strains but for which the growers seldom credit the Department. In the Hlègu Township (Insein) *ngasein* 8 is said to have entirely replaced the *ngasein dume* previously grown. Distribution of improved paddy from Hmawbi has this year been confined mainly to the Hmawbi neighbourhood with a view to replacing local paddies of less value and carrying on this replacement in wider circles every year. If the local growers keep the seed pure this can be bought for further distribution. In the neighbourhood of Hmawbi small parcels of bone meal have been given free to farmers for trial.

A survey of the paddy areas within five miles of the Mandalay Farm and five miles of Singaing (Kyauksè) went to show that there must be at least 50,000 acres under *taungdeikpan* and *ngasein* (2104) in the two districts. These paddies are generally known as "*theikban*" but here again names such as *athinsaba* (society paddy) given to varieties recognized as superior give no credit to their source. The farmers' paddy from these strains has become contaminated with red grain and distribution of the pure strains is being renewed, no less than 7,176 baskets being sent out from the Mandalay Farm in the year. It is unfortunately not certain that all this has been used for seed as enquiries point to the fact that buyers, whose object in buying Farm paddy was said to be for seed, have not used the paddy for this purpose.

Drought almost ruined the areas under white-flowered selected cotton in Meiktila: under 7,000 viss of this "*kapas*" were ginned at Mahlaing Ginnery and only some 3,000 viss of seed were available for distribution for the 1922-23 crop. Some 30 tons of Spanish groundnut have been distributed through the Department in Myingyan, Meiktila and Pakkòku and about 25 tons through private growers.

Japanese paddy was greatly in demand but little seed was available owing to mixing: about 3 tons were distributed in Meiktila and Myingyan by the Department and private seed-growers have sold about 4 tons more. Wheat introduced at Pindale (Meiktila) in 1921-22 proved successful on 59 acres and about 500 baskets will be distributed this year.

In the Northern Circle seeds distributed directly from agricultural stations or at the instance of the Department included over 25,000 sugarcanes, 165 tons paddy, 21 tons wheat, 4½ tons Karachi gram, and 5 tons linseed. Over 150 tons of Karachi gram have been bought for distribution in 1922-23.

From the Allanmyo Ginnery over 8,000 viss Cambodia cotton seed was returned to cotton-growers, enough to sow at least 1,000 acres. From the Pwinbyu Farm about 18 tons of *ngasein* 10 and *byatfluidat* paddies have been distributed.

An exceptional demand for sugarcane for "*setts*" at Hmawbi resulted in sales of over Rs. 1,300 the produce of less than three acres.

In the Southern Shan States three private seed farms comprising 96 acres were stocked with new wheats to accelerate distribution and out of the crop of over 38 tons about 15 tons had been distributed for seed before the end of the year.

Mr. Stock after attending the Board of Agriculture Meeting at Pusa in February 1922 visited Jubbulpore, Nagpur, and Cawnpore to study the methods of cotton-seed distribution and other problems and gained experience which will be very valuable when improved cotton seed is ready for distribution on a large scale.

Plans for seed godowns at Hmawbi, Mandalay, and Tatkôn which can probably be built by the end of 1922 are in hand and as an existing building is available at Mahlaing pure seed distribution should make still greater strides next year. Experience will indicate how these seed godowns can be made most useful and if they prove of value the system can be extended. The value of pure seed is becoming more widely known; at the end of 1921 for instance Karachi gram sold for seed by the Department at Rs. 5 a basket was being sold by growers in Sagaing who could spare a little at Rs. 10 a basket. Spanish groundnut has also fetched high prices. While, however, pure paddy strains command a premium, especially from small millers, most of the produce instead of being used for seed seems to be lost through being sold to mills. Many reasons are given for this, among them the extraordinary reason that Government in introducing pure seed with a view to higher yields is aiming at higher taxation. Perhaps the most important factor in Lower Burma is that landlords and their tenants are often too late in the market to get pure seed. The provision of stocks in godowns will do much to obviate this.

One of the most encouraging reports on district work as showing the real appreciation of the value of the Department's improved paddy is that in Bassein District an *akyozaung* has built a godown to trade in improved seed. This experiment will be carefully watched. If individual and co-operative enterprise finds it profitable to store and sell good seed many of our distribution difficulties will be solved.

28. District Agriculturists, who were absorbed into the Lower Subordinate Agricultural Service as Junior Agricultural Assistants from 1st March 1922, have done very useful work in some districts. The District Agriculturist has clearly influenced practice in the Mōnywa District and good work has been done in Sagaing, Meiktila, and Mīnbur. *Kwin* maps and registers for recording areas under new crops and the effect of seed distribution have been started and have already proved of considerable use. The District Agriculturists from Amherst, Pyapôn, Myaungmya, and Ma-ubin have been transferred to Hmawbi for intensive seed distribution and further training: their work was too scattered and too difficult to supervise with the present staff to be of permanent value. Definite programmes of work in limited areas will be insisted on and if the policy of starting a number of small farms at prominent centres to be rented to selected farmers chosen by local agricultural associations is carried out, these Junior Agricultural Assistants will become itinerant instructors with regular centres for work.

29. High prices of implements are the great hindrance to sales. The advantages of Cyprus ploughs are widely known but the cost, Rs. 35 to Rs. 40, is much too high for the ordinary dry-zone farmer. Sugarcane-growers in Yamèthin have been enabled to buy cane-crushers with agricultural advances. Fourteen Cyprus ploughs and 18 cane-crushers were sold in the Northern Circle, and 7 small seed drills in the Myingyan Circle. A much larger number of cane-crushers could have been sold but were not available in Rangoon. Tests of the Hmawbi paddy-threshing machine, to discover whether it would pay to offer facilities for threshing to local farmers, failed owing to the breakdown of the engine. Several implements have been lent to farmers for trial and the hiring of implements to small farmers may soon become a regular part of demonstration work. So long as prices of implements remain high, a "Cyprus" plough for instance costs from a fifth to a tenth of the average dry-zone farmer's gross yearly

income, they will not be much used however popular they may be unless some such system as hiring them out is resorted to.

30. As for tractors there is little evidence as yet for or against their use. The Fordson at Mahlaing has ploughed about 60 acres at a cost, not allowing for depreciation, of Rs. 6 an acre.

Tractors.

Five different tractors were tried for three hours at the Mandalay Farm on 7th September 1921. Rain prevented the tests being held during the Conference. The conclusions arrived at as a result of this test which though short was severe were—

(a) that thoroughly trained drivers are required in each case, a very important factor in view of the comparative scarcity and high wages of skilled mechanics in Burma and the small probable number of working days.

(b) that they would be useful in breaking up new land or in ploughing land during the hot weather for cultivation in the rains.

The Bates' Steel Mule gave the best performance.

31. The Provincial Cotton Committee in April 1921 decided on the opening of a cotton market by way of experiment at Mahlaing where the Deputy Commissioner, Meiktila, had agreed to allow the use of the bazar. Rules were drawn up and an advisory committee appointed to advise the officer in control of the bazar. The market was opened on October 23rd but the very poor cotton crop following on the failure of the early sesamum crop had forced the cotton-grower to sell largely in advance and the market failed. The committee met again in May 1922 and after discussing the causes of failure at Mahlaing and the prospects of success elsewhere decided in favour of opening a market at Myingyan in October 1922. A sub-committee was appointed to work out details for consideration by the committee in August. Proposals to start a cotton market at Allanmyo in 1923 have been keenly taken up and a strong local committee is dealing with the matter. The committee in July 1921 discussed the recommendations of the Indian Cotton Committee as regards licensing of gins and presses and the assignment of marks and numbers to factories and conditions. The majority of the committee was against these recommendations on the ground that they would involve small ginnerers in much extra trouble and expense.

Provincial Cotton Committee.

32. The Deputy Commissioner, Yamethin, again organised a cattle show at Yamethin in December 1921, which was attended by officials of the Department, the Department contributing Rs. 1,000 towards the prize money. Some 7,000 cattle and buffaloes were brought to the show and excellent exhibits of sugarcane and other crops were shown. Similar shows will probably be held at Mandalay and Mahlaing next year in connection with the central farms and may do much to focus interest in the work of the central farms.

Cattle Show.

33. The institution of small unofficial township committees of prominent landowners and farmers to discuss local agricultural problems with officials of the Department is a new development of the year. Many committees of this type have been formed and should in time become most valuable agencies for focussing attention on the problems felt by the farmer and for spreading the knowledge of the aims and work of the Department. The conception of such a committee is that the officials of the Agricultural Department may have a body of intelligent opinion in each centre where work is carried on to discuss the local problems. These committees may point the way to regular Farmers' Associations. While the Departmental officials have thus on the one hand a committee with whom they can discuss local problems in each centre, interested farmers are on the other hand being encouraged to meet on the central farms periodically to see what is being done there and to get the advantage of discussion with officials on the farms.

Township Committees.

34. Experience with the four experimental homesteads at Hmawbi Farm is yet too small to allow of any conclusions being drawn. At the opening of the Agricultural and

Homesteads.

Co-operative Conference, Mandalay, in August 1921, I drew attention to the "Homestead" problem in the following words :—

"I commend this question to the earnest consideration of every farmer, whether landlord or tenant, and of every person interested in the future of Burma. The fenced villages met with in many places make one think of society where life and property are unsafe and people have to live together for mutual defence rather than of a thriving and progressive people whose activities are extending in all directions. The cramped villages with muddy roads on strips of land by creeks in Lower Burma and unsightly river banks make one feel that the farmer and children and his labourers and his cattle would be healthier living in the fields in permanent buildings all the year round. The attainment of a farming community where most farms would have the homestead in a convenient place with a labourer's cottage or two nearby involves large changes, the banking of money instead of hoarding it at home or investing it in jewellery, vast expenditure on wells, permanent buildings, and fencing and security of tenure for tenants : but it would check the ravages of disease among people and cattle, result in a vast increase in outturn, encourage circulation of money, and finally make still stronger that spirit of self-reliance and sturdy independence through which the Burma of the future will become increasingly happy and prosperous."

Sub-Committee XII of the Conference under the Chairmanship of U Hla Pe, M.L.C., discussed the questions of leases and homesteads and the Conference passed a resolution in favour of leases and homesteads. A note on homesteads was prepared for a Conference of Commissioners in October 1921 and the principle involved was generally approved. The subject has been discussed with several Deputy Commissioners, landowners, and others during the year and difficulties have been pointed out. The prospect, however, of inducing landlords to sink money in fencing and permanent buildings with the prospect of small additional rent for at least several years is perhaps remote at present and it may need the provision of model farms in many places before the ideal can be translated into practice. But the clean healthy monasteries in spacious compounds might well be taken as in some way illustrating the ideal.

CHAPTER V.

AGRICULTURAL CHEMISTRY, ENTOMOLOGY, AND ENGINEERING.

35. In addition to the very important work on Burma beans reviewed in Chapter III investigations by Mr. Charlton into the nuisances caused by parboiling paddy operations and on means for the eradication of *bedabin* (water hyacinth) were pursued with most important results. Large scale tests showed that with solutions of sulphuric acid and calcium hyposulphite, the cost of chemicals being only Rs. 1-4 per ton of rice, smells were entirely suppressed. The solution, however, attacks metal very readily and mixing the sulphuric acid with water is no easy matter for the class of labour employed at the mills. Samples of the rice so prepared have been sent for biological tests to England. Further small scale experiments on breakage in milling led to the conclusion that rapid drying was an important factor in breakage and that steeping the paddy in very hot water will prevent smells as well as reduce very considerably the necessary steeping time. Large scale experiments will be necessary to test these conclusions which, if they can be put into practice, will be of great value to the parboiling industry by reducing the cost of parboiling and lessening breakage.

Experiments in spraying *bedabin* with various solutions were carried out at Mandalay. Crude oil, liquid fuel oil, and calcium hyposulphite all proved expensive and unsatisfactory : solutions of arsenic killed the plants, the cost varying from Rs. 11 per acre for ordinary size plants in dry weather to Rs. 58 for large closely packed plants in wet weather. Sea water was also found to kill the plants in a few days and even one-tenth per cent. of brine had a visibly harmful action. Attempts to burn the growing plants with a blow lamp were unsuccessful. Steam has also been tried but the loss of heat was enormous, the temperature three feet from the nozzle of a one-inch hundred-foot pipe with a boiler pressure of 150 lbs. being only about blood heat. Further tests will be made with higher steam pressures and different types of nozzle. To test

the question of seed propagation *beda* plants were grown on the bank of a *beda*-free pond and surrounded by wire netting to prevent plants being blown into the pond but no *beda* plants appears in the pond in seven months.

A number of manure and soil analyses have been carried out and a beginning made with the selection of groundnuts for oil content which varies by over two per cent. Should oil content prove to be an inherited character, in the course of four or five years work important results may be expected.

36. During the year Maung Ba Gyaw completed certain farm buildings and a steel water tank and trestle with supply mains at Mahlaing Farm. The buildings took longer than was expected and as Maung Ba Gyaw had decided to take leave no elaborate programme could be undertaken, as it was most unlikely that any suitable man could be found to act for a few months.

The Agricultural Engineer.

Tests were carried out with eight different bullock-power sugarcane crushers at Thawatti and it was found that no crusher gave all round satisfactory results: the eagerness of cane-growers, however, to buy the crushers proves that several were thought to be well worth the cost. A "Pearl" horizontal crusher adaptable for oil engine or bullock power aroused great interest but it arrived too late to allow of protracted trials which will be carried out as far as possible next season.

Cane Crushers.

With a view to cheapening and quickening jaggery-boiling methods, "Poona Multiple" and "McGleshan" furnaces, two types constructed by Maung Ba Gyaw, and two Burmese furnaces were tested in the Thawatti neighbourhood. Cane-growers had made lavish promises of help but "owing to the great delay on the part of the growers who had undertaken the erection of the furnaces on their land, the furnaces were not completed till very late in the season." The tests showed that cost of manufacture of 100 viss of jaggery was under Rs. 1-7 with a "Thawatti" type furnace, Rs. 1-13 with the Poona Multiple furnace, and from Rs. 2-4 to Rs. 4-13 with the Burmese furnaces. Maung Ba Gyaw estimates a saving in timber fuel alone of three quarters of a ton for every 100 viss of jaggery manufactured with the Thawatti furnace over the ordinary Burmese furnaces as it is possible to use all the crushed cane as fuel. The new furnace has several other advantages and as a result of this year's experience improvements in design are expected to give even better results next year. Maung Ba Gyaw holds that the universal adoption of these furnaces by jaggery-makers throughout Burma would result in the saving of $7\frac{1}{2}$ tons of fuel timber per acre of cane or, assuming a ton of fuel to cost three rupees, a saving of at least three lakhs of rupees on 15,000 acres of cane. The only drawback to the improved furnaces is the greater cost of boiling pans, the Thawatti furnace costing over Rs. 1,250 as compared with Rs. 400 for a Burmese furnace.

Jaggery Boiling Furnaces.

A small building ten feet square with walls of rammed earth 18 inches thick has been built on the Mandalay Farm. The building will be carefully watched and by next year it may be possible to say something of its merits or demerits.

Pisc de Ferrc.

Maung Ba Gyaw has now decided to join the Public Works Department and the question of appointing a successor is under consideration.

Personal.

37. Mr. Ghosh toured widely during the year and investigated the ravages caused by rats and crabs, insect pests, and fungal diseases. Pests occurring in all the important crops were examined, specimens collected, and the life-histories investigated in the laboratory as far as possible. In the Leiktho Township (Toungoo) rats were so numerous and conditions so difficult that ordinary methods of poisoning were deemed useless. The Deputy Commissioner (Mr. I. G. Lloyd) has made trials with

The Assistant Entomologist.

Rats.

Liverpool virus and Ratin and the results will be awaited with interest. Mr. Ghosh attended a meeting of farmers and officials in March to discuss measures for rat destruction in the Minbu District Canal Area and measures agreed on will be tried when a plague of rats again occurs.

Investigation of the diseases called *gwabo* and *gwinna*, which at their worst destroy 60 per cent. of the paddy crop grown by farmers in the Minbu District, pointed to these being fungal diseases rather than insect ravages and will need the attention of the Mycologist. Mr. Ghosh has come to the conclusion that *Chilo simplex*, the worst of the stem borers in India, is not present in Burma in any area yet visited and actual counts appear to show that stem-borers, commonly known as *sitpo*, of which four varieties have come to light, do not in the cases investigated affect more than 11 per cent. of the stems, indicating one per cent. or less actual damage to the main paddy crop. Dry-weather paddy, however, suffers severely from the *sitpo* in the Minbu District and it is estimated that only one-third of the possible yield over 3,000 acres is obtained every year resulting in a loss of about a lakh of rupees. Attempts are to be made to deal with this pest for the 1923 crop.

Coconut palm beetles (*Oryctes rhinoceros*) were reared and observed in the laboratory and local investigations made in Pinyinmana, Thatôn, Insein, and Akyab. This beetle breeds throughout the year and any attempt to check its ravages will need systematic attention to breeding-places every three months. As these breeding-places exist almost everywhere in the form of dung heaps, rotting straw, and rotting trunks of dead palm trees, and hundreds of beetles have been found in a small heap a few feet square, the extreme difficulty of dealing with it becomes apparent. The red weevil (*Rhynchophorus ferrugineus*) aids and abets the destructive work of the rhinoceros beetle. A poster has been prepared for distribution suggesting measures for dealing with these beetles and enquiries are to be made by the Deputy Director who is to visit Madras about the effects of legislation in dealing with pests of this kind. Only concerted, widespread, and willing action on the part of every householder could keep the beetle pest in check in infected areas. The facts now known make it probable that in present conditions coconut plantations can succeed only where they are well isolated from infected areas and possible breeding-places.

38. Some forty to fifty lakhs worth of raw silk comes to Burma every year from China. Much of this could certainly be produced in Burma and efforts are now being made to build up the small industry which already exists. In the Karen Hills of the Toungoo District there are some 500 silkworm breeders and in the Prome District almost as many. They, however, grow only small and badly-worked areas of mulberry and most can turn out less than half a viss of raw silk each annually. *Pebrine* has for years caused ravages among the silkworms especially in Prome and the number of breeders has steadily declined. The first measures to be taken are therefore to supply disease-free eggs, to demonstrate improved methods of growing mulberry, and to encourage extension of mulberry areas.

Work has been begun on a small scale with a small area for mulberry kindly lent by the Forest Department and in a building lent by the Registrar, Co-operative Societies, at Maymyo; Prome, Toungoo, and hybrid races from Lashio of silkworms have been bred and small quantities of disease-free eggs supplied mainly to Prome rearers. Selected eggs are used for breeding only and the moths from the selected eggs are expected to be disease free. Layings of selected eggs supplied to Taungle (Prome) rose from 75 in February to 500 in June and it is expected that 100 layings will produce in the second generation 10,000 layings, enough to produce 200 viss raw silk worth from five to eight thousand rupees. To ensure freedom from disease a continual supply of disease-free seed will have to be issued to the rearers.

The Prome rearers have, under Mr. Ghosh's tuition, adopted a system of pruning which will admit of permanent bush and tree mulberry plantations and preliminary reports on the silkworms bred in June are most encouraging. In November 1920 Taungle Village had only some four acres under mulberry, this year there are 20 acres. Burmese, Indian, and hybrid races will be bred for selection at Maymyo and European and Japanese *univoltine* races will be imported and tried next year.

A temporary staff has been sanctioned. A Sericultural Assistant for training for work in the Karen Hills has been chosen and it is hoped early next year to train small numbers of Karens in mulberry-growing, silkworm-breeding, and silk-reeling at Maymyo. The interest taken and the help given by Mr. Swithinbank (Prome) and Mr. I. G. Lloyd (Toungoo) have greatly forwarded Mr. Ghosh's efforts.

CHAPTER VI.

PUBLICATIONS, AND SUPPLY OF INFORMATION.

39. In addition to the papers read at the Agricultural and Co-operative Conference a number of short articles have been written by Deputy Directors and other experts of the Department for publication in *Burma's Progress* and other newspapers. To draw the attention of farmers and others to the farms a series of short notes on "What to see at the Farms" were prepared every month. For 1922-23 these notes will be expanded and in conjunction with the regular monthly meetings which it is hoped can be held at some of the Farms should keep those interested in touch with the work of the Department. Bulletin No. 17 containing Instructions on Bee-keeping was written by Mr. C.C. Ghosh, Assistant Entomologist, and published during the year.

A new leaflet on the cultivation of onions was published and the leaflets needing revision have been revised and in many cases rewritten: a new series will shortly be published. Requests for information and advice are growing rapidly and with the splitting up of the circles, the Deputy Directors and their Assistants will soon be in a better position to deal with such requests.

Mr. Charlton's report on a new method of determining the prussic acid content of Burma beans has been accepted for publication as a Bulletin from the Imperial Institute, Pusa,

CHAPTER VII.

MISCELLANEOUS.

40. The lines of work and the principal results of the expert staff have been reviewed under the appropriate heads and the details of the work at the agricultural stations can be found in the reports of those stations which are published separately; Mr. McKerral, Mr. Charlton, and Mr. Stock have also given much time to the detailed plans for the lighting and equipment of the new college.

All officers have toured extensively and feel that with circles of moderate size there is a chance of very definite progress in the near future. The students who have returned from Poona are displaying great keenness in their work and if in course of time their initiative and scientific work equal their keenness there will be no need to fear that out of them men will not be forthcoming for the higher appointments.

41. The receipts of the Department amounted to Rs. 34,928 and the expenditure, excluding expenditure by the Public Works Department on buildings, to Rs. 5,22,615 of which Rs. 23,600 was spent on the students under training at Poona and Mandalay, and Rs. 39,050 on contributions to botanical and other public gardens.

42. A map attached to the Report shows the present circles, proposed circles, and the various farms. A statement compiled from the Season and Crop Report and printed on the map shows the occupied area, the estimated culturable waste, and the acreage under the principal crop in each district in 1921-22. An appendix also compiled from the Season and Crop Report shows the area under the principal crops in each district in 1921-22 and a statement taken from the Land Revenue Report of 1920-21 shows the areas owned and rented, and may

be of interest from the wider aspects of agriculture. The programmes of work of the various stations for 1922-23 are also printed as an Appendix.

43. Mr. McKerral's long experience and intimate knowledge of the agriculture of the Province and his willingness to help with that knowledge and experience are of great benefit to the Department and have been fittingly recognised by his promotion to the Selection Grade in May 1922 on the completion of 15 years' service in Burma. The relations between officers of the Department and district officials have been cordial and interest in the work of the Department has been stimulated by visits of officials and non-officials to the farms.

Miscellaneous.

The Department is greatly indebted to Messrs. Steel Bros. for help in connection with experiments on parboiling of paddy, to Messrs. Burr & Co., Cowie & Co., Finlay Fleming & Co., McKenzie & Co., and Scott & Co., for exhibits and machinery and tractors at the Agricultural and Co-operative Conference and the Mandalay Farm in 1921 and to other firms and individuals too numerous to mention who have helped officers of the Department in many ways.

44. While results cannot in most cases be reduced to figures, an example of what can be achieved is shown in the case of gram, a comparatively small crop in Burma; the substitution of Karachi for Burmese gram which it is expected will be completed in 1923 in the wilt-infested gram areas in Upper Burma will give increased crops of a value more than enough to pay the present annual cost of the Department. All reports indicate an increasing resort to officers of the Department for help and advice and to the growing popularity of the Department's improved seeds. With farmers tending to rely more and more on the Department and with a growing staff of keen officers steady progress is assured.

Conclusion.

J. CLAGUE,

MAYMYO, 5th September 1922.

Director of Agriculture, Burma.

APPENDIX I.—Glossary.

Vernacular.	English.	Botanical.
Akyosaung ...	Voluntary helpers ...	.....
	Egyptian clover or Berseem ...	Trifolium Alexandrinum.
Bedabin ...	Water Hyacinth ...	Eichornia crassipes.
Byat ...	A variety of Kaukkyi paddy ...	.....
Gwabo. ...	Diseases of paddy ...	.....
Gwinna ...		
Hoito ...	A variety of Japanese paddy ...	.....
Kachin-pè ...	A variety of bean ...	Phaseolus calcaratus (mixed variety).
Kaukkyi ...	Six to seven months' paddy ...	Oryza sativa.
Kauklat ...	Five months' paddy ...	Oryza sativa.
Kwin ...	A survey area, usually about one square mile.	.....
Letywezin ...	A paddy of the Kauklat variety ...	.....
Matpè ...	Black Gram ...	Phaseolus Mungo, Linn.
Ngachima ...	A variety of Kauklat paddy ...	.....
Ngasein ...	A variety of Kaukkyi paddy ...	.....
Pyoksan ...	Parboiled paddy ...	.....
Pèbyin ...	Haricot Bean, streaked variety ...	Phaseolus vulgaris, Linn.
Pèbyugale ...	Rangoon White Bean ...	Phaseolus lunatus, Linn.
Pèdisein ...	Green Gram ...	Phaseolus Mungo, Linn. Radiatus.
Pègya ...	"Rangoon Red Bean" Lima or Duffin Bean.	Phaseolus Lunatus, Linn.
Pègyi ...	Lablab Bean ...	Dolichos lablab, Linn.
Pèsinngon ...	Pigeon Pea ...	Cajanus Indicus, Sprang.
Pèyin ...	Rice Bean ...	Phaseolus calcaratus, Roxb.
Paik-san or Pawwut	Sunn Hemp ...	Crotalaria juncea, Linn.
.....	Saccoline—A variety of fodder millet	Sorghum, sp.
Sitpo ...	Paddy stem borer ...	Schoenobius bipunctifer, Wlk.
Taungdeikpan ...	A variety of Kauklat paddy ...	.....
Teosinte ...	.....	Reana luxurians.
Wagale ...	Cotton ...	Gossypium neglectum, var. Burmanica.
Wagyi ...	Cotton ...	Gossypium obtusifolium, var. Nanking.
Ya ...	Any upland dry cultivated area ...	.....

APPENDIX II.—Principal crops in 000 acres (less than 2,500 acres not included), 1921-22.

District.	Net area sown.	Paddy.	Millet.	Little millet and Italian millet.	Maise.	Gram.	Sea-mum.	Chillies.	Sugar-cane.	Cotton.	Tobacco.	Betelnut.	Peyal.	Pibru gale.	Pibru.	Other beans.	Plantains.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(16)	(18)
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Akyab ...	7178	6672	...	...	...	...	...	108	...	...	...	...	...	...	...	...	41
Hill District of Arakan ...	119	96	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kyaukppeu ...	1829	1656	...	...	...	...	...	...	...	...	49	...	...	...	...	...	...
Sandoway ...	897	765	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Insein ...	5711	5299	...	...	...	...	...	...	...	...	...	...	...	...	...	...	91
Hanthawaddy ...	8389	7930	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tharrawaddy ...	6137	5522	...	...	26	145	...	...	...	...	30	...	71	...	...	148	46
Pegu ...	9343	9057	...	...	...	...	...	...	...	...	54	...	...	...	...	...	...
Prome ...	3815	3310	...	...	...	...	39	...	...	...	...	...	113	...	...	...	31
Bassein ...	7667	7013	...	...	...	60	...	...	...	...	31	...	23	...	...	...	101
Henzada ...	6379	5268	...	...	111	48	...	...	...	...	73	...	85	...	...	204	139
Myaungmya ...	7592	7256	...	...	...	...	...	...	...	...	...	...	...	...	...	...	44
Ma-ubin ...	4842	4071	...	...	39	...	...	33	...	...	46	...	...	...	...	272	58
Pyawon ...	6821	6690	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toungoo ...	4768	4125	...	...	...	...	60	...	46	...	72	90	48	...	...	...	56
Salween ...	295	247	...	...	...	...	...	...	...	...	...	38	...	...	...	...	...
Thaton ...	6952	6169	...	...	...	...	...	...	83	...	...	...	...	...	...	...	36
Amherst ...	4978	4293	...	...	...	...	...	...	...	...	...	37	...	...	...	...	...
Tavoy ...	1492	1045	...	...	...	...	...	...	...	...	...	39	...	...	...	...	...
Mergul ...	1367	813	...	...	...	...	...	...	...	...	...	40	...	...	...	...	37
Thayetmyo ...	1968	835	...	...	120	...	824	...	...	489	91	...	...	...	...	32	...
Pakokku ...	5544	820	1844	...	367	91	420	...	...	29	73	...	74	249	76	446	...
Minbu ...	2908	1283	138	...	280	98	570	33	...	...	...	...	90	58	61	218	...
Magwe ...	5643	987	413	371	407	...	2093	...	...	88	...	...	69	30	...	484	...
Mandalay ...	1919	1067	...	...	58	...	69	...	...	...	34	...	75	250	60	158	36
Bhamo ...	343	330	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Myitkyina ...	455	428	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Katha ...	2136	2066	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shwebo ...	6822	5204	106	...	...	51	498	...	...	60	...	...	50	90	175	317	...
Sagaing ...	5713	508	697	...	99	230	1195	...	...	904	44	...	102	615	186	29	...
Lower Chindwin ...	5523	813	1975	...	45	185	1269	...	...	324	...	...	63	268	183	496	...
Upper Chindwin ...	908	792	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kyaukse ...	1838	1091	...	...	...	58	253	93	...	...	...	...	40	123	...	27	73
Mektila ...	4247	1023	909	69	100	77	978	210	...	343	...	...	...	431	290	197	...
Yamethin ...	3987	2066	296	...	317	29	736	...	72	...	...	...	40	...	...	343	...
Nyaungyan ...	6673	381	2041	334	76	70	1223	53	...	34	41	...	44	551	372	814	...
Total, Burma crop, 1921-22*	15,3244	10,7020	8424	4017	2114	1193	1,0337	683	320	3103	814	319	1041	2690	1447	4465	1034
Total, Burma crop, 1920-21*	14,8245†	10,3389	6995	394	1713	624	1,1484	877	247	3655	1003	320	982	3080	1287	3413	1087

* Includes crops with less than 2,500 acres not shown in the details.

† Revised figures.

APPENDIX III.—Classification of Occupiers of Land, and details of Tenancies at Full and Fixed Rents during the year ending 30th June 1921.

District.	Area occupied by.			Tenancies at full rents.					
	Agriculturists.	Non-agriculturists.		Number of cases in which the land has been let continuously		Number of tenants who have rented their land continuously		Area let at full rents.	Amount of money for which rented.
		Resident.	Non-resident.	Five years and over.	Under five years.	Five years and over.	Under five years.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Acres.	Acres.	Acres.	No.	No.	No.	No.	Acres.	Rs.
Lower Burma including Thayetmyo ...	7,267,184	682,275	1,817,473	87,915	116,953	31,524	181,441	3,669,899	7,04,48,302
Upper Burma excluding Thayetmyo ...	7,222,490	296,679	323,404	4,109	7,822	2,800	10,683	90,308	10,98,349
Total { 1920-21 ...	14,489,674	978,954	2,140,877	92,024	124,775	34,324	192,124	3,660,167	7,15,46,651
{ 1919-20 ...	14,640,784	929,365	2,061,494	81,036	115,176	33,590	176,258	3,505,268	7,15,34,179

APPENDIX IV.

Programme of Work for the Northern Circle, 1922-23.*Mandalay Agricultural Station.*

- (1) Manurial, varietal, and irrigation experiments with paddy to be continued.
- (2) Selection of pure lines of the principal Shwebo paddies.
- (3) Propagation on a field scale of Hoito (Japanese paddy).
- (4) Trials of fodder crops for the new dairy area—maize, berseem, oats, teosinte, etc.
- (5) Trials with sugarcane and miscellaneous crops.
- (6) Implement and seed distribution from depôt.
- (7) Training of ten Lower Subordinate Students.

Hopin Agricultural Station.

- (1) Multiplication of suitable sugarcane—Gilman, Toungoo, Yellow, etc.
- (2) Distribution of canes to cultivators.
- (3) Demonstration of jaggery boiling.
- (4) Rotation crops—peas, soy bean, etc.
- (5) Clearing and lay-out of the station to be completed.

Padu Agricultural Station.

- (1) Trials with gram varieties.
- (2) Distribution of Karachi gram.
- (3) Wheat varietal trials.
- (4) *Pèsinngon* or arhar variety trials.
- (5) Cotton trials on a small scale.

Yawnghwe Agricultural Station.

- (1) Cultivation experiments with potatoes.
- (2) Trials of exotic potato varieties.
- (3) Distribution of Federation wheat and trials of other exotic wheat.
- (4) Trials of American cottons.

Talkon Agricultural Station.

- (1) Trials of sugarcane varieties and multiplication and distribution of the best.
- (2) Sesamum varietal experiments for crop yield and oil content (in collaboration with the Agricultural Chemist).
- (3) Beans, jowar (saccoline), and miscellaneous crops.
- (4) Distribution of seed and implements from the depôt.

District Work.

- (1) Distribution of Karachi gram seed in the Sagaing and Mònywa Districts.
- (2) Paddy distribution in Mandalay, Kyauksè, and Shwebo.
- (3) Trials with Japanese paddy (Hoito) in Shwebo, Yamèthin, and Meiktila Districts.
- (4) Distribution of erect groundnut seed in the Thazi Subdivision.
- (5) Distribution of sugarcane setts and crushers in the Yamèthin, Kyauksè, and Myitkyina Districts.
- (6) Cambodia cotton trials and distribution in the Mònywa District.

A. MCKERRAL,

*Dy. Director of Agriculture, Northern Circle, Burma.***Programme of Work of Deputy Director of Agriculture, Central Circle, Myingyan, for 1922-23.***Cotton—*

- (1) Introduction of improved strains for dry-zone cultivation.
- (2) Spacing trials.
- (3) Manurial experiments—a series of permanent manurial plots will be laid down on the Mahlaing Farm. Tests will also be carried out with oil cake and green manure.

Groundnut—

- (1) Comparative trials with "erect" and "spreading" types.
- (2) Spacing trials.
- (3) Manurial experiments with cattle manure, oil cake and green manure.

Sesamum—

Selection of high yielding strains.

Pulses—

Varietal tests.

Miscellaneous—

The application of improved types of indigenous implements for drill sowing and line cultivation of cotton and beans.

F. D. STOCK,

Dy. Director of Agriculture Myingyan Circle.

Programme of Work of the Deputy Director of Agriculture, West Central Circle, Thayetmyo, for 1922-23.

- (1) **Allanmyo Experimental Station—**
 - (a) Clearing and laying out of new area.
 - (b) Experiments (as many as can be carried out) on—
 - I. Sowing date and spacing of Cambodia cotton.
 - II. Comparison of cotton grown alone with cotton and sesamum mixed.
 - III. Sesamum in rows and sesamum broad casted.
 - IV. Sesamum alone and *pésinngón* alone and sesamum and *pésinngón* mixed.
 - V. Local and exotic groundnuts.
 - VI. Effect of lime and fieldyard manure on yield of cotton.
 - VII. Pure strain of *pédisein*.
 - VIII. Cultivation and costing experiments with harrow and Burmese plough, Burmese plough, and Cyprus and all steel ploughs.
 - IX. Sorghum broadcasted and sorghum in rows.
 - X. Indian seed drill.
 - XI. Effect of intercultivation on yield of *pédisein* and *pésinngón* sown in rows.
 - XII. Sesamum trials.
- (2) **District work, Thayetmyo District—**
 - (a) Ginning of Cambodia cotton for cultivators and distribution of seed.
 - (b) Supervision and instruction in cultivation of Cambodia cotton.
 - (c) Distribution of improved seeds to cultivators.
 - (d) Supervision and instruction in growing cold weather crops and sugarcane.
 - (e) Demonstration of the best methods of growing sesamum, *pésinngón*, and cotton.
 - (f) Short courses for cultivators at the farm.
 - (g) Demonstration and sale of improved agricultural implements.
 - (h) A survey of the agricultural operations and problems of the district.
 - (i) Formation of Township Agricultural Committees.
- (3) **District work, Minbu District—**
 - (a) Brief Survey of agricultural conditions and problems.
 - (b) Supervision of the district farm at Pwinbyu.

L. LORD,

Dy. Director of Agriculture, West Central Circle, Thayetmyo.

Programme of Work of the Deputy Director of Agriculture, Southern Circle, Insein, for the year 1922-23.

A.—Hmawbi Experimental Station—

- (1) **Manurial experiments ;**
 - (a) To continue the determination of the residual effect of Bone Super and Bone Phosphate in 4th acre plots.
 - (b) To determine the effect of basic slag on paddy land.
 - (c) With lime, slag, and green manure on unproductive fields.
 - (d) With green manure after the paddy harvest.
 - (e) To determine the effect of various manures applied to the nurseries.
 - (f) Renovation of nurseries.
- (2) **Cultivation experiments with the object of establishing a second crop after early paddy.**
- (3) **Seed rate experiment.**
To determine the optimum seed rate in nurseries.
- (4) **Selection of pure lines of paddy.**
- (5) **Multiplication and distribution of selected varieties.**
- (6) **Sugarcane :** Exotic and local varieties will be grown on the upland for comparison and their respective yields tested.
- (7) **Comparative tests of the effect of irrigation, and non-irrigation on all the varieties grown.**
- (8) **Distribution of selected canes.**
- (9) **Guinea grass (a) propagation and distribution, (b) manurial treatment.**
- (10) **Treatment of pasture.**
- (11) **Coconut cultivation with local and exotic varieties.**
- (12) **Fruit culture and grafting.**
- (13) **Cultivation of various vegetables and distribution of seed.**
- (14) **A variety of crops will be grown on the upland.**

B.—Seed Farms—

- (1) **Zigon (a).**—The farm will continue to multiply selected paddy for distribution.
- (b) Yield tests with other varieties will be carried out.
- (c) Several exotic varieties of sugarcane will be tested for suitability to the locality.
- (d) Guinea grass will be grown for demonstration and distribution.
- (2) **Nyaunglebin.**—The multiplication and distribution of selected paddy will be carried on.

C.—District Work—

- (1) **Paddy distribution** will be carried on as before, an effort being made to intensify the work in smaller well-defined localities.

- (2) Trials and demonstrations will be carried out.
- (3) Suitable paddies will be collected for selection.
- (4) Supervision and direction of the work of District Agriculturists.

D. HENDRY,

Dy. Director of Agriculture, Southern Circle, Insein.

Programme of Work of East Central Circle, To be opened during 1922-23.

- (1) Taking over and continuation of the work at Tatkôn Farm and District work in Yaméthin and Toungoo at present carried on by Deputy Director of Agriculture, Northern Circle, and the Deputy Director of Agriculture, Southern Circle.
- (2) Selection of small sugarcane farms at Pyinmana.
- (3) Preliminary experiments with sugarcane.

Irrawaddy Circle, To be opened during 1922-23.

- (1) Preliminary investigation and selection of paddies.
- (2) Preparation of part of new farm for experimental work in 1923-24.

Arakan Circle, To be opened during 1922-23.

- (1) Preliminary investigation and selection of paddies.
- (2) Preliminary investigation of coconut palm questions.
- (3) Preparation of part of new farm for experimental work in 1923-24.

Programme of Work for 1922-23 of the Economic Botanist.

- (i) The survey of indigenous cottons will be continued.
- (ii) Continued study of variation in Burmese cottons.
- (iii) Systematic breeding of improved strains of cotton for dry zone cultivation.
- (iv) Studies in sesamum and classification of types.

T. D. STOCK,

Economic Botanist, Burma.

Programme of Work of the Agricultural Chemist, Burma, for the year 1922-23.

- (1) Continuation of the work on prussic acid in Burma beans—
 - (a) The results of the analysis of the present crop will determine the course to be pursued. It is intended to abandon mass selections for single plant selection unless results for the 1921 crop justify the retention of the previous method.
 - (b) Effect of various plant nutrients on the content of prussic acid.
 - (c) Selection of definitely pure lines.
- (2) Analysis of typical soils of Burma with a view to publishing as a bulletin which will serve as a skeleton soil survey to be subsequently amplified.
- (3) Study of agricultural conditions in Burma.
- (4) Training of Agricultural Assistants.
- (5) Preparation of a detailed syllabus for the new college.
- (6) Investigation of agricultural industries, e.g., jaggery manufacture, with a view to their improvement if possible.
- (7) Selection of sesamum for high oil content.

Some of the above work will be done in collaboration with the various Deputy Directors of Agriculture or Agricultural Engineer concerned.

J. CHARLTON,

Agricultural Chemist, Burma, Mandalay South.

Programme of Work of the Agricultural Engineer, Burma, for the year 1922-23.

- (1) General inspection of Farm machinery.
- (2) Erection of a model Megass burning furnace at Tatkôn.
- (3) Installation of a small gas engine and gas producer to drive farm machinery and cane-crusher at Tatkôn.
- (4) Transfer of Hopin Jaggery Factory to Thawatti or elsewhere for manufacture of jaggery from growers' canes.
- (5) To begin the Agricultural Engineering Workshop on the farm at Mandalay.
- (6) To design and manufacture agricultural implements which will be more suitable for farmers than the existing implements.
- (7) To carry out power-threshing demonstrations at the Government Farm, Hmawbi.
- (8) To carry out experiments with tractors.

MAUNG BA GYAW,

Agricultural Engineer, Burma, Mandalay South.

Programme of Work of the Assistant Entomologist for the year 1922-23.

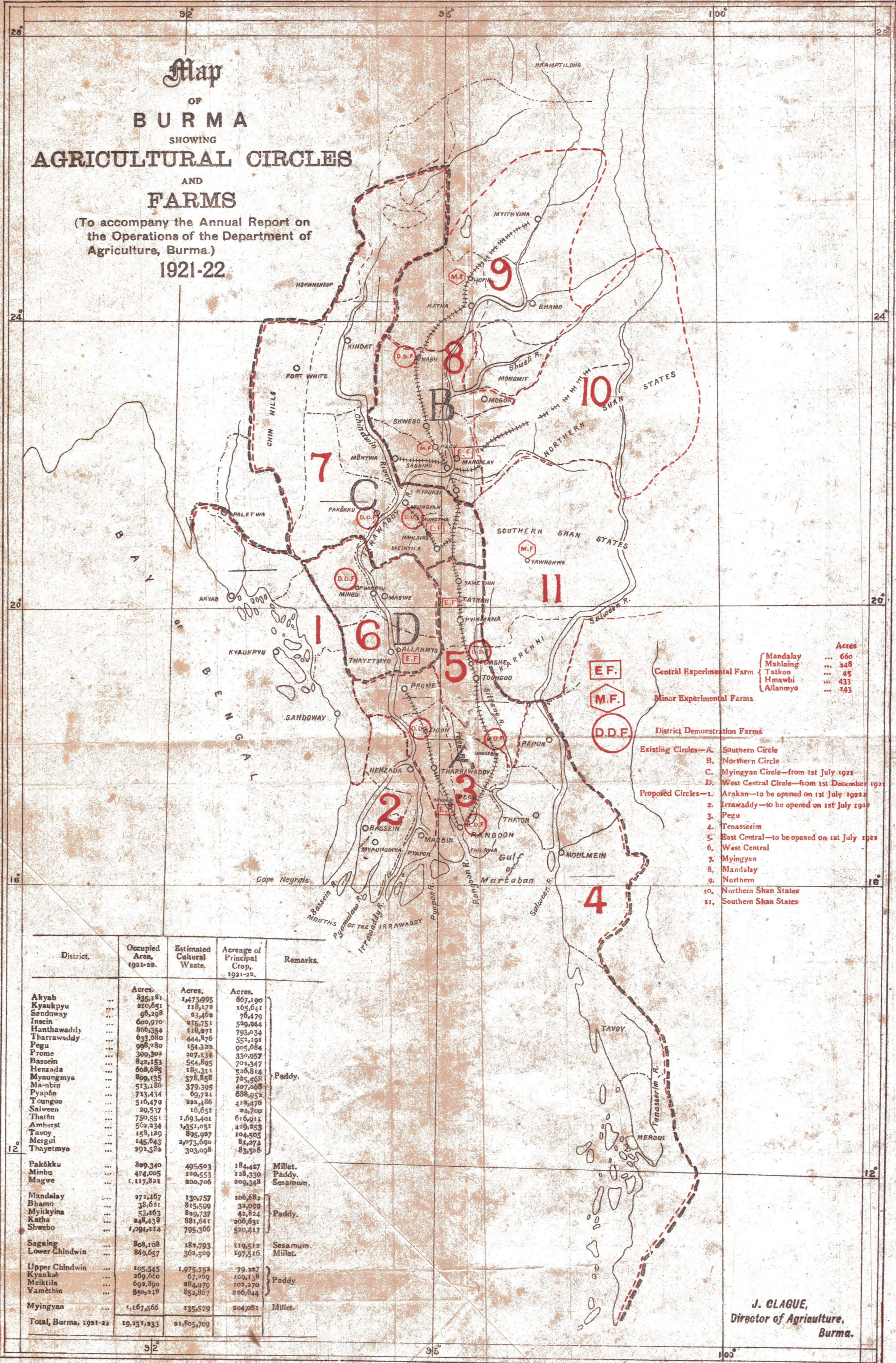
- I. *Crop Pests*—
- (1) Paddy—(a) Special study of pests.
(b) Study of comparative natural immunity of different varieties of paddy against insect pests.
 - (2) General study of the pests of sugarcane, cotton, etc.
 - (3) Stored grain pests.
- II. *Coconut*.—Propaganda work for preventive measures against the Palm Beetle (*Oryctes rhinoceros*) on the basis of the bionomical study already made.
- III. *Bee-keeping* as an experimental measure at Maymyo.
- IV. *Sericulture*.—The work aimed at in the immediate future may be classified as below :—
- (1) Introducing proper methods of growing mulberry.
 - (2) Extending mulberry areas.
At present the rearers grow only small patches of mulberry in a temporary and defective manner.
 - (3) Supplying disease-free seed.
 - (4) Improving reeling as a cottage industry so that the rearers who reel their own cocoons may produce raw silk suitable for the Mandalay market.
 - (5) Putting the rearers in touch with the Mandalay market.
 - (6) Introducing improved races of worms among the rearers.
- Keeping the above in view, the work of the nursery, which has been started at Maymyo, will be pushed through as far as possible.
- An expert reeler is attached to the nursery. As far as possible selected rearers will be trained in the nursery in growing mulberry, rearing, and reeling, and propaganda work will be undertaken in the silkworm-rearing districts.
- V. Replies to enquiries regarding pests from the public, agricultural officers, and district officers.
- VI. Teaching.

C. C. GHOSH,

Assistant Entomologist, Burma, Mandalay South.

Map OF BURMA SHOWING AGRICULTURAL CIRCLES AND FARMS

(To accompany the Annual Report on the Operations of the Department of Agriculture, Burma.)
1921-22



- | | Acres |
|----------|-------|
| Mandaly | 660 |
| Mahlaing | 348 |
| Tatkon | 45 |
| Hmawbi | 433 |
| Allanmye | 143 |
- Central Experimental Farm
- Minor Experimental Farms
- District Demonstration Farms
- Existing Circles—A. Southern Circle
B. Northern Circle
C. Myingyan Circle—from 1st July 1921
D. West Central Circle—from 1st December 1921
- Proposed Circles—1. Arakan—to be opened on 1st July 1922
2. Irrawaddy—to be opened on 1st July 1922
3. Pegu
4. Tenasserim
5. East Central—to be opened on 1st July 1922
6. West Central
7. Myingyan
8. Mandalay
9. Northern
10. Northern Shan States
11. Southern Shan States

District.	Occupied Area, 1921-22.	Estimated Cultural Waste.	Acres of Principal Crop, 1921-22.	Remarks.
	Acres.	Acres.	Acres.	
Akyab	835,181	1,473,995	667,190	Paddy.
Kyaukpyu	210,651	118,174	165,641	
Sandoway	96,298	23,469	76,479	
Insein	600,970	215,751	529,944	
Hanthawaddy	806,354	118,271	793,034	
Tharrawaddy	633,680	444,876	552,191	
Pegu	998,280	154,322	905,684	
Prome	399,302	207,134	330,957	
Bassein	812,183	554,895	701,347	
Henzada	668,685	183,311	526,814	
Myaungmya	899,135	378,858	725,568	
Ma-nbin	513,180	379,395	407,068	
Pyapon	713,434	69,741	688,952	
Toungoo	516,479	222,486	419,476	
Salween	20,537	16,651	22,700	
Thaton	750,551	1,693,401	616,911	
Amherst	562,234	1,351,051	429,253	
Tavoy	158,129	895,927	104,505	
Mergui	245,643	2,073,690	21,274	
Thayetmyo	292,582	303,098	83,526	
Pakokku	899,340	495,503	184,427	Millet.
Minbu	474,005	120,553	128,330	Paddy.
Magwe	1,117,821	200,706	209,328	Sesamum.
Mandalay	272,467	130,757	106,682	Paddy.
Bhamo	38,621	815,599	34,099	
Myitkyina	53,163	220,737	42,824	
Katha	248,438	881,641	206,631	
Shwebo	1,094,114	795,366	590,417	
Sagaing	808,108	182,793	110,512	Sesamum.
Lower Chindwin	849,657	362,509	197,516	Millet.
Upper Chindwin	105,545	1,975,753	79,227	Paddy.
Kyaukse	269,660	67,209	109,138	
Meiktila	602,890	284,979	102,270	
Yamethin	550,218	852,867	206,044	
Myingyan	1,167,566	135,579	204,081	
Total, Burma, 1921-22	19,231,233	21,805,709		

J. CLAGUE,
Director of Agriculture,
Burma.

R E P O R T

ON THE

OPERATIONS OF THE DEPARTMENT
OF AGRICULTURE,

ERRATUM SLIP TO THE REPORT OF THE DEPARTMENT OF
AGRICULTURE, MADRAS PRESIDENCY, FOR THE
OFFICIAL YEAR 1914-15.

Page 19, paragraph 64.—For the fourth sentence of this paragraph, read the following:—

“We have just heard that the University of Manchester has accepted the work which he has published from Coimbatore and that they propose to confer the degree of D.Sc. upon him.”

ERRATUM TO G.O. No. 1949, REVENUE, DATED 26TH AUGUST 1915.

Paragraph 4—

For the words “have earned for him the degree of D.Sc. from the University of Leeds.”

Read “have been recognised by the University of Manchester who propose to confer the degree of D.Sc. upon him.”

J-214
E5

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OFFICE OF THE
DIRECTOR OF AGRICULTURE, MADRAS,

R.O.C. No. 455 B of 15.

Dated

1915.

ENCLOSURES.

From

D. T. CHADWICK, Esq., M.A., I.C.S.,

DIRECTOR OF AGRICULTURE,

Madras.

To

THE SECRETARY TO THE COMMISSIONER OF REVENUE
SETTLEMENT, SURVEY, LAND RECORDS AND
AGRICULTURE,

Madras.

SIR,

I have the honour to submit the annual report on the Agricultural Department for the year 1914-15.

I.—ADMINISTRATION.

A.—STAFF.

2. I was in charge of the office of the Director of Agriculture throughout the year and inspected all centres in which work was in progress except Tanjore and South Canara. I also attended the Planters' meeting at Bangalore, a subsequent meeting of their Executive Committee in Madras, a conference with the Educational Department on Nature study, the Cotton Conference at Delhi, a conference in Madras with representatives of the leading trading and agricultural interests of the Presidency, a discussion with the members of the Indian Committee on Co-operation, agricultural meetings at Tiruppur, Berhampur, Madurantakam and Koilpatti and was present at His Excellency the Governor's inspection of Taliparamba and Palur farms, besides being a witness before the Madras Survey Committee.

3. During Mr. Hilson's absence on six months' leave Mr. Thomas was in charge of the Northern Division with M.R.Ry. K. Ramasustrulu Nayudu as Assistant Director. Mr. Sampson was single-handed in the south. M.R.Ry. D. Ananda Rao was posted as Assistant Principal to Coimbatore and during Dr. Barber's absence on leave M.R.Ry. T. S. Venkatarama Ayyar held charge of his office. A Personal Assistant has been posted to the Head Office, for which I am grateful. Rao Bahadur M.R.Ry. J. Dharmaranga Razu was appointed but unfortunately died before he could join and his place was taken by M.R.Ry. V. S. Asvatha Ayyar. Mr. Mehta's services were dispensed with on the termination of his probationary period at the close of the year. Otherwise there were no changes in the gazetted staff. The organization of the college has been further regularised by the formal constitution of a College Board.

4. The year closed with six vacancies in a sanctioned subordinate staff in the districts of 51. Some of these have been filled subsequently. Special arrangements were made during the year to depute an Assistant Farm Manager to the

Parlakimedi Estate Farm. Men were transferred as little as possible and as junior men are beginning to relieve the seniors of much of the farm work it is possible to keep the latter more continuously on district work. The generally excellent effect of this will be seen in the section below which deals with district work for which concentration, continuity and friendly relations with the local ryots are indispensable. Towards the close of the year information was received that the Secretary of State had accepted the proposals for the expansion of the department. These provide for seven divisions in the districts, the establishment of more district farms, the recruitment of a trained district staff in every district, the co-ordination of the prospects of assistants in the scientific sections with those of men in the districts and a general improvement in the pay and prospects of most of the men in the service. The department thus possesses for the first time an ordered scheme along which development can take place.

5. Mr. Coventry, C.I.B., the Agricultural Adviser to the Government of India, inspected Coimbatore and also the farms in the south and west in February. He appeared to be well satisfied on the whole with what he saw and his report is with Government. Five gazetted officers from other provinces came on tours of inspection in the year to different parts of the Presidency.

B.—BUILDINGS AND LAYING OUT OF FARMS.

6. No new farms were opened during the year, but an additional area was added on lease to Samalkota, and a stretch of waste sand dunes was added to Hagari. The buildings at Anakapalli were completed and have been very well designed and arranged by the Farm Manager. Most of those at Sirvel were finished and both farms were put into order. Both however suffered, Anakapalle from a flood and a cyclone, Sirvel from a breach in the Kurnool-Cuddapah canal which effectively cut off all supplies of water. The ginney at Hagari was not finished in the year.

7. As regards Coimbatore, it is satisfactory to say that the difficulty of the water-supply has been solved at least for the present by fixing an engine to another well and reserving it for drinking and household purposes. Sanction has been obtained for the following works, the construction of rooms for forty more students, quarters for the Lecturing Botanist and nineteen more houses for the employés at the College. The site for the Rest House for Indian visitors, and dispensary, etc., has been acquired but the buildings have not yet been started.

II.—AGRICULTURAL EDUCATION.

8. The year was noticeable for the introduction on June 7th of the new scheme sanctioned in G.O. No. 2381, Revenue, dated 17th August 1914. By this, instruction in the first two years is devoted mainly to general agriculture and its allied occupations, *e.g.*, the dairy, cattle feeding and rearing, care of implements, etc.,—the lectures in both scientific and agricultural subjects being fitted in with the general scheme of practical work. It is possible to take in 40 students a year for this course. Those who wish to prosecute their studies further may be taken for an additional 18 months' course devoted mainly to the sciences as applied to agriculture. About 100 applications were received and just as in previous years a week's preliminary examination at Coimbatore was held to pick out the most promising students. The result was that 42 were admitted. The year thus opened with a total strength of 74 in the College and closed with 70 still in residence. Stimulated undoubtedly to some extent by the publication of the scheme for the development of the department there have been 200 applications for the 40 seats in 1915. This competition for admission to the College is an encouraging feature in this agricultural work. It promises to give a wider scope of selection for the department, in itself a great advantage, and it means that a start has been made in getting hold of the younger generation. Very great progress has been made in district work in persuading the working ryot to adopt improvements, etc., but this annual small stream of boys from the College means that more and more of the sons of the middle class landholders are obtaining a knowledge of agricultural principles and practice which they could not otherwise get. If this only grows

and increases, it should have in time considerable economic effect in the districts. Practically all the students who leave Coimbatore become members of the Madras Agricultural Students' Union which is doing most excellent work in keeping the old boys together as members of a corporate body. Without such a bond of union those who do not join the department are apt to get lost in the districts. The Union has changed its magazine from a quarterly to a monthly one. Most of the work connected with the Union naturally falls on the Assistants at Coimbatore and though it is often heavy it is ungrudgingly performed. Founder's Day was kept as usual as an Old Boys' Day, this time under the presidency of the Hon'ble Mr. L. E. Buckley. The Hostel has continued to work satisfactorily under the Warden. With the increase of students it has been necessary to appoint a steward paid out of Hostel funds. The services of a retired Taluk Head Accountant have been obtained. The tone of the College throughout the year has been uniformly good. The work of a Principal of a College may not at times appear to be so showy as that of a District Officer who can point to the sales of so many thousands of pounds of seed, etc., but the department knows that it is the labours of Mr. Wood and of the whole College staff that make these other things possible.

9. All the third year students (15) got through their examinations but the general standard was low. They were not as good as the year which preceded them or as the one that is following on promises to be. They were weakest in Agricultural Engineering. The post of Engineering instructor is the one which it is always the most difficult to fill satisfactorily. As usual the students in the third year were taken on two tours—one to Kistna and Gōdāvāri and the other to Madura and Tinnevely. These tours are of the greatest instructional value. The second year students were examined in Chemistry, Botany, Mycology and Entomology by examiners from other Provinces. They did very well, especially in Chemistry—credit for which is mainly due to the careful teaching of M.R.Ry. Ramaswami Sivan.

III.—RESEARCH AND EXPERIMENTS.

A.—AGRICULTURE.

10. An attempt is made below to collect most of the important or interesting results obtained from the work on the agricultural stations and to indicate the main lines of work there in progress. For greater details reference is solicited to the reports of the different stations. The farms had their full share of the vicissitudes of the season. Anakapalle had six feet of water over it as a result of a breach in the river embankment and consequently some of the buildings were damaged and some fields scoured. After a prolonged shortage of rain Coimbatore suddenly got 8 inches of rain in one night in February when, as a rule, they rarely get 1 inch in the first three months of the year. The green manure crop at Sirvel did very well and the succeeding paddy was most promising when the Kurnool-Cuddapah canal breached and there was no more water. The whole crop died. This was most unfortunate as it was the first year of the farm and the demonstration promised to be most successful. Alike in Bellary and Kurnool the south-west monsoon was good but the north-eastern rains were poor, so that the early-sown crops did well but the late sown ones, *e.g.*, cotton and sorghum, did poorly. A farmer always dilates on the occasions on which the season has not behaved exactly as he thought it ought to have done; and in spite of this list of irregularities some very good crops and useful results were obtained.

Crops —(a) Sugarcane.

11. *Varieties and cultural methods.*—This section deals only with the work on the district farms. Dr. Barber's work is dealt with separately whilst the missionary work in the districts falls under the heading of demonstration, etc. It was due to the presence of the red-rot disease in Gōdāvāri that the first district farm was ever started, *viz.*, at Samalkota. The great achievement there was the discovery of a cane very much more immune to this disease than the local variety, *viz.*, Red Mauritius. But even so there is still some red-rot about. The last three years' work at Samalkota has clearly shown that the loss from this disease may be

entirely prevented by the exercise of a little care. There the practice is to harvest the canes clump by clump and tie together all those from one clump. As the canes are cut they are carefully looked over and any setts cracked or bored or with broken buds are discarded, and if there is any sign of disease in any cane from a clump no setts whatever are taken from the canes of that clump for planting next year. The results have been as follows: out of 18,000 clumps which were grown in 1912-13 only 70 subsequently showed any traces of disease, in 1913-14 out of 38,500 clumps only 838 and in 1914-15 out of 32,200 only 175 or taking the three years together the incidence of the disease is only $1\frac{1}{4}$ per cent—a very different state of affairs from the time when the area under sugarcane in Gōdāvāri was rapidly decreasing because the majority of the clumps were so badly diseased that the cultivation of cane more often resulted in loss than gain. Among the varieties tested at Samalkota B. 3412 for the second year in succession topped the list in yield of raw sugar per acre with $8\frac{1}{2}$ tons. Java 247 again came second. On the average of the last three years the positions of these two are reversed but if B. 3412 maintains its position this year it will be put out in the district. For the conditions in Vizagapatam on the other hand B. 1529 appears to be suitable—a cane which is steadily improving its relative position at Samalkota but as yet has only reached fourth place there. Much reliance however cannot be placed upon the Anakapalle results this year as the farm was first flooded and later many of the canes were laid low by a cyclone. At Nellikuppam Messrs. Parry & Co. are testing most of our varieties of cane on field scale and under factory conditions. These results are not yet to hand.

12. *Manurial*.—Sugarcane is one of the most paying of crops and requires intensive cultivation. Questions therefore connected with its manuring are of importance. A series of experiments tried some time ago showed that on the delta land of Samalkota artificials were not so profitable as oilcakes, and for the last three years different oilcakes, viz., safflower, pungam, gingelly, groundnut and castor have been tried against each other. So far as any inference can be drawn from these results as yet it would appear that none of these possesses any peculiar virtue over its competitors, the controlling factor in the nett profits is the price at which these cakes can be obtained at the time of purchase provided about 120 lbs. of nitrogen is given per acre. There is, if anything, a slight advantage in gingelly cake unless the price rises very high.

(b) *Paddy*.

13. In future most of the work on evolving single strains of better paddies will be undertaken by the Economic Botanist, the work on district farms being more concerned with local cultural and manurial problems. Where a sufficiency of water is obtainable it is the practice in the south of the Presidency for one paddy crop to follow the other without any interval. In Gōdāvāri on the other hand the main crop is harvested in November-December and the second crop is not sown till the end of January or more often in February although throughout January there is always ample water. And this persists although there is from time to time a shortage of water at the end of the second crop season. If the successful cultivation of paddy merely depended on the presence of water here was a great opportunity for finding a crop which would repay sowing in late December or early January and so save a month's water-supply. But water is only one factor, albeit a great one, in the growing of paddy. For six years since 1908-09 trials have been made with all sorts of paddies to find one which will stand these conditions in Gōdāvāri, but without avail. Only occasionally was a harvest got which was worth recording. This emphasizes the fact that with paddy as with other grains there is a proper seed time for each locality.

14. *Seedlings: Thin Seed-beds*.—In trying economic transplantation of paddy which is so widely advocated by the department the mistake is often made of not reducing the amount of seed sown in the seed-bed. If a healthy stand of plant is required, as it is, it stands to reason that strong healthy seedlings should be grown. It has been shown again and again by experience that seedlings from a thick seed-bed do not do so well when transplanted singly as seedlings from a thinly sown seed-bed, but

there have been no comparative figures. Experiments have been made on this for the last three years at Samalkota and the results are uniform each year. The usual local thick seed-beds are sown at the rate of 700 lbs. of seed to the acre. Seed-beds have been sown at rates of 350 lbs., 280 lbs. and 210 lbs. per acre respectively for the last three years. The average yields of the resultant crops have been 3,513, 3,648, 4,066 lbs. of grain per acre and 6,438, 6,525, 6,493 lbs. of straw per acre. There is thus nothing in it in the yields of straw whilst the yields of grain are definitely and in every case in every year in favour of the thinly sown seed-bed. This experiment will not be continued.

15. *Age of seedlings at transplantation.*—The usual proverb is that seedlings should be in the seed-bed for as many days as the weeks the crop subsequently remains in the field. For six years experiments have been conducted at Samalkota to determine whether the age of the seedling at time of transplantation is of vital importance to the subsequent crop. A crop was taken in which 35 days is the normal age of seedlings at transplantation and each year seedlings aged 25 days, 35 days and 45 days have been transplanted. It is clear that this experiment could be put down in two ways; either the seedlings could be sown at intervals of ten days and all the seedlings transplanted the same day or the seed-beds could all be prepared on the same day and the seedlings be transplanted at intervals of ten days. Both have been done. The figures show that the age of the seedling within these limits is practically unimportant where transplantation takes place on the same day, but where the dates of transplantation differ the advantage rests with the crop transplanted earliest although the seedlings used are youngest.

The average figures are:—

		<i>Age of seedlings.</i>			
		25 days.	35 days.	45 days.	
Transplanted the same day	...	3,198	3,192	3,244	}
Transplanted at intervals of ten days	Seed-bed sown the same day				
...	...	3,841	3,638	3,735	
} lb. per acre.					

It is probable that more care was taken with this experiment in the later years and if the figures for 1909-10—which are at variance with all those of subsequent years—be omitted the figures in the last line would read 4,048 3,757 3,674. The inference is that the age of the seedlings is immaterial between 25 and 45 days provided transplantation takes place early. This experiment will be discontinued in this form.

16. *Manurial experiments.*—At Samalkota, Coimbatore and Manganallur experiments are in progress testing the effects of different manures on paddy. On the first two farms this work has been in progress much longer than at Manganallur. Manurial requirements of course, differ with the locality although a long series of experiments in the west have shown that not infrequently one particular manurial constituent, exercises a great effect as a rule on a particular crop. In considering the results of experiments carried out under such different conditions as exist in Coimbatore, Tanjore delta and Gōdāvari delta exact uniformity must not be expected. But there is an increasing mass of evidence that the generally most suitable manure for paddy is green leaf in some form (or bulky organic nitrogenous matter) supplemented by phosphate in some form. Whether the addition of the latter is financially profitable at any particular place depends on local trials there. Evidence is however accumulating from many different sources as to the correctness of the main proposition. Isolated experiments in Kistna Western delta also tend to confirm it. Potash rarely has a beneficial effect. The average of over six years' comparative trials at Samalkota shows 2,585 lbs. per acre on the no manure plot, 2,749 lbs. on that which receives only green leaf, 2,736 on that which gets green leaf *plus* potash and 3,340 on that which has a small application of superphosphate in addition to green leaf. Corresponding average figures at Coimbatore for a like period give 3,114 lbs., 3,291 lbs., 3,175 lbs. and 3,343 lbs. It is doubtful whether the addition of the phosphate to the green leaf pays at Coimbatore. Figures of cost and profit will be worked out for

Samalkota. At Manganallur, the corresponding figures for this year alone are 1,700 lbs., 1,925 lbs., 2,240 lbs. and 2370 lbs. respectively. The results of more years' work there is however needed before anything definite can be said. The fringe of this work has of course only been touched, though the problem has been greatly cleared by the fact that time need not be spent on trials with potash and many of the mineral combinations in which nitrogen occurs. Experiments have been started at Manganallur to determine the form in which phosphate can be most advantageously applied. So far as they have gone they tend to show that although paddy is grown under swamp conditions phosphate in the form of super is more readily available to the plant than mineral phosphates or bone meal. The time and method of application is also of importance. Mr. Sampson writes in regard to the Manganallur experiments: "It is evident from observation of the growth of the crops especially in the case of superphosphate that these manures have a decidedly stimulating effect; not only do the crops become established sooner but they assume a more healthy and vigorous appearance than is apparent from the difference in crop yield and it is probable that a second application during crop growth would have a greater influence on grain production." This has to be tested.

17. *Increase of straw to increase of grain.*—The complaint is sometimes made that the application of artificial fertilisers causes an undue increase in the quantity of straw at the expense of the grain. This has not been the experience at the farms with the use of superphosphate in moderate quantities. Thus the figures at Manganallur gave as percentages of grain yield to straw yield on the no manure plots 71 per cent. and 64 per cent. and on those on which super had been added 81 per cent. and 64 per cent. Where super was given in addition to leaf the percentages of grain to straw on the plots which received leaf alone were 83 per cent. and 98 per cent. and on those which received leaf *plus* super in moderate quantities (120 lbs. to the acre) 83 per cent. and 105 per cent. When the dose of super was doubled (*i.e.*, 240 lbs. an acre) straw did increase more rapidly than the grain yield. The figures at Coimbatore corroborate this.

(c) Cotton.

18. Selection of single plant strains is being continued at Koilpatti, Hagari and Nandyal; and in the former district those which are considered to be the best are grown on 2 acre blocks to provide sufficient lint for spinning tests. We are again indebted to Messrs. Harvey & Co. for doing these and their reports have been most favourable showing that these strains spin up to forty's and are strong and uniform. Another testimony to the value of these strains is shown by the fact that the Sri Chidambara Vinayakar mills at Koilpatti are paying a bonus of Rs. 2 to 3 per 250 lbs. of lint to villagers in order to procure the crop. Two of the strains put out in the villages disappointed expectations. Their quality and ginning percentage were maintained but the yield was only average. When young they carried a profusion of bolls and a very heavy yield was anticipated. But later many of these bolls were shed. It is not clear whether this was due to late rains in the season or not. In the previous year they had yielded very heavily. Both at Hagari and Nandyal a series of single plant selections are being very carefully tested. The seed which is being put out in both these districts is derived from single plants and some of the later selections on the farms promise to do still better. Selection work on Cambodia is in progress at Koilpatti and Coimbatore.

(d) Dry Grains.

19. The extent to which work is in progress on dry grains and fodder crops is possibly not realized, but detailed work is in progress on sorghum, the millets, ragi, chillies, and "dry" paddy besides many fodder crops. The profits obtainable per acre from these crops cannot compare with those won from paddy, sugarcane and cotton, etc., and consequently elaborate experiments on manuring for instance are out of place; nor do questions of quality arise in regard to these grains to the extent that they do in cotton lint for instance. The chief lines upon which improvement can be found are therefore necessarily more confined to cultural methods, seed selection and prevention of disease. Under the first head come a

whole series of experiments, e.g., the most profitable rotation of crops in the different tracts, the use of the drill and harrow, the use of light iron ploughs on garden soils, the best method of applying water to ragi, etc. Also work on all dry land crops is not under the same control as that on paddy. The whole year's work may be lost through a vagary of the season. Cases of this will be found below.

20. Under the first of these heads, viz., rotation of crops comes the systematic cultivation of the waste lands of North Malabar. Chillies did especially well this year and some of the varieties yielded at Taliparamba a profit of Rs. 170 to Rs. 200 an acre. The hot weather rains were short and so ragi was caught by the monsoon before it was well established. The depression in the prices of ginger and turmeric also unfortunately continued and neutralized the effect of good yields. At Palur, Nandyal and Hagari rotation experiments are in progress, but of course the heavy fall in the price of groundnut and cotton has affected these series of trials which are to be judged by financial results as well as by the maintenance of the fertility of the soil. At Nandyal the rotation of a mixed crop of horse gram and cotton—a common local practice—followed by sorghum has been tested for six years against the simple rotation of pure cotton, sorghum. The only thing to be said for it is that thereby some horse gram for cattle food is obtained cheaply. The gram has no effect on the following sorghum crop nor apparently much on the cotton crop. This experiment is being discontinued and other rotations tested.

In Palur, the work of testing the best cereal to be grown mixed or in rotation with groundnut was continued.

21. Under the same head of cultural experiments come the deep cultivation before the hot weather of land on which dry paddy is to be sown, and the relative value of sowing ragi in flat beds or on ridges and furrows. The results so far as they go are in favour of deep cultivation for dry paddies early in the season. In the second case the experiments at Hagari which were continued go to show that the ridge and furrow system of planting is neither better nor more economical of water than the ordinary flat system in the case of ragi. This is somewhat at variance with the experience at Coimbatore and it would appear that the yields are about the same in both systems but that the quantity of water used depends on the care with which the land is laid out in the first instance. Also trials show that no economical results of value are to be expected from reducing the seed rate of ragi and chillies. Irrigated or Chitrai Cholam is one of the most important crops grown under wells in Coimbatore district, the profits from which mainly depend on the amount of water which has to be baled to mature the crop. Economy of water is thus most important. Attempts have been made for several years at Coimbatore to see whether this could not be achieved by growing the crop in ridges and furrows instead of on flat beds. This cholam however needs an irrigation to cause it to sprout; and a difficulty has always been found in getting an even start for the crop before it is big enough to earth up.

22. *Seed selection and varieties—Sorghum.*—At Hagari plots were again sown to test the yields of the six single plant selections, but no results were obtained as throughout the whole of that tract of Bellary the sorghum crop failed. It is these kinds of vicissitudes which make work on dry grain crops so much longer than on crops on which conditions are more under control. However one very useful piece of work was completed by Mr. Hilson on this crop. There are two main varieties of very different value from the point of view of fodder, one possessing a pithy stalk and the other a sweet one. Yet when the ryots sow seed which they expect is going to give them sweet stalked fodder, a large number of these pithy stalked ones always appear. Careful experiments at Hagari and Nandyal have shown that cross fertilization of sorghum readily occurs in the field and that this composition of the stalks is a simple Mendelian characteristic in which sweetness is recessive. It is thus simple in future to obtain a pure strain for sweetness of fodder; it is necessary to get a good grain yield on it also.

23. *Ragi, Italian millet and Oumbu.*—The testing of different single strains of ragi was continued at Hagari with good promise, whilst the season there also favoured Italian millet which gave a record yield. It failed completely in the previous year. It has also again done well at Coimbatore. The grain of one of

the foreign varieties of cumbu is beginning to find favour in the neighbourhood of Coimbatore. Work is being continued thereon.

(e) *Fodder Crops and Grasses.*

24. *Foreign varieties.*—These fodder crops and grasses are becoming more and more important every year as all improvement of cattle is closely bound up with the provision of good and cheap fodder. The best comparative tests can be made at Coimbatore where there is a herd of cattle. The standard fodder crop of the district is cholam, periamanjā, sown thickly and grown under irrigation. But the recent experience at Coimbatore goes to show that guinea grass would be more profitable to grow for this purpose. The former gives per acre from 25,000 to 33,000 lbs. of green fodder whilst guinea grass gives from 22,000 to 36,000 lbs. and is more economical to grow and has not so much waste. Silver Beet or Swiss chard mentioned last year has again done well on the whole giving 25,000 lbs. in six cuttings between October and April. Teff grass was also again grown and made into hay. It was of good quality but the yield—1 ton an acre—is not very good. At Koilpatti the local irungu cholam usually grown for fodder has been entirely superseded by periamanjā introduced from Coimbatore and there have been considerable sales of it to ryots in the district.

25. *Indigenous grasses.*—There is reason to believe that the natural supply of many of the most valuable indigenous fodder grasses of India has been grievously diminished by the practice of unrestricted grazing. Cattle turned on to a pasture naturally eat the more succulent grasses first, so that in places where cattle in considerable numbers always wander over the grounds as soon as a flush of grass comes year by year, the better grasses have less chance of maturing and spreading. The inferior grasses are encouraged to spread at the expense of the better. The obvious remedy is to devise some scheme for sowing seed of better grasses and for protecting the pasture till growth is established. But no one has ever done any work on Madras grasses from an economical point of view. So this department is not yet in a position to distribute seed. In most of the papers of earlier years, *Pennisetum cenchroides*—the far-famed grass of the Kangayam country—is mentioned as if it would flourish everywhere, which of course is not the case; or the exotic *Paspalum dilatatum* is recommended. This last is growing admirably in the lower portions of Sim's Park, Coonoor, but does not flourish on the dry-arid plains. A start has been made to collect all the local grasses which are held in greatest estimation by the ordinary local herdsmen and they will be tried and tested. A comparative plot of some of these were laid down at Hagari last year. Of a cognate nature is the keeping of correct and careful accounts to find the cost of converting 200 acres of bare sand dunes into useful and profitable pasture. This has been started.

(f) *Groundnut.*

26. *Varieties.*—Tests were continued to compare the value of 13 different kinds of groundnut. West African continues to maintain its place as the best nut on unirrigated land having given an average yield for the last three years of 505 lbs. of oil per acre; but on land irrigated from wells local Mauritius is still ahead with an average of 950 lbs. West African coming third with 877 lbs.

(g) *Pepper.*

27. The year on the West Coast was altogether peculiar. There was practically a seven months' drought from October 1913 to May 1914 as only 1.56" of rain were received instead of the average 8.35". The result was that many of the vines died and all, except those in the most sheltered corners, suffered from lack of shade in the hot weather. On the other hand there was almost an entire absence of the usual disease "pollu," and the final result on the whole was a record yield of pepper from the farm, viz., 4,741 Madras measures of green pepper (practically 4,741 lbs. of dry pepper); but the yields varied so much according as to the amount of shade received in May that for the comparative purposes the results

from the different plots are of little value. Of the varieties Kallavalli continued to improve its position as the heaviest yielder.

(h) Live Stock.

28. *Cattle*.—The first attempts to obtain a special officer for cattle failed and the only herd maintained by the department is the one at Coimbatore. It did well throughout the year. There were 34 births, 26 animals were bought, 42 were sold and 3 calves died. At the end of the year the herd, including working bullocks, numbered 205, of which 37 were cows and 6 heifers. Many of the heifers born on the estate are now coming to maturity, but it is slow work. The dairy dealt with 79,300 lbs. of milk as compared with 66,900 last year, and besides sales of fresh milk 1,886 lbs. of butter were sold as compared to 1,358 lbs. last year. Debiting the milk used by the dairy at 1 anna a pound and allowing for depreciation, establishment, etc., there is a small profit on the year's working. The average yield of milk of the whole herd, including the dry cows, only works out to approximately $3\frac{1}{2}$ lbs. of milk a day. This valued at 1 anna a pound comes to Rs. $6\frac{1}{2}$ a month per cow which is certainly more than the cost of its keep. But a much higher average daily yield of milk is required.

29. *Sheep*.—The flock at Hagari continued to do well and at the end of the year had increased from 36 to 58. Unfortunately the shepherd in charge failed to note several of the matings and consequently the male parentage of some of the last born lambs is not known. There are two rams with the flock. The average clip of wool has not improved as much as was hoped being only $1\frac{1}{4}$ lbs. though one animal for the second year in succession gave over 3 lbs. An interesting trial was made to see whether it would pay to buy young lambs and fatten them on some of the fodder crops for the Bellary market. Those purchased were a mixed lot of lambs, none of which had done well from birth and they did not grow as well as was expected, with the result that when the growing of the crop was taken into account the balance on the profit side was only the manure. Mr. Hilson believes that better results ought to be obtainable and is repeating the trial with some of the farm-bred hogs.

B.—CHEMISTRY.

30. The soil survey of the delta portion of Guntūr district was completed and it is expected that the final maps will be ready in a short time. Two thousand four hundred and twenty-seven analyses were made of different products of which 53 were for cultivators. Mr. Harrison continued his work on the gases in paddy soil during the growing period of the crop and another memoir on it was accepted by Pusa and published. It appears that the gases mainly given off by the decomposition of organic matter in paddy soils react with the organized film of diatoms on the surface of the water of the field, promoting the oxygenation of the surrounding water and therefore with a slow rate of drainage improving the aeration of the roots. A long series of experiments also goes to show that gaseous nitrogen is evolved from paddy soils especially during the growing period of the crop. The general trend of all this work is that green manure crops have not so much direct manurial value on paddy as has been imagined but have a very important influence on the healthy growth of the crop by improving the aeration of the water and soil, by improving the mechanical texture of the soil and by promoting biological action. The investigation is being pursued. In conjunction with the Government Mycologist some bacterial work was done. This is mentioned in the section on Mycology.

C.—ECONOMIC BOTANY.

31. Work on paddy occupied most of the attention of the Economic Botanist and his staff. It was the first year in which they had been able to raise crops from seed of known parentage, and the crops grown on the small plot of land on the Central Farm utilized as a breeding station were a revelation of the extraordinary variations which may occur in paddy. Looked at from the point

of view of an agriculturist, which is the all important one, two facts stood out. One was the extent to which the ordinary varieties in the ryots' fields are not really true to type, and therefore the difficulty of improving the crop by mere single plant selections. Even when these are made as carefully as possible for desirable characteristics from crops which were believed to be pure the odds are practically even that in the next season these selections will split up into plants revealing all sorts of combinations of characteristics instead of coming pure. The other fact was the importance from the point of view of yield of obtaining a pure strain in which all the plants come to maturity uniformly. A field must be harvested at one time, the grain cannot be plucked like cotton and plants which either mature before or after the majority are merely so much loss so far as the harvest of grain is concerned. Considerable attention was naturally given in the first year to the inheritance of morphological characteristics and a paper on some of these was contributed to the Indian Science Congress. Arrangements have been made to provide the Botanist with more uniform land on which to grow his selected seed. The wet land on the Central Farm is notoriously variable and when it comes to testing economic as distinct from purely morphological qualities it is essential that the conditions under which the plots are grown be uniform. Some 600 lots of paddy are being carried on, of which a third are for studying the inheritance of important economic characters. A beginning has been made of an economic survey of the paddies in the most important rice growing tracts of the Presidency. In cotton attention is being concentrated on Cambodia and Cambodia crosses. The Deputy Directors of the Northern and Southern ranges have already done considerable work on the local indigenous cottons and in this they will not be disturbed.

D.—GENERAL BOTANY.

32. Much of the work under this section comes under the head of teaching, but work in connection with the herbarium is always in progress, for which purpose tours were made in various parts of the Presidency. Some 2,000 specimens were collected in the year and 1,586 sheets added to the herbarium. Three thousand six hundred and sixty-four sheets had been sent to Mr. Gamble at Kew for his work on the Madras Flora before he wrote and asked that no more be sent for some little time and until the sea route was safer. In round figures he has received 10,500 sheets for his book on the Madras Flora. One hundred and eighty specimens were identified during the year for various correspondents.

E.—ENTOMOLOGY.

33. Mr. Bainbriggé Fletcher's book which was mentioned in last year's report was issued to the public and has been very favourably reviewed in journals both in India and abroad. I am also informed that there have been many private sales of it. As will be seen from Mr. Ballard's report (Appendix VI) the new Insectary has proved most useful in working out the life histories of several insect pests. In the districts preparations were made to try new methods against the Deccan grasshopper. The ryots do not take at all kindly to bagging the hoppers. Deep ploughing in order to destroy the egg masses is efficacious but it is difficult to get ryots to do this on a large scale, and unless all or the majority of the villagers work together against a pest those who have taken trouble have the mortification of seeing their crops destroyed by the insects which come from their neighbours' fields. Considerable success has attended campaigns against grasshoppers in the United States of America by the use of poisoned bait. The attractive principle for the Deccan grasshopper has however not yet been discovered. Mixtures of Paris green and jaggery flavoured with mango, lime and many other ingredients were all tried alike in vain. Fortunately the season was very unfavourable to this insect and the ryots' crops did not suffer much from its depredations. The use of light traps is often recommended as a remedy against *schoenobius bipunctifer*, the insect which causes the dead white head seen in paddy fields, but a prolonged trial with them showed that this remedy cannot really be relied upon. The most successful district work was done on Mr. Stevenson's mango gardens in Salem against the

mango hopper. The trees were treated periodically with fish oil soap made by the Fisheries Department, which promises to be a very useful and cheap insecticide and the crop was saved. Mr. Stevenson saw that instructions were faithfully carried out and he was fully satisfied with the results.

34. *Sericulture*.—The district work on sericulture is dealt with in a later section of this report. French seed of the univoltine species were obtained from the Salvation Army at Simla but neither at Coimbatore or Kollegal were cocoons successfully reared. At the Salvation Army Settlement at Bethupadi a few did come through and the resultant cocoons were much larger and heavier than those obtained from the ordinary multivoltine species. The partial success obtained at Bethupadi was not due to any special methods and precautions, but is useful in showing that these cocoons may live in Southern India and trials with them will be continued.

F.—MYCOLOGY.

35. In previous reports it has been customary to fill most of this paragraph with an account of the district work against the palmyra, coconut and areca palm diseases. That is really district work and in future will be dealt with in the section devoted thereto. In the West Indies a disease on coconut palms very similar in description to that found on the palmyras in Gōdāvāri and the coconuts in Malabar is ascribed to a coliform bacillus. Coliform bacilli have been isolated from the rotting portions of palms in this country affected with budrot, but inoculations with pure cultures thereof on healthy palms have not induced the disease, whilst inoculations of healthy palms with pure cultures of the fungus *Pythium palmivorum* have resulted in all the symptoms of budrot with subsequent death. It is thus established that the cause of the disease known as budrot in Southern India is Dr. Butler's fungus *Pythium palmivorum*. A new disease has been reported on coconuts in Cochin and is under investigation. A fungus on paddy which converts the loose head of grain into a solid black diseased spike was worked out in detail and field operations against it will be tried next year. The cause of black rot in plantains has not so far been discovered. General correspondence is developing; thirty-six bundles of diseased plants were received for investigation and twenty-one applications of investigating diseases on crops were received.

G.—THE SUGARCANE BREEDING STATION.

36. Dr. Barber's report is published as Appendix VIII. The extraordinary differences in habit between the different seedling canes were mentioned in last year's report as well as the fact that the chemical analyses of the different seedlings promised great variations. The complete analysis of last year's seedlings shows that 61 of the Madras seedlings analysed at over 17 per cent. sucrose, 37 over 18 per cent., 8 over 19 per cent. and 2 over 20 per cent. These are all satisfactory figures for this one feature as will be seen by the fact that Red Mauritius, Java 247, Barbados 208, B. 1,529 which are the best of the recently imported canes range between 16 per cent. and 20 per cent. Some 150 packages of cane have been sent to the stations in Northern India. Among these are nine Madras seedlings which have been distributed mainly in order to see how they fare in the north. It would appear that, in 1913-14, the seedlings were if anything treated too well on the station so that vegetative growth increased at the cost of sugar content, for when cuttings from them were planted on field conditions, an improvement in sucrose content took place concurrently with a fall in the general luxuriance of their growth. Hitherto one of the most difficult matters has been the collection of pollen which frequently has had to be brought from scattered and distant villages. However, this year by utilizing part of the wet lands at the Central Farm and at Taliparamba and Samalkota this difficulty has been much reduced. Dr. Coleman in Mysore has kindly helped once more. The North Indian canes which hitherto had never flowered did so this year but unfortunately did not set fertile pollen. Some 23,000 seedlings were successfully raised in the year. Dr. Barber and his staff contributed during the year several papers on their work and on sugarcane to Pusa, and the International Congress of Tropical Agriculture, etc.

H.—PISCICULTURE.

[Sir F. Nicholson, K.O.I.E., writes as follows.]

37. *Fresh water pisciculture.*—As in previous years this was in charge of Mr. H. C. Wilson. The Sunkesula fish farm was maintained, the breeding and distribution of larvicidal fish was developed, the Īpur fish-farm plan was sanctioned and its construction begun, several important tanks were stocked, the Nilgiri trout streams were duly conserved and their supplies of fish food replenished, the waters of the Bhavani and Moyar continued under conservation, the acclimatisation of tench in the plains was achieved, and the rivers of Coorg and South Canara carefully surveyed in view to further operations. There were numerous minor operations in progress, but the large Collair lake scheme is at a standstill by reason of the number of traps and fixed engines in the locality. Certain restrictive measures have been introduced and others were under investigation.

38. *Marine Pisciculture.*—This was confined in actual operation to the Tuticorin lagoon fish-farm of about 160 acres which was duly constructed and began work towards the end of the year, and to the edible oyster farm at Pulicat which continued to work successfully, though with vicissitudes due to floods and droughts. The pearl oyster farm near Pamban received the general sanction of Government in January 1915 and the matter now awaits the submission of detailed plans and estimates by the Public Works Department, and the acquisition of the island.

General.—The staff both for inland and marine pisciculture was considerably strengthened during the year and this will lead to developments hitherto impossible.

IV.—DEMONSTRATION, AID TO THE PUBLIC, SHOWS, AGRICULTURAL ASSOCIATIONS AND GENERAL PROGRESS.

39. The year has been marked by a general development of district work all round. In practically all lines there has been distinct advance.

(a) *Operations against disease.*

40. *Palmyra disease in Gōdāvāri and Kistna.*—It may be thought that this disease is doomed to be ever with us, but mention was made last year of a change in method. Not only were steps taken to cut dead and infected trees as soon as signs of infection were apparent but in one small tract of Kistna the villagers were persuaded to cut all trees within the known infected area searching for hidden signs of disease and where these were present to operate at once. This method has in the course of the year been pushed still further so that all infected tracts in all villages of Kistna have been so examined and a start has been made in Gōdāvāri district. When it is remembered that 95 per cent. of the trees operated upon recover and that an infected tree can remain a source of infection to others for years it is clear that if this system of detailed examination can be generally introduced there will be a fair chance of overtaking this disease. The system by which the State supplies the supervision and driving power and the ryots do the work at their own cost is the ideal one for dealing with disease. Great credit is due to M.R.Ry. V. Ramanadhan, the Kistna Tahsildar and his staff for the work they had done there. In all 220,403 trees in the two districts were cut of which 33,553 were dead at the time of operation, 40,286 were trees with external signs of infection and 9,738 were infected trees showing no external symptoms. The remaining ones were healthy trees partially cut in the process of examination. These figures may be contrasted with those of previous years. The increase in the cost of staff has been comparatively small; yet in 1913-14 the figures were 100,741 trees cut (71,341 dead and 29,400 infected) and in the years previous to that about 80,000 a year all dead because no attempt was then made to deal with infection. At the end of the year 27 villages in Kistna were removed from the infected list.

Coconut disease in Malabar.—The same disease *Pythium Palmivorum* attacks coconuts in Malabar, but these palms are not nearly so susceptible to it as are palmyras. The disease is widespread, and not intense or virulent anywhere. 1,497 infected trees were destroyed.

41. *Mahali disease on arecanuts.*—Work was continued in South Malabar and in a remote corner of South Canara to demonstrate the efficacy of spraying arecanuts with Bordeaux mixture as a preventive against mahali (*Phytophthora*). In all more than 29,000 trees were successfully treated as compared with 14,000 in 1913-1914 and 2,100 in 1912-1913 when field work was first started.

42. *Work against smut on cholam.*—In Bellary and Kurnool a definite attempt was made to persuade the ryots to steep their cholam seed in a 2 per cent. solution of copper-sulphate before sowing as a preventive against smut. They did it on seed sufficient to sow 1,300 acres but more work of this nature ought to have been done in Kurnool.

(b) *Crops.*

43. *Sugarcane.*—Work in connection with this crop is at present of peculiar interest because of the high prices ruling for sugar and jaggery. The current year should see a considerable expansion of this work especially in Vizagapatam district where a beginning was already made (a) by the distribution to the ryots of 45,700 setts of B. 1529, (b) by the sale to them of 16,400 lb. of castor cake for manurial purposes and (c) by getting them to use improved furnances of which two were erected. In South Canara, Red Mauritius is now established in 150 villages. It is however in very scattered portions. The total area under it is 424 acres as compared with 194 last year and 84 in the one previous to that whilst the use of iron crushing mills continues to spread. Six years ago they were unknown but since then some 130 have been sold. The cultivation of it is also reviving in Malabar under the stimulus of high prices. A start was made in introducing improved furnaces into Chittoor district which it is calculated means an average increased profit of Rs. 15 in converting each acre of cane into jaggery.

44. *Cotton.*—As before, work was confined to the Tinnevely, Bellary, and Kurnool districts and in all progress resulted. In the south a new circle was opened for village work in the Rāmnād district. In Tinnevely 400 acres were cultivated in October 1913 on seed farm by 61 contract growers besides another 95 acres sown with different unit strains to provide lint for spinning tests. From the seed farms 120,015 lbs. of good pure seed were obtained. Of this 103,465 lbs. were sold to ryots from seed depôts in the sowing season of 1914 at 20 per cent. above ordinary bazaar prices. This was sufficient for 12,170 acres. The figure for the previous year was 89,500 lbs. seed sold sufficient for 10,500 acres. In 1913-14 three villages took the produce grown from departmental seed direct to the ginning firms without intervention of middlemen and obtained their own seed back pure. In 1914-15 twenty villages so took 132,750 lb. of kappas and obtained 97,500 lbs. of pure seed. Most of this was kept for sowing purposes and was certainly sufficient for another 10,500 acres in October 1914. Therefore in the season of 1914-15 there were from 20,000 to 22,000 acres under departmental seed more than double the area obtained in the previous year. By this joint sale it is calculated that the ryots made an additional Re. 1-2 per acre (or very nearly their assessment) independently of any profits they made by selling their surplus seed for sowing for which there was a good demand. There are obviously very great possibilities in this system of joint-sale both as a means of profit for the cultivator and as a means of spreading new types. But it has not been possible yet to form thoroughly operative co-operative societies as matters of finance have not been arranged. If the smaller producer is to obtain the benefits of this joint sale he must be able to get advances against his growing crop; otherwise he has recourse to the middlemen and all chances of his joining in joint sales after harvest disappear. This has to be arranged because not only have all the firms in the trade now agreed to gin such joint consignments separately from those of any one else but one mill is offering higher prices to obtain the lint from our departmental seed. One of the special strains put out last year in the south of the district did very well, but unfortunately the one around Virudupatti shed many of its bolls late in the season and the yield was affected. In Bellary 693 acres were sown on seed farm conditions and 58,253 lbs. of good seed was obtained. 51,943 lbs. (sufficient for 7,000 acres) were sold at 15 per cent. above

local prices of seed. In Kurnool from 651 acres of seed farm 43,702 lbs. of seed were obtained of which 30,736 lbs. were sold. In Bellary all the seed sown was of unit strain and in Kurnool most of the seed sold was from a single plant selection. This year all will be. The total area under seed farm conditions in October 1914 was 2,250 acres in the three districts, and altogether 186,144 lbs. of seed were sold sufficient for 21,900 acres. If to these two acreages be added the area sown with seed retained by joint sale in Tinnevely, 34,000 acres are this year to our knowledge under seed of selected varieties. In the previous year the area under this known seed was 14,600 acres, so a very considerable development has taken place. The budget allotment was Rs. 46,350, actual payments were Rs. 46,390, and receipts Rs. 41,257. In these figures also come the expense in spreading drill cultivation in Tinnevely (v. below); also at the latter part of the season there was a very heavy fall in the price of cotton due to the outbreak of war. It has on the whole been a very satisfactory year's work.

45. *Drill cultivation in Tinnevely.*—Concurrently with the work on cotton the use of the drill and harrow is being introduced into Tinnevely. Hitherto coolies were largely trained in the use of these implements on the Koilpatti farm and as a result most of them were drawn from the labouring classes. But as a result of better organization arrangements were made in Tinnevely to give more training in the villages and as a result many of the sons of the more respectable farmers are learning how to use these implements. The area on which they were used by the ryots themselves shows a great increase, viz., 11,329 acres, as compared with 7,117 in 1913-14 and 3,877 in 1912-13. 32 sets of implements were sold as compared with 35 in 1913-14 and 14 in 1912-13. Sales would probably have been greater still but owing to the fall in price in cotton on account of the war about September, October, there is tightness in money. The drill is being more and more used by ryots for the cumbu crop, and it is a mistake to look on this improvement in method of cultivation as one solely for the benefit of cotton. Cleaner and more careful cultivation of the soil benefits every crop grown upon that land. Moreover the figures given above include the area on which cumbu was sown with the drill and the soil was afterwards inter-cultivated. In 1910-11 these implements were only used on 70 acres of cumbu but in 1914-15 they were used by ryots on 1,990 acres.

46. *Paddy—Seed and seed-rate.*—There continues to be a very strong demand in the neighbourhood of all the farms for the surplus seed which is always sold slightly above ordinary market rates. Figures are not ready for the Southern division but in the Northern and Central divisions 63,124 lbs. of seed were sold; and the village associations which in Malabar are doing good work bought up most of that available from Taliparamba. The practice of reducing the seed-rate continues to spread and single seedling transplantation has spread very considerably in the Bhavani valley and has been started under the Amaravati irrigation. A general reduction in the seed rate is in progress around Samalkota and surplus seedlings from the Anakapalli farm were distributed to 48 of the ryots of the neighbourhood to be transplanted singly on their lands for demonstrational purposes. Only from one part of the whole Presidency is any complaint about this system heard and that is from portions of Shiyali and Mayavaram Taluks. Detailed district work was started there on these lines some four or five years ago and then on account of the opening of new farms the man had to be taken away. Had he remained it is doubtful if even this complaint had been heard. Some there say that they had excellent yields from these single seedlings for the first three years and then the fertility of the land appeared to become affected, and they are now transplanting in twos and threes. Even if they find that this system pays them best in the long run (although it is notorious that the Tanjore ryots do not manure their fields to the extent that the Tinnevely or Coimbatore men do, and although Kistna which for years and years has practically used nothing but single seedlings has no such complaint to make) there is still a large reserve of credit due in Shiyali and Mayavaram to the introduction of this system of economic transplantation, for transplanting with twos and threes means that from 50-60 lbs. of seed are being used per acre, whilst in the old original system about 120 lbs.

of seed were commonly used. So that even now there is a saving of at least Rs. 2 an acre. In this connection an interesting fact has occurred. It has been possible this year to post a man once more for district work in these two taluks and he has sold 30,327 lbs. of green manure seed (Kolinji) much more than was anticipated. Thus it is not unreasonable to conclude that had it been possible to keep a man for district work there for the last four years continuously any real difficulty which was being felt by the ryots would have been met. In all this work the importance of preparing the seed bed carefully in the first instance and sowing it thinly must be borne in mind. (v. para. 14 *supra*). Strong healthy well developed seedlings are required and not the puny produce of a congested area.

47. *Manures*.—In the previous year small quantities of fish manure were sold to many ryots in the Southern Division for trial and as a result many more orders were booked for it in the year under report at enhanced rates, but unfortunately it could not be supplied as the catch of fish in the West Coast was a complete failure. Attempts are being made in the current year to get ryots to try small applications of superphosphate to supplement the green manure in accordance with the results on the farms (v. para. 16 *supra*). As a result of the Trade Conference of last December manure depots will probably be established in time. In all these matters of artificials it is above all things important that the ryot only gets the substance he requires and gets it pure.

48. *Green manure*.—The most rapid advance made has possibly been in the Musiri and Perambalur taluks of Trichinopoly district where work was begun (though the staff was very short) at the request of the Collector Mr. Buckley as the rates for leaves from the forest had been raised. Over 1,000 acres were grown with daincha in these two taluks and the growth was so good that often the crop from one acre was cut and distributed over two or three acres. Moreover which is still more satisfactory—the ryots made arrangements to keep some of their crop for seed for the next year. In Sholavandan circle equal if not better results were obtained, and one village there estimated the value of the improvement as worth to them Rs. 20 an acre. This is not impossible when it is remembered that in that village daincha only costs them about Rs. 5 to 4 per acre to grow whilst previously they had been getting green leaf from the forests in Ariyalur in Trichinopoly district. The leaf had to be purchased, brought, from the forests to the railway station, trained to Sholavandan and then carted and spread upon the fields. Daincha continues to give much better results on land inclined to salinity than a good sweet land. This is probably due to its effect on the mechanical texture of the soil. In Madura circle work has not progressed so well as in Sholavandan mainly because the area was larger and there was a change of officers. Instances also were not wanting of the disappointments which at times result from working with agents of absentee landlords. There is no doubt about the sympathy and good intentions of the landlords but most of them are busy men, and among agents, there are agents and agents. It is obvious that some will not look with favour on a new fangled system which requires a little care and only costs about Rs. 3 to 4 an acre most of which goes in labour, in place of one which involves direct purchase. Daincha seed is still purchased from Bengal. In Malabar the absence of rain in April-May (1" as compared to an average of 8") affected adversely the cowpeas which are there being introduced for green manure. Daincha is getting a start around Mangalore. In Chingleput and South Arcot the work also developed. Taken as a whole the sales in the year amounted to 150,814 lbs. of seed (Southern Division 82,823 lb., Central 61,458 lbs. and the Northern 6,533 lbs.) as compared with 158,600 lbs. in 1913-14 and 60,800 lbs. in 1912-13).

49. *Indigo*.—As soon as it became probable that the European war would not suddenly collapse it seemed likely that the ryots who cultivated indigo this year would make great profits, and it was also likely that the price of indigo seed would rise rapidly. A special grant was therefore obtained from Government and a stock of good indigo seed was laid in before prices rose very high. Afterwards 24,570 lbs. of good indigo seed were sold in villages in which old vats still existed

in a state of fair repair, but in which latterly the trade in it had decreased. Later in the year prices of seed more than doubled and much adulteration took place. There were no complaints against the seed sold by the department and very many applications had to be rejected because stocks were exhausted.

50. *Intensive dry cultivation in Malabar.*—In spite of the fall in the price of ginger and turmeric which were the two chief commercial crops in the rotation recommended for these lands this system is steadily spreading. Amongst other things the residual effects of the manures applied to these crops have a great effect on the cereal in the rotation so that instead of modan paddy only being a catch crop, it has given to many ryots yields comparable with those of paddy on wet lands. Also over 10,000 chilli seedlings were sold from Taliparamba farm.

51. *Sericulture.*—In 1913-14 the fieldman on sericultural work in Kollegal was mostly occupied in missionary and advisory work. Although his teaching had had some effect, in 1914-15 an effort was made towards more practical work. He was ordered to work in a smaller group of villages, a rearing house was built for him in the taluk office compound and land on which mulberry could be grown was secured. The object was to see if he could rear disease free seed and whether the rearers would pay higher prices. Unfortunately early in the season the shed was burnt down, and the seed sent from Bengal was of very poor quality. The rearing house was then moved into one of the neighbouring villages and although the season was late 14,500 healthy worms were brought through the fourth moult. From these 13,000 good cocoons were sold for seed purposes at Rs. 2-12 a thousand when ordinary Mysore seed was fetching Rs. 2-4 or Rs. 1-8 per 1,000. The seed proved to be absolutely free from Pebrine and Flacheric the two most deadly of silkworm diseases. The work will be continued.

52. *Implements.*—When first attention was paid to agricultural improvements in 1864 a rush was made for the introduction of Western machinery. It often proved unsuitable and during the last eight years much more attention has been paid to local crops and improvements in local practices than to the sale of new ploughs, etc. However a demand for these is growing up, and implements are sold, lent or hired from the farms more extensively than is possibly known. In 1914-15, 32 sets of drills and harrows were sold in Tinnevely district, 27 Scind ploughs from Palur, 26 monsoon ploughs (mostly from Palur), 9 triangular harrows, 6 improved country ploughs; seven power sprayers and at least two improved jaggery furnaces. There were probably more of these latter made and sold as the West Coast has not reported figures. Besides these, ploughs were hired out or lent to four ryots near Anakapalli and to two at Nandyal, whilst at Coimbatore Rs. 150 was received from ryots for the use of heavier ploughs at Rs. 5 an acre. At Koilpatti arrangements have been made to hire to a village association with a view to eventual purchase a two furrow disc plough costing Rs. 220. One of this kind has done excellent work on the Koilpatti farm for two years and has attracted much attention. The country people have humourously dubbed it the "Chatty" plough. It has been very difficult to procure spares and even supplies at times in Madras and the Trade Conference was very useful in bringing this to the notice of all firms, etc. It is unfortunate that the increase in freights and cost of production due to the war has caused the retail price of most of these implements to be increased just when a real demand for them was beginning to appear.

53. *Live stock.*—The Government have decided to appoint an officer especially for cattle breeding but he has not yet arrived. Consequently, the work on cattle is confined to Coimbatore. The failures which have so repeatedly attended the efforts of Government to place breeding bulls at public institutions free for stud purposes have frequently been the cause of sorrowful comment in official reports. In these circumstances, the figures at Coimbatore where bulls have been kept at stud for the cattle of local ryots are interesting. This has been done since the farm was opened seven years ago, and the numbers of ryots' cows covered in each of these years are respectively, 5, 6, 52, 139, 247, 425 and 570 (last year); and this though the fee for service has been steadily raised from nothing to 12 annas a covering. This is a great contrast to past experience in other places. It is merely the result of keeping good bulls.

attending to the ryots promptly when they bring their cows and of gaining their confidence. The local demand exists. Agricultural officers chiefly in the Central Division assisted the ryots in getting their useless male stock castrated by the officers of the Veterinary Department.

54. *Cattle shows and Agricultural lectures, etc.*—Cattle shows were held at Ongole, Tiruppur and Madura. At the two last, agricultural lectures, demonstrations and exhibitions were given as well as at Pudukōttai and Ammapet. An exhibit was also sent to the Agri-Horticultural Society's show at Madras. The Tiruppur show is noticeable as being the only one managed by a District Agricultural Association (that of Coimbatore) without any aid whatever from local or provincial funds. This is most creditable. Another feature about it is the increasing interest in it displayed by the smaller breeder. Agricultural lectures have been given at many places in the districts. Two very successful demonstrations were held at Palur; but the most effective demonstrational work is done by meetings on the land of ryots who have successfully tried methods advocated by the department. This was done widely.

55. *Agricultural Associations.*—Of the old district associations Ganjām continues to do good work and also Coimbatore in the Tiruppur show. Madura also is keeping interest alive in its show. The village associations in Malabar, some 25 of them, have also done very good work. Some five co-operative agricultural societies have been formed for the joint purchase of manures, etc., but most of them have not as yet had a full year's work.

56. *Miscellaneous.*—The criminal tribes settlements at Kammapuram and Bommanigadda were visited by agricultural officers 10 and 9 times respectively and much advice and active assistance was given. In the latter station the utility of this was somewhat impaired by frequent changes of the officers in charge. The stations at Bethupadi and Bapatla were also visited. Reports on the possibilities of five other sites as agricultural settlements were prepared and submitted. General correspondence with literate ryots increases. In the head office at Madras 1,119 applications for advice were received direct from ryots.

57 *General Progress.*—The year has been one of widespread development on many lines. As compared with last year—the busiest then to date—the chief items in the balance stand as follows:—

- (i) Twice the number of students were admitted to Coimbatore.
- (ii) The method of dealing with palmyra disease was much improved and more than twice the number of trees were examined (220,403 against 100,741).
- (iii) More than twice the number of areca palms were sprayed (29,000 against 14,000).
- (iv) There was more than twice the area under pure seed of selected cotton (34,000 acres against 14,600).
- (v) The area drilled by the ryots' themselves in Tinnevely district increased by nearly 60 per cent. (11,329 against 7,117).
- (vi) The area economically transplanted continued to increase and the sales of paddy for seed increased.
- (vii) There was more than twice the area under Red Mauritius cane in South Canara (424 acres against 194).
- (viii) The number of ryots' cows served at Coimbatore increased by one-third (570 against 425) although the fee was increased, from 8 As. to 12 As.
- (ix) The number of monsoon ploughs sold increased from 3 or 4 to 26 independently of other implements, and of those which were hired out.
- (x) District work was begun against smut and sufficient seed was treated to sow 1,100 acres. The average annual loss from smut is about 7 per cent. of the crop and is frequently much more.
- (xi) Five more men were definitely allotted for district work in five more centres. Practical work on silk was also started.

But the call is still very general for more and more men in the districts. There are many fields of work untouched. It is a source of great satisfaction that the scheme for reorganization and ordered development has been so quickly sanctioned.

V.—AGRICULTURAL ENGINEERING.

58. In most other provinces all work on machinery required for agricultural purposes and within the purchasing power and capacity of the ryot to attend to it is dealt with by this department. In Madras it lies with the Director of Industries and to him and his department belongs the credit of spreading the use of oil-engines for well irrigation more widely, I believe, than in any other part of India. That department has so far dealt with the erection of 413 power plants for irrigation. A suggestion was made at the end of the year that this work together with agricultural engineering generally should be entrusted in future to this department. The matter is under examination. Messrs. Parry & Co. worked their steam tackle very successfully at Nellikuppam.

VI.—PUBLICATIONS AND SUPPLY OF INFORMATION.

59. Mr. Wood has almost completed a most useful note-book of agricultural facts, and figures modelled on McConnell's book for Western farming, and M.R.By. Rai Bahadur K. Rangachariar is at work on an Elementary Botany. It is not realised at what cheap rates these books on agriculture are made available to the public. McConnell's book costs Rs. 6, Mr. Wood's for South Indian conditions, As. 14.

60. The following bulletins and leaflets have been issued during the year :—

Number.	Subject.	Prepared by	Language.	Number of copies printed.
1914.				
III	Some general methods of controlling attacks by insect-pests—Agricultural methods.	T. Bainbrigge Fletcher ..	English ...	5,000
IV	Some general methods of controlling attacks by insect-pests—Mechanical methods.	Do. ...	English ...	5,000
V	The fodder question in Coimbatore	R. Cecil Wood	English ... Tamil ...	2,500 5,000
VI	.....	.....	.....	.....
VII	The Mahali or Koleroga disease of Arecanuts ...	W. McRae	English ... Canarese ... Malayalam ...	300 400 500
VIII	Possible use for oil engines when not required for pumping.	R. Cecil Wood	English ... Tamil ... Telugu ...	5,000 10,000 10,000
IX	Indigo	G. D. Mehta, Deputy Director of Agriculture, Central Division.	English ... Tamil ... Telugu ...	500 8,000 7,000
1915.				
I	What the ryot has to say about the advantages of 'Daincha,' etc.	S. Subrahmanya Ayyar ...	English ... Tamil ... Telugu ...	15,000 15,000 15,000
II	What the ryot has to say about the advantages of 'Wild Indigo.'	Do. ...	English ... Tamil ... Telugu ...	15,000 15,000 15,000
III	What the ryot has to say about the advantages of 'Triangular Harrow.'	Do. ...	English ... Tamil ... Telugu ...	15,000 15,000 15,000

Very large numbers of leaflets were sent to Tahsildars and Revenue Inspectors for distribution. Over 73,967 copies of the Agricultural Calendar published in five languages were distributed through Tahsildars, Presidents of Taluk Boards and Assistant Inspectors of Schools.

VII.—STATISTICS.

61. *Crop forecasts and crop cutting experiments.*—Nineteen crop forecasts dealing with the sowings and outturns of paddy, cotton, sugarcane, gingelly, castor and indigo were issued. As a result of correspondence the Board of Revenue issued instructions altering the form in which Tahsildars should send in their returns and also arranged that Collectors should supply this office direct with more complete abstracts of cultivation from the village accounts. In accordance with the request of the International Federation of Master Cotton

Spinners and of the Trade Conference in Madras held in 1914, weekly statements of the quantities of cotton pressed at the various presses and used by the different mills in the Presidency are compiled and issued. Eighty-six crop cutting experiments were made on ryots' lands by officers of the department. These are of doubtful utility and the work always clashes with the time of harvest on the farms.

VIII.—MISCELLANEOUS.

62. *The Agricultural and Trade Conference, 1914.*—A most useful Conference was held in Madras in December between the chief firms interested in Indian produce, some leading agriculturists, representatives of railways, and officers of the Co-operative, Agricultural and Industrial departments which His Excellency the Governor very kindly opened. The Hon'ble Mr. Ll. E. Buckley attended every day. The Conference was the first of its kind and was especially useful in obtaining criticisms on lines of work and in clearing ideas for future methods of development in the districts. It was also a good advertisement of the nature and class of work in progress of which several firms were ignorant. It generally has promoted more knowledge and understanding and has made future work easier. The notes of the Conference have been published and are available for sale.

63. *Special Reports.*—The outbreak of war naturally produced many enquiries for outlets of produce and for new markets. Eighteen enquiries from firms abroad were received and information was given to them. These enquiries were also passed on to the producing districts. Two special reports were written for Government during the year—one on sugar, and one giving a history of the vicissitudes of the Agricultural Department since its inception in 1864 and especially assaying the work which has been done in the last eight years.

64. *Personal.*—It is a very great pleasure to record once more general good work at Coimbatore and in the districts. Under Mr. Wood the College continues to flourish and expand. The work which Mr. Harrison has done and published in India is deservedly obtaining recognition both in India and abroad. We have just heard that his University of Leeds has awarded him the degree of D.Sc. solely on the work which he has published from Coimbatore. The Southern Division has benefited greatly by an uninterrupted year of Mr. Sampson's administration. Among the Farm Managers M.R.Ry. Balakrishnamurti for work at Anapalli and in Vizagapatam, M.R.Ry. Muttuswami Ayyar for some years' very careful conduct of experimental work at Samalkota, M.R.Ry. Govinda Kidavu for the work on the West Coast, and M.R.Ry. Kolandaswami Pillai for his management of Koilpatti and of the cotton work deserve special mention; whilst all were pleased to welcome to the department M.R.Ry. Rao Sahib A. Rama Rao who has done good work at Sivagiri. All congratulate him on his well earned title. Messrs. Couchman and Innes have again been of the greatest assistance.

65. Final accounts for the year have not yet been received from the Accountant-General, but according to the departmental accounts the total expenditure in the year was Rs. 4,95,980; receipts Rs. 8,540; net expenditure, Rs. 3,97,440.

The budget allotment was Rs. 5,32,300.

I have the honour to remain,

Sir,

Your most obedient servant,

D. T. CHADWICK,
Director of Agriculture.

APPENDIX I.

ADMINISTRATION REPORT OF THE AGRICULTURAL COLLEGE, RESEARCH
INSTITUTE AND CENTRAL FARM, COIMBATORE, FOR THE
YEAR 1914-15.

I. COLLEGE.

Teaching.—There was no change in the prescribed curriculum for the two senior classes, except that it was possible to give class III rather more instruction in Dairying than usual. They went on the usual tours, one in the northern districts, as far as Anakapalle, and one in the south through Tinnevely to Ambāsamudram. Except during these tours, their work was supervised by the Assistant Principal.

Fresh lectures were written for the new classes. The skeleton syllabus was found on the whole very nearly correct, though slight adjustment will be necessary. More use was made of the Implement Museum: when dealing with this subject, one or two lectures were given in the museum itself. A chance question in one of the examinations showed the necessity for the strict maintenance of the students' observation books: owing to the absence of the Chief Assistant, and the extra work necessitated by the new course, it had not been possible to correct them, with the result that, failing the necessary spur, the students had not taken any trouble to prosecute private enquiries out of class hours. Notes by the lecturers in the various subjects are appended.

Chemistry.—Owing to the changes brought about by the new curriculum of studies, no lectures were given in General Chemistry. The old course in Physics given to the first year students has been abandoned, and in its place, sixteen lectures of a popular character were given according to the general scheme. In addition, eleven lectures of a similar type were given in Agricultural Chemistry.

Fifty-nine lectures on Agricultural Chemistry were given to the second-year class who also attended 28 practical classes.

Eighteen students presented themselves for examination at the diploma examination in Agricultural Chemistry and of these eight passed in the first class and ten in second class. There were no failures or third class passes.

Botany.—The new course of studies was introduced in June, and the first-year students received instruction as laid down in the syllabus. They had 28 classes during the year.

The second-year students of the old diploma course attended 57 lectures and 60 practical classes.

The Diploma Examination was held in December and, out of the eighteen students (inclusive of the student of last year) that sat for the examination, seventeen passed (two in first class, six in second and nine in third) and one failed.

Mycology.—The usual course on plant diseases, consisting of 27 lectures and 27 practical classes, was given to the second year students during the last term. In the final examination nine students were placed in the first class, seven in the second and one in the third.

The first year students of the new course had six demonstrations.

Entomology.—Eight lectures in Zoology and six preliminary lectures in Entomology were given to the first year students.

The second year students were given lectures on the chief crop-pests and the methods of control which should be used. The students were examined by Dr. Deslie Coleman, Director of Agriculture, Mysore. Four were placed in the first class, ten in the second and three in the third.

2. *Examinations.*—The outside Examiners for the diploma were Mr. Evans, Deputy Director of Agriculture in the Central Provinces, Mr. Aitchison, Principal, Veterinary College, and M.R.Ry. Narayanamurti of the Industries Department. All the students passed: the general standard was however low: it is probable that with the new course, a wider selection of students, and the chances of re-examination (which is not at present permitted), a higher standard will be more strictly adhered to. The second year students, examined in Agricultural Chemistry by Mr. Annett, in Agricultural Botany by Mr. Graham and in Mycology and Entomology by Dr. Coleman, have done very well: all will proceed to their last year. The College Medals were all won by Telugu students: the Clogstoun and the Keess going to Viraraghava Rao, who was very closely run by Viraswami for the latter: while Sitarama Patrudu obtained the Robertson prize.

3. *Students.*—The opening strength of the College shows an increase on previous years, due to the adoption of the new curriculum. In class III, there were fifteen, in class II, seventeen, while the new class contained forty-two. These were selected after a week's probation. There were no withdrawals from the senior classes: the first year class lost four, finishing with a strength of thirty-eight.

Hostel.—The hostel continued under the care of M.R.Ry. Tadulinga Mudaliyar as Warden. The increase in the work of keeping the hostel accounts, and supervising the catering arrangements, made it necessary to employ a wholtime officer, and eventually one M.R.Ry. K. Hanumanta Rao, a retired Taluk Head Accountant, was selected as "Steward." This post carries with it a salary of Rs. 80, the cost of which is met by the hostel funds. The hostel during the year took over the non-vegetarian section, so that it now caters for every one, 32 Brahman, 20 non-Brahman vegetarian and 14 non-vegetarian: four students messed with relatives on the estate. It was found necessary during the year to raise the fees from Rs. 12 to 13 exclusive of the weekly oil bath: this was partly due to the general rise in the price of foodstuffs, and partly due to an improvement in the standard of the meals.

The auditing of the accounts was very kindly undertaken by Messrs. M. R. Ramaswami Sivan, T. V. Narayana Rao and B. V. Nath. There was an actual loss of Rs. 142 during the year which has been made up from previous savings.

The Students' Club.—The Students' Club finished up the year with a balance on the right side, and an account has been opened with the Bank of Madras. The new tennis court was used regularly and yet another will be needed for the coming year. The hockey team received colours for the first time and had a successful season: cricket and tennis matches were also played. A new ground was laid out in the maidan to serve as a football field. The Tennis championship was won by a first year student Rangaswami Pillai. The sports championship was won by V. T. Venkatajalam Mudaliyar.

4. *Building.*—The library has been improved by the addition of two handsome screens which shut off the passage through one side of the room and thus ensure a greater privacy; in their construction were utilised some doors originally fitted to one of the library cases by mistake; doors of the correct pattern have now been fitted in the place of these. The big lecture room has been done up, and in it are to be found a full set of the college groups. Two Honour Boards, on which are carved the names of the Captain and Secretary of the Students' Club, are also fitted, so that this room will become the repository, so to speak, of college tradition. A handsome bench for the accommodation of visitors has been placed in the Front Hall.

Accommodation is found for the office of the Government Sugarcane Expert in addition to the regular College staff. The change in the curriculum has shorn the Physics Laboratory of much of its usefulness, and proposals will probably be submitted utilising the space in another way. Meanwhile, it was possible to find a separate room for the Assistant Principal.

5. *The Library.*—During the year about one hundred volumes have been added to the Library: 76 were purchased at a cost of Rs. 500 odd, the rest being obtained free, by presentation or exchange. Eight new periodicals were taken in, three of them being exchanges. Two hundred and eighty books were sent for binding during the year to the Government Branch Press at Ootacamund: two hundred more were sent to the Press at Madras. The catalogue of Bulletins, Leaflets, etc., has been sent to the Press and copies are expected shortly.

Certain proposals were discussed during the year for putting the library in charge of one of the sectional officers, and proposals have been submitted to the Director to this end, while changes in the method of circulating periodicals to the members of the college staff have recently been put into effect.

6. *Staff.*—The meetings of the college lecturers which had hitherto been informal were regularised under the name of the College Board. This meets to discuss general college and estate business, and also educational problems, when only those of the staff who are engaged in teaching, are entitled to vote. The minutes are kept by the Assistant Principal who acts as Secretary. The appointment of M.R.Ry. D. Ananda Rao Garu to this post, dates from the 17th July. The Chief Assistant was away from duty from the 2nd July to the beginning of the new year. Both the Veterinary Assistant and the Special (Agricultural) Assistant took a month's privilege leave. The post of Engineering Assistant was held by an acting man throughout.

The note book of Agricultural Facts and Figures was revised for publication during the year and is now in the Press.

7. *Visitors.*—The list of Honorary Visitors has been revised from the 1st January: the new list contains seventeen names as against twenty-five in the old list. Six Honorary Visitors on the old list visited the college during the year. The college was also visited by the Hon'ble Mr. A. G. Cardew and Mr. Coventry, C.I.S., the Agricultural Adviser to the Government of India. The Director of Agriculture paid three visits during the year. During the year, the Rev. Paul Beck of the Basel Mission resided on the Estate, for training in Farm Management and Estate Methods: on the outbreak of hostilities he had to leave.

II. ESTATE.

8. *Estate*.—There has been a great improvement in the water-supply, as additional pumping plant has been put down at well No. 60 in the south-west corner of the Estate. This supply is coupled up with the present pipe system, and serves the whole of the buildings south of the maidan, including all the hostel blocks, and the greater portion of the B and C type quarters, thus saving the college well, which has been able in these conditions to meet all demands. Progress has also been made in planning for future extension on the Estate and on the south-east corner arrangements have been made for the orderly expansion of the Colony: here will be placed the new Provincial officer's quarters, and the removal of the scavengers' quarters, the tidying up of the corner and the provision of a proper gate will materially improve what is at present rather a back entrance, although a popular entrance, to the Estate.

9. *Quarters*.—It is feared that delay will be experienced in the construction of the new quarters needed. Two Provincial officers' quarters, for the Government Lecturing Botanist and the Assistant Principal, nine B type and ten C type have been sanctioned. A certain amount of relief was experienced by the taking over from the department of Public Works of the old contractor's quarters, whereby one C, three Intermediate and eight D type were added to the Estate. Recently sanction has been obtained to the acquisition of the stretch of land between this and the Forest College; the buildings including the Rest house for Indian visitors, dispensary, etc., have not yet been begun.

10. *Sanitation*.—Poudrette was manufactured on the Estate as usual: some two hundred cartloads were produced during the year, which were utilised to manure guinea grass, fodder cholam and paddy. The utilisation of the sullage water from the houses is also under contemplation, by the provision of a drain to run south of the quarters towards the west, where land can be found on which this water can be used. This will improve what is at present an unsightly and odorous drain, and save the waste of water which now occurs. During the year nineteen births and seven deaths were recorded. No serious epidemic appeared. The Sanitary Staff inaugurated an energetic mosquito campaign on the advice of the Entomologist, and this has been most successful. Mosquitos have not been exterminated, though constant search is made to find out where they are breeding, but the numbers have been enormously reduced to the comfort of everyone on the place.

Quarters are to be provided of the standard design for the Estate scavengers, in the south west of the Estate and work has recently begun.

III. FARM.

11. *Farm*.—The season presented surprises all through. Drought marked the opening months, and this following on the short rainfall and small straw crops of the previous year brought about a serious shortage of fodder. It was not until September that proper sowing rains were received, but from then onward the rains were plentiful and well distributed. A fall of 2.4 inches occurred in January, and interfered considerably with the paddy harvest, while on the 28th February, the unprecedented fall of 8.3 inches was received. This has improved the grazing wonderfully, and as last year's crops were above the average, the fodder in reserve at present is more than usual.

Apart from a trial of a motor tractor which took two 2-disc ploughs through the black cotton soil in F. 37, considerable progress was made in improving the methods of tilling of the land. A great fillip was given to hot weather ploughing by the late rains, and quite a business has been done in hiring out ploughs to neighbours. There is considerable scope for work of this kind in the vicinity, could men be spared for it.

12. *Livestock*.—A slight increase in numbers is recorded. More bullocks have been purchased to meet the increasing demands of the students' classes: and the dairy herd is still in need of more cows.

Attention may be called to the popularity of the Farm stud bulls: in spite of a rise in price from 8 As. to 12 As., 570 animals were brought for service, both cows and buffaloes. The figures for the past seven years are interesting: 5, 6, 52, 139, 247, 425, 570. This shows clearly that owners are fully alive to the value of goodstock, and that if treated fairly and promptly by some one in whom they have confidence as they have in the Veterinary Assistant, Mr. D'Silva, they will readily make use of Government bulls. The number of cases treated at the hospital also showed an increase.

Miscellaneous additions to the livestock, included a jutka pony, and some leghorn fowls. The second annual sale was held in February, when fair prices were realised.

13. *The Dairy*.—This Institution was under the immediate control of the Assistant Principal and has shown a gratifying improvement. The greatest business is done in the sale of fresh milk and at present no attempt is made to work out the cost of production, the milk being simply credited to the Farm at a uniform rate of one anna a pound. There is little doubt that it costs less than this to produce, as we can buy plenty of milk in the neighbourhood at this price. The sale of butter has rapidly risen. One thousand and seventy-five pounds were sold in the previous year: the figure for this year is 1,886 lbs. A profit and loss account is given below.

To	By						
	RS.	A.	P.		RS.	A.	P.
Purchase of milk—				Sale of milk	3,090	3	9
Farm 53,357 lbs.				Cream	91	4	3
Outside 25,952 lbs.	4,956	13	6	Butter	1,909	2	0
Depreciation—				Ghee	132	10	10
Buildings at 2 per cent. on				Separated milk	498	8	4
9,000	291	9	4	Butter milk	52	1	4
Plant 12 per cent. on 930				Curds	2	12	10
Establishment	395	9	0	Stock in hand	0	10	0
Petty expenditure	63	14	2				
Balance being profit	69	7	1				
Total ...	5,777	5	4	Total ...	5,777	5	4

14. *Staff*.—The Farm Manager at the commencement of the year was M.R.Ry. Rajagopala Achari; he was relieved by M.R.Ry. Thiru Muruganathan Pillai in June. In November his place was taken by M.R.Ry. S. Subrahmanya Ayyar. The Assistant Farm Managers during the year were Unnikrishna Menon, S. Narayanayya and K. T. Bhandary. A Veterinary Assistant Farm Manager was posted to the farm in August, and has been placed in charge of the feeding of all farm cattle and calves: he is also in charge of the Leghorn poultry which were obtained towards the end of the year.

15. *Accounts*.—

Profit and loss account for the year ending 31st March 1915.

DR.			CR.	
	RS.	RS.	RS.	RS.
To amount as per valuation, March 31, 1914—			By receipts	18,504
Livestock (a)	15,366		By amount as per valuation, March 31, 1914—	
Tillage and standing crops ...	1,421		Livestock (a)	18,101
Produce in store	4,868		Tillage and standing crops ...	2,187
Implements	9,090		Produce in store	10,255
Machinery (b)	16,960		Implements	9,802
Buildings and estate improvements (c)	58,505		Machinery (b)	21,801
		1,08,205	Buildings and estate improvements (c)	60,958
To charges in the year		48,491	By balance being loss	7,593
		1,49,696		1,49,696

(a) Includes dairy herd and stud bulls.

(b) Includes dairy machinery.

(c) Includes dairy building.

COIMBATORE,
4th May 1915.

R. CECIL WOOD,
Principal.

APPENDIX II.

ADMINISTRATION REPORTS OF THE AGRICULTURAL STATIONS DURING THE YEAR 1914-15.

ADMINISTRATION REPORT OF THE DEPUTY DIRECTOR OF AGRICULTURE, NORTHERN DIVISION, FOR THE YEAR 1914-15.

I have the honour to submit the administration report of my division for the year 1914-15.

1. *Staff*.—I was in charge of the division until the 9th May 1914 and from the 9th November 1914 until the end of the year. During the interval I was on leave and Mr. Roger Thomas, Probationary Deputy Director of Agriculture, acted in my stead. As usual most of the

year was spent in camp, all the farms received frequent visits and tours were made in the district.

The recently formed sub-division remained under the charge of M.R. Ry. D. Ananda Rao Garu, Assistant Director of Agriculture, until 1st July 1914 when M.R. Ry. K. Ramasasthulu Nayudu Garu took over charge from that officer.

2. *District work.*—(a) *A Local cotton.*—*Bellary district.*—Work was carried on along the usual lines and the same type of cotton Hagari No. 1 continued to be distributed. The year marks a great advance in the expansion of this work. The sowing rains were timely and there was a large demand for our seed but at a lower rate than that asked, namely, 26 lbs. per rupee, which was considered excessive. The price was reduced to 30 lbs. per rupee, i.e., 14 per cent. higher than the rate for local cotton, and 51,943 lbs. were sold. This is sufficient to sow 7,200 acres.

Six hundred and seventy-four acres of seed farm were sown to produce seed for distribution next year.

(b) *Cambodia cotton.*—As was the case last year kappas was bought locally, ginned by the department and the seed distributed. One thousand seven hundred and thirty-two pounds were sold in the Bellary circle and 680 lbs. in the Circars. In the latter area, more particularly in Vizagapatam, the crop did very well and gave very good yields. The quality of the produce is also better than is the case in the Ceded Districts. Expansion of the area under this crop is however likely to be checked by the fall in the price of cotton.

(c) *Sugar-cane.*—Attempts to effect an improvement in the method of cultivation in Gōdāvari district have been given up. The area under this crop in this district is not big enough to warrant further work considering the expansion of work in other directions and the shortness of staff and the yield with the present indifferent cultivation is too good for the ryot to bother about possible means of correcting the defects in his method of cultivation. There is a much better field for work with this crop in Vizagapatam district. The area of the crop is bigger and the cultivator is more alive and readier to consider suggested methods of improvement. Work here will consist in (a) distributing canes of a new variety, B. 1529, to replace B. 208 which has already got a hold in the district but is proving unsuitable as the buds begin to shoot when the canes begin to ripen and the quality and quantity of jaggery are affected; (b) inducing cultivators to plant the crop in rows, (c) advocating the use of oil-cake as manure for this crop and (d) endeavouring to persuade cane-growers to improve their furnaces. A start with this work has already been made and 45,700 setts of B. 1529 have been distributed, 16,400 lbs. of castor-cake distributed for the 1914-15 crop, two improved furnaces erected and arrangements have been made to supply oil-cake to ryots who wish to try this manure for their next season's crop.

(d) *Paddy.*—(1) *Improvement in cultivation.*—In Gōdāvari district where most of this work is being done the work was expanded. One hundred and three acres were sown at the departmental rate and 2,800 acres were transplanted with single seedlings. This however does not by any means represent all the work that has been done in pushing this improvement in this district. While arranging for the sowing and transplanting of these demonstration plots the district officers endeavour to get other ryots to reduce the seed-rate they employ without bothering them about single planting, as it has been found that if they can be induced to do the first, their coolies will automatically do the second for them. Thus many ryots who hesitate to adopt the departmental method in its entirety try a small reduction in the seed-rate one year and make a further reduction the next until they arrive at a rate not very much higher than that advocated by the department. In this way a gradual reduction in the seed-rate is being brought about and in most of the villages in which we have worked the mamool rate is now considerably lower than it used to be—

(2) *Seed distribution.*—Most of this was done from Semalkota farm, where 21,200 lbs. of seed were distributed. At Anakapalle 920 lbs. of seed was distributed and seedlings from thin sown seed beds sufficient to transplant in all 4 acres were distributed to 48 ryots to demonstrate to them the advantage of planting good healthy seedlings.

(e) *Green manure.*—Three thousand eight hundred pounds of green-manure seeds chiefly sesbania were distributed. Most of this work was done in Gōdāvari district.

(f) *Treatment of sorghum seed against smut.*—The treatment of sorghum seed with a 2 per cent. solution of copper sulphate has been advocated generally wherever sorghum is grown in those tracts where we have district officers working. In this division the Ceded Districts offer the biggest field for this work and an organised attempt was made there this year to bring about the adoption of this practice. In the Bellary circle 1,100 acres of sorghum were sown with seed treated under the supervision of the district officer in which area no smutted heads were noticed when the fields were inspected.

3. *Implements.*—The gallows plough is now doing duty at Anakapalle and is turning out satisfactory work there, as is the smaller E.T. plough which is being found extremely useful for garden cultivation both there and at Hagari. As regards the disc plough further trials have been made both at Hagari and at Nandyal, and the general conclusion arrived at, that for use on the dry land in these districts work will have to begin in December while there is still some moisture in the land as later it becomes too hard and the plough does not work deeply enough nor does it lean furrow.

Hagari Agricultural Station.

Season.—The rainfall was in defect and was almost wholly confined to the south-west monsoon period. As is usual in such years the early sown crops were good, but there was not enough moisture to ensure a satisfactory yield of cotton and only enough to carry the sorghum crop up to the flowering point but no further.

2. (a) *Cotton.*—The crop was sown in good time but as indicated above gave only a poor return. The average acre-yield amounted to 148 lbs. for the pure and 96 lbs. for the mixed crop. The best yield was 256 lbs. from a plot of Hagari No. 25 sown for seed purposes.

(b) *Sorghum.*—The yields of grain from this crop were miserable and of straw fair. The average acre-yield of grain was 15 lbs. and of straw 1,156 lbs. A better yield of grain was obtained by sowing the crop thinly in the Bengal gram crop though in this case the yield of straw was greatly in defect. The figures were 36 lbs. grain and 820 lbs. straw per acre.

This year a fair area was put down under fodder sorghum which considering the season has done remarkably well and has given an average yield of 8,000 lbs. per acre. The practice might well be taken up by the local cultivator and would, if adopted, relieve him in a few years of anxiety with regard to his fodder supply.

(c) *Bengal gram.*—The crop this year was in every case grown mixed with a small quantity of sorghum to ensure a supply of seed of that crop. The average acre-yield was 80 lbs. and the highest 100 lbs. both of which are distinctly poor.

(d) *Safflower.*—This crop was grown on a small area and gave an average acre-yield of 220 lbs.

3. *Garden crops.*—The crops in the garden this year have in the main done well and the yields of ragi, groundnut and tobacco are about the best we have ever had. This is largely attributed to the manuring the fields received from the folding of sheep upon them.

(a) *Ragi.*—The average acre-yield of this crop this year was 2,325 lbs. grain and 5,037 lbs. of straw, an advance on last year's figures. The best yield was obtained from an area of 62 cents and amounted to 3,334 lbs. grain and 7,750 lbs. straw.

(b) *Sugar-cane.*—The season has again been against this crop and the yield is low, only 3,500 lbs. of jaggery per acre.

(c) *Onions.*—The crop was normal and gave an average acre-yield of 9,846 lbs. of bulbs dried and ready for market.

(d) *Cambodia cotton.*—This crop this year was very free from disease but has not given a very heavy yield though it was good for the year. It was grown on a total area of 1.33 acres and gave an average acre-yield of 486 lbs.

(e) *Tobacco.*—A very good yield of 1,350 lbs. of cured tobacco was obtained. The crop has proved one of the most profitable of the garden crops this year.

(f) *Groundnut.*—This crop was grown both pure and mixed with grain crops. The former did exceedingly well and gave a yield of 1,830 lbs. of dried nuts per acre. The latter suffered from the luxuriant growth of the grain crops and gave only 313 lbs. of dried nuts per acre.

(g) *Chillies.*—The total area under this crop was three-quarters of an acre and an average yield of 2,473 lbs. of green and 345 lbs. of ripe chillies per acre was obtained.

4. *Sheep.*—The flock has again done well and 28 lambs were dropped during the year, three of which died. A few of the ewes were bred from twice in the year and one ewe produced twins. This performance seems to be somewhat of a novelty in this neighbourhood and not a few visitors came to see the lambs.

During the year some store lambs were bought in to be folded on the green-manure crops grown in the garden and fattened. They were fed with crushed cotton seed as concentrated food, but did not make the growth they ought to have done. On this account and because of the heavy cost of producing the green-manure crops the experiment was not a financial success. It has, however, shown that if lambs which had not been robbed of part of their mother's milk could be got there would be a reasonable chance of making a profit, and that this plan of feeding off green crops is an excellent means of manuring the land. The experiment is being repeated with some farm-bred hogs this year, but these are only now coming on for sale. Two of the best were disposed of in Bellary market and realised Rs. 13-12 each. Their live weights were 116 and 120 lbs. respectively. A three-year old ram weighing 125 lbs. was sold at the same time and brought Rs. 17-8-0. Weighments of these fattening hogs are being taken once a month and the results so obtained show that they are making an average increase of 4 oz. per head per day.

The flock as it stood at the end of the official year consisted of 58 individuals; 2 rams, 22 breeding ewes, and 34 lambs.

5. *Staff.*—Farm Manager K. Narayana Ayyangar was in charge of the farm (black-cotton soil area) throughout the year. Farm Manager S. Ramaswami Pillai was in charge of cotton work and district work generally. Assistant Farm Manager G. R. Venkatchellapati was in charge of the garden. Assistant Farm Manager V. S. Subrahmanya Sastri did duty in the farm up to 1st November 1914 when he went on combined privilege leave for one month and twenty days and furlough for one year. Assistant Farm Manager Bhairy Siva Rao joined duty at the farm from Anakapalle on the 6th January 1915.

Samalkota Agricultural Station.

Season.—The rainfall during the south-west monsoon period was slightly below the average and the north-east monsoon rains failed altogether. The season was however otherwise favourable.

2. *Crops*—(a) *Sugar-cane.*—This year this crop was again very satisfactory. Germination was good and there was very little red rot present, only .5 (point 5) of the clumps on an area of 2.94 acres containing canes which were diseased. The average acre-yield of raw-sugar works out at 10,000 lbs. which is one candy less than last year and five candies above the average for the district. The best yield was obtained from B. 3412 which on an experimental plot of 6.7 cents yielded at the rate of 18,574 lbs. of raw-sugar per acre.

(b) *Paddy*—(1) *Rainfed.*—The season was favourable to this crop inasmuch as the distribution of the rain was such that it was unnecessary to give any irrigation. The yields however are in no way startling, though the average acre-yield of 1,700 lbs. grain and 3,300 lbs. straw over an area of 2.17 acres is good. The two budama varieties, black and white, are the best yielders and the former gave the highest yield of the year 2,980 lbs. grain and 6,560 lbs. straw per acre from an experimental area of 6½ cents.

(2) *Irrigated.*—Satisfactory yields have again been obtained from this crop. The crop was only very slightly affected by smut and lodging was limited to a small area. The average acre-yield for the whole area under this crop for the main crop season was 3,059 lbs. grain and 3,568 lbs. straw.

(c) *Green-manure crops.*—The experiment tried last year of mixing other green-manure crops with sunnhemp, to occupy the land after the removal of that crop for fodder ended in failure. It has been tried again this year, but does not promise any better success. For this purpose sesbania is no good as it does not succeed when sown in the standing crop of paddy even when alone. As regards the other crops indigo and cassia tora, sunnhemp seems too heavy a shade crop.

(d) *Cambodia cotton.*—As a pure crop the yields this year from this crop are a record 1,796 lbs. of kappas per acre from an area of 24 cents. As a mixed crop the yield was miserable, 93 lbs. of kappas per acre from 20 cents.

(3) *Experimental work.*—As a result of the experimental work that has been done at this station the following conclusions have been arrived at with regard to sugar-cane and paddy.

3. *Sugar-cane*—(a) *Manuring.*—The question of which oil-cake will be the most paying to use for this crop will, provided that the quantity of nitrogen applied in this farm is from 100 to 125 lbs. per acre, be settled by the availability, price and nitrogen content of the cake. For with this proviso one cake is as good as another.

(b) *Varieties.*—Of the two Java varieties, both of which are able to withstand drought and water-logging 36 is a poorer yielder than 247.

Another conclusion that may safely be recorded, though it is hardly an experimental result is that red rot disease can be checked and kept within bounds by a rigorous selection of setts.

4. *Irrigated paddy*—(a) *Cultivation experiments.*—(1) In this delta the practice of breaking up the land a long time before the planting of this crop is not to be recommended as it results in a lower yield being obtained.

(2) A seed-rate of 210 lbs for an acre of seed bed is ample and will provide sufficient seedlings to transplant 20 acres of crop with single seedlings.

(3) Provided the crop is planted in good time it is matterless whether the seedlings are 25 or 45 days old at the time of transplanting.

(b) *Manuring.*—(1) An application of five bags (820 lbs.) of castor-cake plus 2 cwts. of superphosphate, gives an increased yield as compared with a similar application of cake with or without potash or no manuring at all. A similar result has to be recorded if green-manure is substituted for castor-cake.

The profitableness however of these methods of manuring more particularly the first mentioned will depend on the residual effect of the manures which is being tested.

(2) The application of 5 tons of straw per acre with a complete manuring compared with a complete manuring alone reduces the yield in the second crop season, both of grain and straw and in the main crop season does not materially affect the yield of grain but greatly increases the outturn of straw.

5. *Seed distribution.*—The following qualities of seed have been distributed during the year:—

Paddy—	LBS.
Konamani 	12,365
Rasangi 	4,938
Garikasannavari	1,360
Other varieties.	2,542

Green-manure seeds—					LBS.
Sesbania	...	...	...	...	2,022
Sugar-cane	...	...	...	...	1,122 canes mostly outside the Presidency.
Cambodia cotton	...	...	...	...	280

6. *Staff.*—Farm Managers V. Muthuswami Ayyar and N. Sitaramaswami Nayudu were stationed at this farm throughout the year. The former in charge of the farm and the latter in charge of the district work. Assistant Farm Manager S. Subbaya remained at this station until the 2nd August 1914 when he was transferred to the Central division. He was on privilege leave for 2 months from 1st April 1914. Assistant Farm Manager D. Panakala Rao remained at this farm throughout the year except during the period from 7th June 1914 to 11th August 1914 when he was on leave on loss of pay. Assistant Farm Manager K. Ramanuja Achari joined duty from Managanallur on 8th June 1914. He was on privilege leave for 3 weeks from 26th January 1915 to 15th February 1915.

Anakapalle Agricultural Station.

During the year under report the necessary preliminary arrangements for bringing this station into working order were completed. The buildings in the station are now quarters for three officers, a seed-store, a cattle shed with manure pits and an implement shed, with a small room for preparing cattle-food attached. Wells have been filled up and the dry land fields levelled. All that now remains to be done is the erection of a pumping plant near one of the wells which work it was expected would have been finished last hot weather. It has now been taken in hand and it is expected to be completed before the break of the next monsoon. The land has been laid out and its final division into dry land, garden land and wet land made. By mutual arrangement with neighbours some awkward bends and corners in the boundary line have been got rid of and the fence line is now as straight as it is possible for it to be. The area of the farm now consists of 9.7 acres dry land, 11.0 acres garden land, 16.0 acres wet land and 4.35 acres taken up by farm-yard buildings, roads and bunds.

Up to present no experimental work has been done except in so far as the testing the suitability of new varieties of sugar-cane and new crops like Cambodia cotton to the climate and land, can be called experimental work. The cropping scheme was arranged with the object of finding the most uniform areas on which to carry out experiments, but owing to heavy rains in September the embankment of the river breached and the farm was flooded. The surface soil was washed from dry land fields into the garden land and both had to be relevelled. Both garden and wet land crops were submerged and sugar-cane lodged. We are therefore no further on than we were and this work will have to be done again.

2. *Season.*—The rainfall recorded for the year amounted to 45.7 inches, 9 inches heavier than last year. Its distribution was however very faulty. Practically all the rain was received in the south-west monsoon period and most of it fell in heavy showers which did more harm than good. The rain received in the north-east monsoon period amounted to .12 inches only, there were therefore no cold weather crops grown on the dry land.

3. *Crops.*—(a) *Dry land.*—Sazza was the only crop grown during the year, and from the seed-bed to the threshing floor it was dogged by unfavourable conditions.

Timely rains for the sowing of seed-beds were received in May but when the seedlings were ready for planting rain held off and they were rather old before this operation could be carried out. Immediately after planting a spell of wet weather set in which retarded the growth of the crop. This was followed by a spell of very dry weather which in moderation would have been useful but was carried on for too long a period. The weather after this was propitious but at the time of harvest when dry weather would have been exceedingly welcome heavy rain set in again and interfered with harvesting operation.

The return from this crop 1,587 lbs. grain per acre was therefore only fair.

The average acre-yield of sazza straw is not available as it was damaged by floods in consequence of which no weighing was made.

The seed-beds of ragi, the crop which should have followed sazza were spoiled by the flood and horsegram which was sown in its place was a failure owing to the lack of rain in the north-east monsoon period.

(b) *Garden land.*—*Cambodia cotton.*—The crop sown in August-September of 1913 was allowed to produce a second picking in April-May of 1914 and gave the handsome yield of 1,400 lbs. per acre from an area of 2½ acres. The first sowing of this year's crop was spoilt by the flood and the second sowing which was a little late has done fairly well. Only one picking has been taken as the field is required for a early crop. But this has given 720 lbs. of kappas per acre which is good considering all conditions. These yields and the quality of the product show that the introduction of this crop in this district will be successful. There is likely to be some initial difficulty in getting the produce ginned and in finding a fair market for the crop but endeavours will be made this year to get round these difficulties.

Other crops grown on the garden lands were fodder sorghum, ragi and korra in the punaa (early) season and ragi in the pairu (cold weather) season.

The first named crop did very well and gave the excellent yield of 25,100 lbs. of green fodder per acre. Early ragi and korra gave fair yields 1,544 lbs. and 1,371 lbs. of grain per acre respectively and pairu ragi was good yielding 2,542 lbs. of grain per acre.

(c) *Wet lands*.—In the punasa season gogu and ragi were grown. The former gave a fair yield of 729 lbs. of fibre of fair quality per acre. The latter was poor and gave an average acre-yield of 1,043 lbs. of grain per acre.

In the main crop season paddy was grown over the whole of this area except that part occupied by sugarcane.

In the beginning the season was favourable to paddy but the damage done by the flood followed by the failure of the north-east monsoon rains has caused the yields of this crop to be considerably lower than they ought to have been.

The following varieties were grown and gave the average acre-yields noted alongside:—

	Grain.	Straw.
Bobbiliganti	871	888
Mypali	2,092	2,483
Azzanum	1,917	2,370
Maharajabogam	2,246	3,209
Balaramabogam	2,209	3,505
Gunuprapu sannalu	2,239	3,029

The low yield of Bobbiliganti is partly due to the bad season but mainly to the fact that it followed the crop of gogu previously mentioned. It is the practice in this district to take three crops from the wet lands, one in the early or punasa season, one in the main season and one in the late or pairu season. The early and late crops are of short term, *e.g.*, ragi, gogu, gingelly, onions, maize, etc., and most of them can be grown in both seasons. The main crop is always paddy. It is a question whether it would not pay better to grow a green-manure crop in the punasa season to be ploughed in and to transplant the paddy crop earlier. The low yields obtained from Bobbiliganti as compared with yields from the three last mentioned varieties favour the proposed change. The question however will be one of the first to be tackled as soon as experimental work can be begun. The yields of azzanum and maharajabogam are lowered by their having followed paddy seedlings on part of the area which they occupied. The average acre-yield for the whole paddy crop this year was 1,897 lbs. grain and 2,557 lbs. straw, and the best yield was 2,565 lbs. of grain and 3,750 lbs. straw given by maharajabogam in field No. 24.

(d) *Sugar-cane*.—The following varieties B. 6,450, B. 208, B. 1,529 keli and bonta were grown. In common with the other crops of the farm this crop had a series of trials to contend against.

These began early on with the flooding of the fields by a heavy rain shortly after planting. This was followed by a very dry hot period. Later after a period of comparative quiet the crop was laid flat by a cyclone and subjected to a prolonged submersion by the flood. Bonta however was the only variety which seemed to have lost heart and added red rot to its list of troubles. The others did fairly well and B. 1529 particularly seems eminently suitable for this tract. B. 208 on the other hand is proving unsuitable. With the cessation of growth when the cane begins to ripen the buds in this variety begin to develop and form shoots. This is a disadvantage in two ways, the quantity and quality of the jaggery is affected even if all the shoots are cut off before crushing the cane, and when the cane has to stand a short time before planting is done it is impossible to cut it into setts without damaging the young shoots, which of course acts detrimentally on the stand of the succeeding crop. For these reasons the further spread of B. 208 will not be encouraged and B. 1529 will be distributed in its place.

The average acre yields were as follows:—

B. 6450, B. 208, B. 1529, Keli, Bonta.

4. *Seed-distribution*.—This has been confined mainly to green-manure seeds, sugar-cane, paddy and Cambodia cotton. The quantities are as follows:—

	LBS.
Paddy	920
Green-manure seeds	1,600
Cambodia cotton	400
Sugar-cane setts	45,700

Paddy seedlings from thin sown seed-beds sufficient to transplant acres were also distributed to 48 cultivators in the neighbourhood of the farm. During the year an attempt was made to revive the indigo industry in tracts where it had formerly flourished, and a large quantity of indigo seed was purchased for distribution. The extracting plant in the district is however in such bad repair that no owner could be induced to put his in order on the chance of making a profit though the cultivators were willing enough to grow the crop and supply material. The seed is however being distributed and up to the end of the official year 5,576 lbs. had been disposed of.

b. Implements.—Light iron ploughs were lent to six ryots two of whom purchased ploughs for themselves, one a Punjab plough and one an E.T. plough. The use of these light iron ploughs was demonstrated in the district and on the farm to visitors and it is expected that a demand for these will arise as soon when cultivators have become better acquainted with their usefulness.

6. Staff.—Farm Managers M.R.Ry. D. Balakrishnamurthi and M.R.Ry. L. S. Natesa Ayyar worked on this farm throughout the year. Assistant Farm Manager Bhairy Siva Rao remained until the 4th January 1915 when he left for Hagari. Assistant Farm Manager T. Budhividheya Rao joined duty on 15th May 1914 and remained at this station throughout the year.

G. R. HILSON,

Deputy Director of Agriculture, Northern Division.

14th May 1915.

ADMINISTRATION REPORT OF THE ASSISTANT DIRECTOR OF AGRICULTURE, NORTHERN DIVISION,
FOR THE YEAR 1914-15.

I have the honour to submit the Administration Report of the sub-division for the year 1914-15.

Staff.—During the year under report M.R.Ry. D. Ananda Rao Garu, now Assistant Principal, Agricultural College, Coimbatore, was in charge of the sub-division till the 1st of July. I relieved him on the 2nd and remained in charge of the division till the end of the year. During his three months' period, my predecessor spent 45 days in camp. He visited Nandyal and Sirvel Agricultural stations thrice, inspected the Patimannu substitute experimental plots once, and attended the selection of students for entrance into the Coimbatore Agricultural College in June. A portion of his time was also occupied in making enquiries into the raising of early seed-beds for paddy in some of the villages in the Kistna Western Delta. During my period of nine months in the sub-division, I spent 116 days in camp. I visited Nandyal and Sirvel Agricultural stations eight and seven times respectively, and inspected the patimannu substitute plots twice. In addition I visited Tatapudi Lanka and Ponnalur tank and submitted reports thereon.

At the Nandyal Agricultural Station, Farm Manager M.R.Ry. M. Raghavulu Nayudu was in charge from the beginning till the 5th of May in addition to his district work on cotton improvement. From the 6th of May he was on privilege leave for six weeks while the farm was managed by the Assistant Farm Manager V. S. Ramaswami Ayyar till 18th June on which latter date Farm Manager M.R.Ry. T. V. Rajagopala Achari joined duty and managed the farm till the end of the year. Assistant Farm Manager V. S. Ramaswami Ayyar was transferred to Sirvel where he joined duty on 27th June 1914. Assistant Farm Manager V. Ratnaji Rao was the only Assistant who stayed in the Farm throughout the year helping the managers. In the district work round about Nandyal, there were no changes in the staff. M.R.Ry. M. Raghavulu Nayudu conducted the cotton improvement work single-handed throughout the year.

At Sirvel, Farm Manager M.R.Ry. V. G. Dhanakoti Razu was in charge of the farm almost single handed from the beginning to the end, save for a short period of three months and fifteen days, from 27th June to 10th October, when he was helped by the Assistant Farm Manager V. S. Ramaswami Ayyar. The latter was on privilege leave for one month and fifteen days from 9th October to 24th November, after the expiry of which, in about a week, he was deputed to Nandyal to help the staff in the sowing of cotton selections, where he remained on duty till the end of the year. There were changes in the farm clerks of this station and on more than one occasion the Farm Manager had to get along without either an Assistant or a clerk.

DISTRICT WORK.

(a) Cotton Improvement.—As in previous years, cotton improvement work consisted of the establishment of seed-farms and the distribution of good seed amongst ryots. Seed for the seed-farms was given free and land assessment was paid. Good kappas from the seed-farms of 1913-14 were purchased at the highest market rates, ginned on the farm and good seed was distributed both to the seed-farms of 1914-15 and to the ryots in general. Of the 48,899 lbs. of good seed of plant No. 2 obtained from the seed-farm kappas of 1913-14, 37,774 lbs. were sold. Of this 9,430 lbs. was given to the seed-farms, 21,868 lbs. amongst ryots in the Nandyal taluk and nearly 6,476 lbs. in Koilkuntla, Sirvel, Atmakur and Nandikotkur taluks. In addition 7,415 lbs. of seed from the ordinary sircar cotton belonging to the Polar seed-farms of 1913-14 was sent to Proddatur, Jammalamadugu and Dhone taluks, where, for want of proper agencies only 2,392 lbs. were sold for sowing purposes and the rest disposed of as cattle-food. The total quantity then of cotton seed distributed for sowing this year is 40,166 lbs. (37,774 and 2,392) which should be sufficient to sow nearly 4,463 acres taking 9 lbs. as seed-rate. This area includes seed-farms. During the year under report, seed-farms were concentrated at Gundupapala, Gospad and Pasarapad. The area under these amounted to 1,050 acres where plant No. 2 was sown. The cotton crop in the seed-farm areas

as well as outside suffered more from the drought in the north-east monsoon period than the cottons on the farm, for want of repeated interculturings and deep ploughing.

(b) *Cambodia Cotton*.—Work with this crop consisted chiefly in distributing good seed amongst the ryots. For this 7,539 lbs. of good kappas were purchased, ginned and good seed was kept for distribution. Out of 4,031 lbs. of good seed obtained 3,089 lbs. were sold. Demand for this seed seems to be gradually decreasing, the chief reason being that Cambodia cotton cultivation has extended far and wide in the district and that the ryot can get his seed supply almost anywhere.

(c) *Green Manures General*.—For want of sufficient hands, the work in this direction could not be pushed ahead.

Dhaincha seed farm areas.—Last year when attempts to grow Dhaincha for seed as a mixed crop on land taken in lease for the purpose failed, some hope of solving this problem was discovered when the department was able to buy nearly 2,032 lbs. of seed from ryots amongst whom 41 lbs. of this seed had been distributed for sowing with the promise that the department would buy all the seed they produced for sale. Accordingly this year both at Nandyal and Sirvel nearly 108 lbs. of Bengal dhaincha was distributed to 22 ryots, who brought 1,865 lb. of seed for sale. This seed was bought at the rate of 5 Madras measures a rupee equal to roughly 17½ lbs. At the beginning of the year Nandyal farm had a stock of 2,065 lbs. Thus the total quantity of seed kept in stock during the year amounted to 3,930 lbs. of which 2,507 lbs. has been sold up to date.

Wild indigo.—During the year in November enquiries were made regarding the supply of wild indigo from Devarapalli and its vicinity in the Kistna district. Wild indigo grows in these parts and since the people are not accustomed to its collection and are more in the habit of collecting *Cassia tora* for which they get 3 to 4 rupees a bag of 50 Madras measures, it was not possible to obtain large supplies of wild indigo. The Karnam of Devarapalli was, however, kind enough to procure for the department 505 lb. of this seed for Rs. 19-13-0. This is a very cheap rate and cheaper than the consignments we had before from Bethamcherla in Kurnool district.

(d) *Indigo*.—For want of imports in artificial indigo from Europe, a fresh impetus has been created amongst the ryots to cultivate indigo with the hope that the once lost trade in this dye would revive and better profits for its cultivation be realized. The demand for this seed at Nandyal rose to such a height that the supply was hardly able to keep pace with it. A grant of Rs. 500 was allotted to Nandyal farm to lay in seed for distribution amongst applicants and 15,992 lbs. of seed were distributed.

(e) *Paddy demonstration plot*.—The paddy demonstration plot at Nandyal continued as usual demonstrating single transplanting of paddy. The demonstration was a success in as much as we were able to get as good a crop as ryots do, using 18 lbs. of seed per acre against 70 or 80 lbs. in vogue.

(f) *Treatment of sorghum seed for smut*.—An attempt to expand this branch of demonstration work was made this year. A two-per cent. copper sulphate solution was prepared in the presence of several ryots and sorghum seed of both varieties (early and main) was steeped in the solution for about 15 minutes before it was sown on the field. Farm Manager M.R.Ry. M. Raghavulu Nayudu, conducted the campaign. Nine villages in Nandyal, Sirvel, Nandikotkur and Dhone taluks were tackled and seed for 179 acres of crop was treated. The Farm Manager personally conducted the steeping of seed in all cases.

(g) *Patimannu substitute Experiments*.—These experiments are now being conducted in the deltaic portion of the Guntur district in about seven different stations. As usual a green manure crop of indigo was sown mixed with sunn-hemp, but owing to the failure of the former for the second year artificial manure was again resorted to. Castor cake at the rate of 330 lbs. per acre and Superphosphate at 112 lbs. per acre were applied. At Zampani in Tenali taluk the experimental plot was washed away during the floods. Out of the remaining six experimental plots the results in four of them seem to be encouraging. As these have passed through their second year and are now in their third year course, it is yet too early to say anything definitely about these results.

Nandyal Agricultural Station.

Season.—Unlike the three years preceding, the annual rainfall was heavy, being 29.09 inches which is only about 8 inches less than 40 years' average. Though this amount was sufficient and satisfactory, yet its distribution was very irregular and unfavourable to most crops except cotton. During the south-west monsoon months, between June and September, a total fall of 21.61 inches was received and this was distributed over 64 days with several heavy down-pours in the interval. Both cotton and sorghum were however sown in good time. Owing to this heavy and continuous fall during this period, indigo which was sown in July suffered and in the case of a single plot it had to be resown. Rains of the north-east monsoon were different in character. They amounted to 2.02 inches for the whole period, of which 1.20 inches was received on a single day and the rest distributed over six days. Dry weather prevailed during this period to a great extent. Consequently sorghum suffered heavily. The

farm land cracked deep, creating a necessity for repeated inter-culturings especially in the case of cotton.

Cotton.—The total area under the crop is 87.58 acres an increase over that of last year. It is, however, not possible to record the average yield of this crop as pickings is still being done. The average yield as estimated will approximate to about 260 lbs. per acre.

Sorghum.—This is second in importance on the farm occupying about 21.81 acres. This crop fared very badly on account of bad weather during the north-east monsoon period and its yield excluding single plant selections has been recorded to be only 299 lbs. per acre. This is less than half the average yield of the district, under normal conditions.

Bengal-gram.—The area under this crop amounted to 26.85 acres. This was put in at the right time. It started vigorously at the outset and promised to give good results. But owing to want of sufficient dew in the cold season, its growth was checked and an average yield of only 91 lbs. per acre was obtained.

Seed distribution.—The following quantities of seed were distributed from Nandyal Farm :—

Seed.	Lbs.	Quantity.
Cotton Plant No. 2	87,774	
„ Ordinary Sircar	2,392	
„ Cambodia	3,089	from the farm and 279 lbs. by the Farm Manager, Samalkota, credited to this farm account.
Dhaincha	2,507½	
Wild indigo	580	
Cultivated indigo	15,992	

Implements.—Two applicants were supplied with cotton soil ploughs for a short period. Their lands were broken open to minimise the troubles from weeds. In both the cases they were satisfied with the work of the plough. One ryot loaned Sampson's Harrow from the farm and used it on his fields.

Visitors.—Distribution of cotton seed on the farm attracted several people to visit the farm during the cotton sowing period.

New works and improvements.—To provide more accommodation, the office room was extended at a cost of Rs. 473-9-4. Repairs to Farm Manager's and Assistant Farm Manager's quarters were undertaken and completed. The big forest rest-house situated east of the farm was handed over to the Agricultural Station on 28th May 1914 and the second rest-house near the farm will be taken over shortly. This new acquisition will provide accommodation for one of the officers of the farm staff which is badly wanted.

Sirvel Agricultural Station.

Season.—The south-west monsoon started late this year. Neither arika nor drill-paddy was sown till the end of July. A great portion of the rainfall fell continuously during the months of August and September, checked the growth of the crops, and prevented after cultivation to a serious extent. In addition, the drought that prevailed during October, November and December coupled with the failure of water-supply, caused great anxiety amongst the ryots of the locality who suffered great losses at the failure of crops. On the farm no experimental work was done this year. Attempts to raise crops to test the initial fertility of the soils ended in failure owing to reasons stated above. One point, however, is worth putting on record in connection with this Agricultural Station and that is the success of the green manure crop (sunn-hemp) on the wet land. With the help of irrigation water from the canal, sunn-hemp at the rate of 28 lbs. per acre was broad-casted towards the end of July in about 15 acres of the wet land. Germination was satisfactory. The crop grew luxuriantly and the quantity of green stuff obtained when it was cut and trampled at the beginning of September amounted to 11,500 lbs. per acre. This was more than sufficient for the area on which it grew, while the total cost of production was only Rs. 6-3-2 per acre.

New works and improvements.—A third block (dry land block No. 2) of about 9.52 acres was taken over in June and fenced during the year. The construction of a manure pit, a cattle shed, an office, the sinking of a well and the erection of the rain-gauge were all completed during the year. The building of a seed-store was commenced, but the work is not yet finished.

K. RAMASASTRULU NAYUDU,

Assistant Director of Agriculture, Northern Division.

4th May 1915.

**ADMINISTRATION REPORT OF THE DEPUTY DIRECTOR OF AGRICULTURE, SOUTHERN DIVISION,
FOR THE YEAR 1914-15.**

I have the honour to submit the administration reports of the Agricultural Stations under my charge.

I was in charge of the Southern Division for the whole period under report except for 20 days on privilege leave from 3rd June 1914 and for 17 days when I was on special duty in connection with the Madras Agricultural and Trade Conference which was held in December last. Mr. K. Ramasastrulu Nayudu, was my assistant until 2nd June 1914 and acted as Deputy Director during my absence on privilege leave till 23rd June 1914, when he was transferred to the Northern Division; after that I was without an assistant until 4th December 1914 when Mr. R. Thomas, Probationary Deputy Director of Agriculture, was posted to this division to assist me.

With the exception of the following changes and transfers in my subordinate staff the work in this division has been uninterrupted and it has been possible to develop this along the lines already laid down.

Farm Manager M.R.Ry. K. Sankara Ayyar, on return from leave on 3rd June 1914, was posted to Madura district for the introduction of green manure crops on lands under the Periyar irrigation. He relieved Assistant Farm Manager, T. A. Krishna Ayyar, who was transferred to the Manganallur Agricultural Station taking the place of Assistant Farm Manager, K. Ramanuja Achari, who was transferred to the Northern Division.

Assistant Farm Manager, M. Raman, was transferred from the Koilpatti Agricultural Station to district work under Cotton Improvement on 9th August 1914 and has been working in the north of the Tinnevely cotton tract where up till then the department had not done any organised work. His place was taken by the Assistant Farm Manager, Rajagopal, G. Mal, newly appointed. Assistant Farm Manager, K. Raghava Achari, was transferred from the Koilpatti Agricultural Station on 5th January 1915 to work under the Government Lecturing Botanist at the Agricultural College, Coimbatore, his place being taken by the Assistant Farm Manager, K. Gopalakishna Raju, who was transferred from the Central Division. Second-grade Farm Manager, M.R.Ry. K. Unni Krishna Menon, was transferred from the Taliparamba Agricultural Station to the Central Agricultural Station, Coimbatore, on 6th June 1914 and his place was taken by Assistant Farm Manager, M. K. Nambiar, from the Central Agricultural Station, Coimbatore. Rao Sahib M.R.Ry. A. Rama Rao was newly appointed as Farm Manager and was posted in charge of the Manganallur Agricultural Station. Most of these changes have meant putting officers of greater experience on to the more responsible duties of district work and filling vacancies of the Agricultural Stations with newly appointed and inexperienced officers. The development of district work in the neighbourhood of the Agricultural Stations has also greatly assisted in the training of newly appointed officers who have much to learn not only of the conduct of district work, but in their bearing and friendly relationship to actual agriculturists. They soon realise that what the ryot has learned by actual experience is not to be treated lightly and that their own knowledge of theoretical and practical agriculture can be greatly extended by a closer acquaintance with those who have been trained only in the school of experience.

It has this year been possible to again carry on district work in the Tanjore district, so far this has been mainly confined to the Mayavaram and Shiyali taluks. It will be remembered that great effort was made in the past in this and other taluks to introduce the practice of single seedling planting. This appears to have become fairly general for the time being, but has now been modified into what might be termed economic planting, i.e., two to three seedlings planted together. The reason given for this shows in what a degraded position the agriculture of these taluks stand. It is stated that single planting although it gives increased yields for one or two years reduces the fertility of the land, which without manure cannot stand this increased drain; and that subsequent yields are less. It is difficult to understand how any farmer can take up such a standpoint, for, it must be abundantly evident that the increased outturn of grain much more than pays for the cost of manuring. At the same time it opens up a large field of work in the introduction of green manuring and better methods of manuring generally. Already in consequence of this years touring work by an officer of this department there has been a marked increase in the sale of green manure seeds. These sales, which amounted to 13,327 lbs. of Kolingi (*Tephrosia purpurea*), considerably exceeded our estimates and would have been still greater if further quantities of seed had been available.

On the West Coast, the district work is still conducted by the staff attached to the Taliparamba Agricultural Station. The area under Mauritius canes in the South Canara district again shows a marked increase and steps have been taken to introduce this into the Uppinangadi and Kasaragode taluks. The following figures, kindly obtained by Mr. Couchman, the Collector of the district, show that the area of improved canes has more than doubled in one year. Previous years' figures have been included for purposes of comparison.

Taluk.	Area of canes in		
	1913.	1914.	1915.
Coondapoor	29.67	67.21	92.67 representing 68 villages.
Udipi	34.40	89.59	220.58 " 57 "
Karkal	1.75	6.00	2.50 " 2 "
Mangalore	17.85	31.00	97.92 " 18 "
Uppinangadi ... ..	...	...	2.23 " 4 "
Kasaragode ... ..	...	...	.10 " 1 "
Total ...	88.67	198.80	424.50 150

Mr. Couchman writes that beyond the extension of cane to Uppinangadi and Kasaragode taluks there is not much more that need be done to assist this crop.

With reference to the figures given above he adds that the largest area under these canes is in the village of Bangra-Kulur, Mangalore taluk, where there are forty acres. The next largest area is in Uppur village near Udipi with 37.60 acres. Of this total area all is red Mauritius except twelve acres of Barbados 208. This latter is a promising variety and is likely to increase on the islands where there are fewer jackals. Much of the credit of this work is due to Mr. Couchman, who keenly interests himself in the work of this department and in the improvements of the Agriculture of this district.

At the request of the Collector, steps were taken to introduce the bullock mhoote in place of the South Canara picotta. This latter water-lift makes a great demand on human labour, which owing to the rise in price of such labour, renders the cultivation of paddy in the dry season very speculative. Moreover, the increased area under cane in many places renders the introduction of more efficient means of lifting water imperative. Nine such mhootes have been fitted up for farmers this season. All the parts of the mhoote have been made in the district itself and buffaloes and cattle have been trained to the work.

Trials of daincha as a green manure crop last year in the South Canara district were fairly successful in spite of the failure of the April-May rains; and a considerable extension of the practice has followed the season. A small quantity of seed was, last season, collected by the owners of these crops and additional requirements were supplied and sold by the department. These crops are chiefly in the neighbourhood of Mangalore. This work is of the first importance, as the coast tracts are hard put to, to obtain green leaves for manuring the wet lands.

A certain amount of progress has been made in the improvement of paddy cultivation in Malabar. Trials made with cowgram as a green manure were disappointing this season owing to the failure of the April-May rains on which the crops were dependent for water and only one or two demonstrations proved successful. Such failure is the exception, however, and not the rule. Further trials will again be made this sowing season. For the same reason the germination of paddy seed-beds which are also dependent on these rains was everywhere sparse and thus more economic planting had perforce to be adopted throughout the district. In spite of this many members of the village societies, started the previous year, testify to the advantages of economic planting. This success must very largely be attributed to the better preparation and manuring of the seed-bed which is insisted on by the department as one of the essentials to success. There was abundant testimony this year to the benefit derived from using selected seed, which was the produce of the crops grown on the Taliparamba Agricultural Station and, for this coming season, most of the seed available on the Agricultural Station has been sold to members of these village societies. This is in spite of the fact that the price for the seed has been fixed above the market rate in order that those who purchase it will better appreciate its value.

Cane cultivation in Malabar has received a considerable impetus owing to the rise in price of the jaggery and is being cultivated in 13 different centres in the district.

The extension of intensive dry land cultivation is slowly spreading, though as mentioned last year it has received a considerable check on account of the fall in the price of ginger. Chillies, however, are still a profitable crop and the cultivation of this is extending. Over 10,000 seedlings besides 2½ lbs. of seed were sold from the Agricultural Station last year. The residual effects of the manures applied to Chillies, Ginger and Turmeric have proved to be very considerable and the subsequent cereal crops have been known to yield as heavily as good wet lands.

The officers attached to the station have, between them, been 365 days on tour.

Work in the neighbourhood of the Koilpatti Agricultural Station has continued on the lines mentioned last year. The scope of the work has been enlarged and a new circle has been opened which includes the cotton tract between Sivakasi, Virudupatti and Satur. For the proper control of the work, the black soil tracts have been divided into four circles one of which is worked by the officers attached to the Koilpatti Agricultural Station and the other three are each under the charge of an Assistant Farm Manager. Owing to the rapidity with which the work of introducing drill cultivation was expanding, it was felt to be necessary to further divide the work; and each circle was this year divided into four or five divisions. Each division contains from about 8 to 12 villages where work was contemplated or already in

progress. A temporary head cooly was appointed to each of these divisions, these being selected from the best coolies trained in previous years. Each division was allotted coolies, implements, etc., and the Head cooly was responsible to the Assistant Farm Manager for their proper distribution to wherever these were wanted. This has always been a difficulty as sowing can only be done when the soil is fit after rain and the unequal distribution of the rain will often allow of work in one village while it will be impossible in another. Except in the new circle all coolies employed were drawn from the villages in the division in which they were to work. Those who required training were trained on the spot and it was thus possible to get a much better class of cooly, many of them being sons of respectable farmers. The results of this organisation have been entirely satisfactory.

It is necessary to again plead the excuse of unfavourable weather conditions hampering the work. The season everywhere was late and the soil seldom got a chance to dry sufficiently to sow. This was especially unfortunate in the new circle around Satar. Here usually sowing is over by the beginning of October, but this year it was continued right into November. In the south the rains were extremely heavy and so wet were the soil conditions that the cotton crop had in some places to be sown three times before a stand was obtained. The last sowings were not completed till the beginning of January. In spite of this the area under drill cultivation increased from 7,117 to 11,329 acres. Work extended to many new villages as well as in villages where improved methods of cultivation had already been introduced. It is very encouraging to see how ryots adapt these implements to suit the season. In one village implements for inter-cultivation and even the country plough were used to open up and dry the land instead of being used to merely loosen the surface in order to conserve soil moisture. In other villages ryots were most thorough in their after-cultivation and when questioned as to the reason of their zeal stated that previously many had noticed that this after-cultivation greatly improved the land for the succeeding cereal crop.

The crops raised from unit strains have not in all cases given results as good as were expected. The seed distributed in the new circle around Virudupatti has been especially disappointing. In the previous season Mr. Steal had given this cotton a trial and he writes that this yielded at the rate of 452 lbs. per acre over an area of 13.89 acres. This year, however, the yields of crops raised from seed of the same strain will not, it is estimated, yield more than if as much as 250 lbs. per acre. In the initial stages, this crop was very promising, but many of the flower buds and young bolls shed before they matured. It is very probable that the heavy rains in this year caused the plants to develop a surface root system which would prevent them withstanding the effects of dry weather when this set in. The superior germination of the seed also was a drawback. The plants were much too close and it was noticed that whenever the plants had sufficient space to develop shedding of buds and young bolls was not so severe. Another unit strain (Company No. 3) grown in this tract is promising although it has not done as well as was expected. Here again the season was against it. It is unfortunate that this has happened in the first year of our extension of work to this area. From Koilpatti southward the unit strain (Company No. 2) grown on seed farms as well as by private growers is doing well and has given great satisfaction. Even here, however, in a few villages the crop has shown a tendency to run to vegetative rather than reproductive growth on account of the very wet season. It is estimated, however, that this will yield 25 per cent. more than the ordinary karunganni. The ordinary karunganni cotton of which a bulk selection is each year made on the Kolipatti Agricultural Station has also done very well this season and is cropping heavily. There has been a very considerable extension in the area under karunganni. Twenty-five different villages arranged for co-operative ginning of kappas for seed purposes and over 600 pothies of seed were stored by them for sale. Most of this was sold for seed, though some appears to have been used for cattle food. Besides this many villages had not sold their cotton when the war commenced and they therefore had to arrange to hand gin their kappas. Much of the seed thus obtained was available for seed. Four hundred and seventy-five pothies or about 117,400 lbs. of seed were sold by the department or issued for growing on seed farms. All the officers responsible for this cotton improvement work have shown great enthusiasm and energy, and to them is due the credit of what success has been achieved this year.

In the Periyar irrigation tract two full-time officers have been employed; one with headquarters at Sholavandan and the other at Madura. Their work has been confined chiefly to the introduction of green manure crops, but, besides this they have endeavoured to improve the cultivation of the paddy crop generally. The work around Sholavandan has developed very satisfactorily and considerable areas of both Daincha (*Sesbania aculeata*) and Kolingi (*Tephrosia purpurea*) were grown, the former on old wet lands and heavy soils and the latter on the lighter new wet lands. Speaking generally, Daincha has given marvellous results on lands which are saline while on sweet lands its effect is not very marked. One case was reported where the yields from saline land was five times as much as the land had ever been known to yield before. Such results are gratifying but at the same time they do not always help on the work. Ryots who own sweet land very naturally think that if a green manure crop gives such results on saline land it ought to do much better on good sweet land, but they do not realise that very often salt lands are abundantly supplied with plant food which as long as their mechanical texture is so poor and drainage practically non-existent,

the paddy crop cannot make use of. These results therefore seem to point to the fact that the value of green manure crops is very largely mechanical.

Trials are being made with superphosphate applied in small quantities as a supplementary manure to green manures on sweet lands. Trials also are being made with manuring the green manure crop with superphosphate by which means it is thought that the green manure crop might grow more vigorously and at the same time take up the phosphate which, when the green manure crop was ploughed, would be liberated for the use of the succeeding paddy crop. Work in the Sholavanam circle is much more advanced than in the Madura circle. This is very largely due to the fact that work was concentrated within a small area. This circle is the apex of the triangle forming the Periyar tract and at first very little progress was made here owing to the proximity of hilly tracts where green leaf was procurable. It was decided therefore that it was necessary to make this circle much similar to the Madura circle so that more detailed work could be done, and the results of this have been eminently satisfactory. It also points to the necessity there is for a large increase in subordinate staff if definite results are to be achieved. Recent sales of green manure seeds in the Madura circle show that the work here is getting a hold and it is expected that considerable progress will be made if the work is undisturbed. Much depends on the officer in charge getting to know the circle and being on friendly terms with the villagers. Early work in this circle was much handicapped by the zeal, which was often genuine enough, of absentee landlords who wished their agents to work with the department in the trial of green manure crops; but, as the success of green manuring is adverse to the immediate interests of the agent, such trials are in most cases bound to end in failure. During the latter part of the period under review this work in the Periyar has been under the charge of Mr. R. Thomas.

District work in the Coimbatore district continues to expand. The introduction of single planting of paddy in the Bhavani valley has been very successful and large areas under this system may be expected next year. There are still some reaches under the Kodiveri aicut where this system has yet to be introduced, but where tried last year the spread of this system should now be largely automatic. Some progress has also been made in the Cauvery valley, while similar work has been continued in the Noyil valley near Coimbatore and has been started in the Amravati valley both in the Udampet and Dhārāpuram taluks. Trials with green manure crops are also being made in all these places and it should be possible next year to report on this success.

Trials with fish manure had to be restricted owing to the supply of this commodity from the West Coast being again a total failure. Many ryots who had applied for manure could not be supplied, while the supplies reached others when it was too late to use the manures for the crops for which they were required. From the fact that ryots were willing to pay considerably more than the current rate for this manure, it shows that they realised its value from previous trials. Evidence seems to show that this manure is of much greater value when applied to heavier types of soil.

The officer in charge of the work in this district has also had charge of the green manure work in the Trichinopoly district. This was started at the instance of the Collector who asked, in the interests of both the people themselves and of the reserved forests, that attempts should be made to introduce green manure crops in those parts of the Musiri and Perambalūr taluks adjoining the Pachamalai hills. In the Musiri taluk, daincha as a green manure crop seems now to be firmly established. Here the green manure crop is raised mixed with cumbu and irrigated when necessary from wells. Although the daincha, which in some cases grows as high as 12 to 15 feet, considerably decreases the yield of cumbu, the value of the green manure crop greatly outweighs the loss of grain. It enables the wet lands to be manured expeditiously as soon as water is received and thus the paddy planting is soon completed in good season. It saves the expense of carting from the forests which is often no small item, even when only the damage done to carts and the cost of maintaining expensive cart bullocks is taken into consideration. Last year over 1,000 acres were grown with daincha in these two taluks and very often the growth was so great that the crop from one acre was ample to manure two or three acres. In Musiri taluk the ryots now make their own arrangements to collect seeds and are thus independent of the department's help. In fact, this year the department have been able to buy up their surplus stock for distribution elsewhere. In Perambalūr taluk no seed was collected and the department has again to render assistance by selling seed there. As, however, the conditions under which the crop is grown are similar to those in Musiri, this tract should be able to supply itself with seed from next year forwards.

Trials with superphosphate as a supplementary manure to the green manure crop are being tried in the coming season.

In addition to this organised work, a certain amount of success is acknowledged by correspondents who have acted on the written advice of the department. Wherever such response is met with endeavour is made to send an officer of the department there to follow up any work started, and it is thus possible to establish what might be termed a clientele which will pave the way for the time when organised work throughout this division will be possible.

During the year under report 1,298 letters have been received from private individuals asking for advice, etc.

Koilpatti Agricultural Station.

Season.—The hot weather rains were favourable and resulted in a good summer on second season picking of cotton. The main season, however, was again late. Except for an unusual rain of 1½ inches in August which was of no value for agricultural purposes, there was no fall of rain sufficient to be of use till the end of September and with the aid of this the red soil crops were sown. The black soil crops were practically all sown in October, but the season was very unfavourable: there were 29 rainy days between October 2nd to November 10th and continual cloudy weather. Anyone who has experience of black cotton soils will realise the difficulties to be contended with. A few of the crops had to be resown, while others such as several of the pulses could not be sown at all. It was not until the middle of November therefore that any weeding or essential operations in the after-cultivation of the crops could be done. Weeds had a free field in which to develop and these combined with the wet soil conditions greatly checked the growth of the tender crops. The fine weather in the later part of November was, however, fully utilised, and the crops were just recovering from the excessive rain when another spell of wet weather occurred in the beginning of December, which again stopped all field work. Cumbu especially suffered from the lack of inter-cultivation while a heavy fall of rain at Christmas time just caught the crop when in full flower and as a result the grain yield was still further reduced, and an average of only 100 Madras measures (about 300 lbs.) of grain was obtained. In many other parts of the district the yields were relatively much less. The cotton crops also had suffered severely from the weather conditions, but as this improved they made rapid development; with abundant moisture in the soil, this development was too luxuriant and the crops were unable to maintain this standard as the soil became drier. Fortunately a heavy rain in the end of February saved the situation for the time being; but the crops had never really made a deep root system and thus could not stand the dry weather conditions which were bound to follow. This was shown by the heavy shedding of buds, flowers and young bolls, which occurred as soon as the hot weather commenced. On the Agricultural Station this was not so severe as might have been expected but outside, especially north of Koilpatti the crops have suffered severely. Crops which looked as if they would give 500 lbs. of kappas have, in some cases, not given more than a quarter of this amount. On the red soil the rains were much too copious. The soil for weeks on end was thoroughly water-logged and as the land is situated on the foreshore of a tank it was impossible to remedy matters. Weeding was impossible and these soon gained the mastery of many of the crops. Nothing could be done to save them as it was impossible to get on to the land. When fine weather did prevail in, the land had set hard and weeding proved a very costly matter. The Cambodia cotton and Cow peas were the only crops which really recovered to any extent.

Black cotton soil work.—The introduction of a double furrow disc plough has added much to the efficiency of the cultivation and the consequent cleanness of the land. This has entirely replaced the "cotton soil" plough. It is of lighter draught and does nearly twice the amount of work. The adjustments make it possible to accurately set the implement to various depths of ploughing. As already mentioned in one of the annual reports of this station, it has been found quite possible to keep "hariali" grass in check by surface manuring the fodder cholam crop and by deep ploughing immediately after the harvest. This method has been adopted on all land on which fodder cholam had been grown and these lands are now practically free from this weed. It was necessary here and there to dig out isolated plants which were found not to have died but this was accomplished without any difficulty as the soil had been pulverised by the ploughing. The same plough set at 6 inches has been used for fallow ploughing after the removal of the recent cumbu crop. Thus it has been possible to get much of the fallow ploughing done before the soil was moist enough to allow the country plough to do the work. This implement, known locally, as the "Chatti" plough, has attracted considerable attention in the neighbourhood and an additional one has been purchased by the department which will be hired out, with a view to subsequent purchase, to the Avalnattam Co-operative Agricultural Association.

Considerable progress has been made in the protection of the fields from wash. Most of the field drains as well as the main drain have now been revetted. Washes do still occur, but not to the same extent as formerly since the revetment has greatly improved the levels of the fields.

The introduction of Perisamanjal Cholam from Coimbatore has meant a large increase in the fodder supply. This variety has now entirely replaced the local Irungu cholam on the farm as a fodder crop. It not only gives a considerably heavier yield, but is a much more leafy fodder and therefore more palatable. Several ryots obtained seed from the department last season and all speak well of it and there has been an increased demand for seed for sowing in the next season. The only objection to this is that seed has to be imported from Coimbatore as this variety does not set seed properly in Tiunnevelly.

The work of cotton selection continues on the lines already laid down.

Company No. 1 which was put out last season in the district has not proved a success. It gives a very fine lint and reports on its spinning value compare it very favourably with

imported American. The acre yield, however, has proved disappointing and only averaged 250 lbs. per acre on the seed farms. At Virudupatti, however, the yield averaged 450 lbs. This strain was therefore issued in that tract this year. But though very promising when young; it has proved most disappointing. The season was very much against it as the rains were much too heavy to enable the crop to develop a deep root system.

Two other strains were put out in the year under report. One named Company No. 2 was issued in the south of the tract and being an uneven ripening cotton, has responded very well to this wet season. Spinning reports say that this cotton is as good as the preceding one in all respects, except that the colour is not quite so good. The other strain put out this year and named Company No. 8 is also promising and in a normal season should do very well. So far, however, its cultivation has been confined to seed farms. It is too soon yet to say so what the acre yields will be. The largest seed farm of this is near Koilpatti and the yield is estimated at 500 lbs. per acre of which 375 lbs. per acre has already been picked. This is an even ripening cotton with a ginning percentage of over 33 per cent. and it is hoped that this will prove useful in supplanting the jari or pulichai cotton, an inferior variety which is now largely grown in the Rāmnād District. Spinning reports say that this is not quite so good as Company No. 1, but it can be used for spinning 40s. The bulk selection karunganni has done remarkably well this year throughout the district and promises to yield a heavy crop.

New works.—Quarters for an Assistant Farm Manager have been built during the year under report and a kappas shed has also been put up. This latter was necessary as all seeds farm kappas is now ginned on the Agricultural station during the year. 780 pothies (1 pothie = 246 lbs.) of seed-farm kappas, inclusive of the crops grown on the Agricultural station itself, were ginned.

The work this year has been exceptionally heavy on account of the increasing district work in the neighbourhood of the Agricultural station, all of which has to be attended to by the officers stationed here. Farm Manager M.R.Ry. N. S. Kulandaiswami Pillai deserves special mention for his work which has meant detailed supervision and constant touring. The Assistant Farm Managers though only recently appointed have also done good work and have spared no pains to learn the work and to assist the Farm Manager in his duties.

Manganallur Agricultural Station.

Season.—There was a certain amount of delay in planting the first crop paddy, i.e., the kuruvai and "udu" * crops owing to water not being received in the channels till the first week in July. The result of this late receipt of water was that the kuruvai was not ready for harvest until the heavy rains of the north-east monsoon were received and the ottadam (the late crop of udu) which was only cut during these heavy rains, could not benefit by them for its second growth. Thus there was a considerable loss in yield from the kuruvai both from shedding and sprouting in the field, while the quality of the grain stored was lessened owing to the very wet weather conditions at the time of harvest, and the difficulty of drying threshed grain. The ottadam subsequently recovered somewhat in condition as good rain was received early in December.

A heavy fall of rain in August did serious damage to recently sown samba seed beds. As a result of this, the supply of seedlings was found insufficient for the whole samba area to be transplanted and seedlings from outside had to be purchased. This proved a useful demonstration which showed the great superiority of our seedlings raised from selected seed and those grown by ryots outside from their own seed. The difference in yield amounted about 18 per cent. in favour of our own seedlings when compared with yields of adjoining fields under otherwise similar treatment and manuring; except for this the season was very favourable to the samba crops.

Crops.—Owing to the uncertainty of the water supply both at the beginning and end of the season the greater part of the double crop area was planted with "udu" instead of with two crops. The "udu" has been much the more profitable system of cultivation for besides saving the cost of second crop cultivation, the yield from a block of over seven acres has this year been 1,231 Madras measures (799 kuruvai and 432 ottadam) against an yield of 997 Madras measures (681 kuruvai and 316 samba) obtained last year. This does not mean to say that "udu" is always the more profitable system but under local conditions with the uncertainty of water-supply at either or both ends of the season it certainly is.

The quality of the crops throughout the farm and of the sample of grain obtained this season was a marked advance on that obtained the previous year. By a bulk selection all varieties of paddy now grown are true to type and this year the crop has been stored and is being issued for sale to the public as seed grain. Several unit selections are under observation and some of these appear quite promising. The examination of these, however, entails a considerable amount of work on the staff. Of varieties introduced none of them appear to be superior to local ones. This is probably due to some extent to the soil conditions under which the crop is grown. A change from ordinary wet land to a heavy delta

* A mixture of a three and a eight month crop.

soil which lacks free drainage seems a probable cause for this. For example this year's sadai samba crop was not only inferior to that grown last year from seed imported from the adjoining district, but also took considerably longer to mature. If this conclusion is correct it seems clear that any attempt at improving existing varieties either by selection of plant breeding should be done on the spot and arrangements to this end are being made in co-operation with the Government Economic Botanist.

The manurial experiments started last season and continued this year on more carefully selected plots, have not given any definite results as shown by crop yields; but from observation of the growth of the crop it is evident that as regards manuring the main question apart from improving the mechanical texture of the soil, is the supply of phosphatic manures, and further experiments to determine what quantities can be most profitably applied will be commenced this coming season.

The difficulty of growing green manure crops on these heavy delta soils has not yet been solved. It is possible to get a good germination of these by sowing in the moist ground before the paddy harvest, but without subsequent rain it is impossible to raise these crops owing to the deep cracks which form immediately after harvest and which rapidly deplete the soil of its moisture besides tearing asunder the roots of the green manure crop.

The difficulties attending the harvesting operations have not diminished with the increase in the number of experimental plots, which have all to be harvested separately; although a considerable area was cut, bundled and stacked for subsequent threshing.

The disease known as "surai" and reported to be due to a mite caused a certain amount of damage. This was specially noticeable in the sadai samba crops. The caterpillar, which attacked the ripening crops last season and which caused so much loss, did very little damage this year. Steps were taken to keep the field bunds out as it was noticed in the previous year that these caterpillars fed freely on the flower heads of natural grasses and it was thought that, if these were prevented from flowering, the caterpillar would be deprived of its food on which it and previous generations could exist till the paddy crop ripened. Whether this was contributory to the lessened damage, it is difficult to say.

Taliparamba Agricultural Station.

Season.—This has been peculiar, but on the whole favourable to crop production. The hot weather showers of April-May failed entirely, but fortunately the early part of the monsoon was irregular and instead of continuous rains and cloudy weather, there were heavy showers with intervening bright weather. In July the rainfall was much above the average and so also in August there being really no break till the third week in September. The September rains were exceptionally good while showers continue on into November and December. The whole season therefore was as if it had been a month late. The rainfall for the year was 147.57 inches and more than 30 inches of rain fell on 121 days. This compares very favourably with an average of 139 inches and 84 rainy days.

Wet lands.—The failure of the hot weather showers necessitated irrigation of sugarcane right on until June and for the same reason the paddy seed beds, which are rain fed, suffered severely, nor was the germination as good as usual. The bright weather in June, however, gave the newly-planted crops a good start and the yields were considerably better than last year. The grain has all been sold for seed at an enhanced rate and those who have grown it in the past speak highly of its superiority over local seed. Of the canes grown, B. 147 continues to do well and sets of this have been distributed to selected cultivators both in Malabar and South Canara for further trial. Another cane, a sport of Red Mauritius which was found in Malabar, is also promising. Except for these two and Red Mauritius, B. 208 and a few varieties grown for the sugar-cane expert, all other varieties tried have been discarded as unsuitable for West Coast conditions.

Pepper gardens.—These suffered very severely from the seven month drought from November till May. The last two months, when only 1 inch instead of about 8 inches of rain fell, were especially trying owing to the high temperature of the air and soil. The lack of rain at this time not only checked the pepper vines, but also delayed the fresh growth of the shade trees and thus the vines felt the dry hot weather all the more severely. When the monsoon commenced, the vines had lost all their leaves, a condition which has never occurred before since the Agricultural station was opened. Thus the vines had not only to form new leaves but had to form its fruit in the monsoon. Fortunately the bright weather in June enabled them to do so and this coupled with the good rainfall of the north-east monsoon which continued until December, resulted in a record crop. Two points specially noticed which presumably were due to the season were:—

(1) That "pollu" (a disease caused by the larva of a flea beetle boring into the berry) which usually causes much damage was hardly seen this season.

(2) All vines which received heavy manuring with concentrated manures except in the case of a few moist low-lying plots gave reduced yields. This would have been expected as naturally such plots would develop more of a surface root system and would therefore feel the effects more of, and take longer to recover from, the prolonged dry weather. The fact that

the pepper harvest did not commence until six weeks later than usual shows how severely the vines had suffered.

It is fortunate that, at a time such as the present when most West Coast produce is suffering from low prices, the pepper should have yielded so well and the price also should be satisfactory.

Dry land crops.—It was not possible this year to get these crops established before the monsoon commenced. It was impossible to time the sowing of ragi seed beds properly. Sowings were made at the usual time, but as rain held off fresh sowings were made. Planting could not be done till well into June and the former seedlings were by that time too old while the later sown seed beds were still too young. The result was that the yields were only a little more than half those obtained in the previous year. Both ginger and turmeric should have been well established by the commencement of the monsoon, but neither of these crops showed above ground when this commenced. Fortunately the subsequent weather conditions favoured the crop and it made a fairly good recovery although many sets failed entirely and there was not a full stand. Ginger is still being grown although there is no sign of the market improving. At present prices it does not pay to grow and this must have been the cause of considerable hardship in the Ernad taluk which is the home of the West Coast ginger crop. Chillies have again proved a valuable crop and have done well in spite of late planting. Having now proved the value of intensive dry cultivation in Malabar, trials with concentrated manures have been arranged for this coming season in order to see how far it will pay to supplement the local manure supply.

The district work which is conducted by the staff of this Agricultural Station has already been referred to. This is continually on the increase. Interest in agricultural matters seems to be awakening in Malabar and many requests are received asking for local advice on agricultural matters. The Collectors of the West Coast districts have continued to interest themselves in the work of this department and their help is gratefully acknowledged.

His Excellency the Governor's visit to the Agricultural Station has left a deep impression in Malabar and has aroused considerable interest among the agricultural classes in this Agricultural Station. People naturally infer that if His Excellency took so much trouble to visit an out of the way place such as this is, there really must be something worth seeing and learning there.

H. C. SAMPSON,

Deputy Director of Agriculture, Southern Division.

6th May 1915.

ADMINISTRATION REPORT OF THE DEPUTY DIRECTOR OF AGRICULTURE, CENTRAL DIVISION,
FOR THE YEAR 1914-15.

Mr. G. D. Mehta, Extra Deputy Director of Agriculture, continued to be in charge of the division throughout the year with the exception of some ten days in March 1915 when he availed of casual leave. He was then relieved by Mr. R. Thomas, Probationary Deputy Director of Agriculture. The Divisional head-quarters were transferred from Cuddalore to St. Thomas Mount, Madras, on July 5, 1914.

2. In regard to district work a Farm Manager who devotes all his attention to district work has been stationed at Chittoor for the past three years; another at Chingleput since August 1914; and a third at Palur since February 1915. In previous years the district work has been largely confined to—

- (1) Economic transplanting of paddy;
- (2) Distribution of seeds for greenmanuring crops on paddy land.

But during the year under report a number of subsidiary lines of work have been taken up, the most important being—

- (a) Improvement of sugarcane cultivation and jaggery making;
- (b) Distribution of indigo seeds;
- (c) Organization of cattle breeding associations;
- (d) Extension of area under Cambodia cotton;
- (e) Assisting in management of Criminal Settlements and other lands;

In addition tropcutting experiments have been conducted as usual.

The green manuring work had reached a scale where it would be practically impossible for one man to deal with it satisfactorily and at the same time continue extending the work in fresh tracts.

3. The work done at Palur, the only agricultural station in the division, is dealt with separately in this report.

4. The season has varied considerably within the division. Rains were excessive in the southern tracts (72 inches being recorded at Palur) while the average for the year for the Chittoor district works out to about 30 inches. The unfavourable season in the northern part of the division has very appreciably affected the progress of work there. The absence of timely rains curtailed the area which might have been transplanted with single seedlings

and a fairly extended period of drought coupled with a very late south-west monsoon did much damage to those of the greenmanure plots that had succeeded in germinating.

5. But what has affected the cultivation of crops considerably more than this year's climatic conditions is the unprecedented state of the market caused by the European war. Thus the groundnut trade has received a terrible check (the market at the time of writing continues to be very dull and shows no immediate signs of recovery); the indigo dye industry is endeavouring to come into its own again; cereal grains are quoted at very low rates—paddy being 80 per cent. below pre-war prices; sugar is sold at enhanced rates, the jaggery market adjusts itself accordingly and the area under sugarcane in consequence shows prospects of considerable increase.

6. It is impossible to ascertain the actual area where economic transplanting of paddy has been conducted. The practice is very common in South Arcot district and it is estimated that some 10,000 acres have been transplanted with single seedlings in that district alone.

7. The appended table gives the quantity of greenmanure seeds distributed within this division in the course of the year. The total amounts to 19,886 Madras measures, sufficient to sow 4,262 acres:—

Variety.	Depot.						Total.	
	Palur.		Chingleput.		Chittoor.			
	M.M.	LBS.	M.M.	LBS.	M.M.	LBS.	M.M.	LBS.
Sunnhemp	1,768	5,525	148	456	1,509	4,716	3,423	10,697
Wild indigo	8,882	29,607	1,750	5,883	999	3,380	11,631	38,770
Dainoha	1,971	6,898	441	1,548	1,084	3,619	3,446	12,060
Indigo ... ..	...	...	...	...	336	1,092	336	1,092

It is a significant fact that practically all this seed has to be imported into the division from outside sources. Thus Bengal daincha seed is obtained from that Presidency. Wild indigo from Tinnevely and Rāmnād, and sunnhemp from Gōdāvāri.

With an ever increasing demand for greenmanure seeds it rests with this department to prove that growing these crops for seed purposes to supply the local market is a paying concern. With this object in view the various green manures have been experimented with on the farm. To date but little success has attended our efforts. The experiments are being continued.

8. (a) Though enterprising individual ryots in this division have in past years hired trained men from the Central Farm at Coimbatore to make furnaces for jaggery manufacture, it is only in the present year that the construction of improved furnaces for demonstrational purposes has been made a definite part of the programme of a district officer. During the year five furnaces were constructed after the improved method. Of these, three were constructed to fit the local pan which is round bottomed and very heavy and which can make one and a half maunds of jaggery at a boiling; and two constructed to fit the improved, light weight, Coimbatore pan which can turn out at least three maunds of jaggery at a boiling. By using the improved furnace the fuel necessary for the boiling may be reduced by one-half if the Coimbatore pan is used and by one-fourth if the local pan is used. One bandy load of fuel is commonly used locally to produce one pothie (= $\frac{1}{4}$ candy) of jaggery. Calculating the outturn of jaggery at ten candies per acre there is a saving of five loads of fuel which at Rs. 8 per load indicates a gross profit of Rs. 15 or Rs. 30 by using the local and Coimbatore pans respectively. From this should be deducted the wages of one additional cooly at Rs. 8 per acre of cane crushed, thus leaving a net profit of Rs. 12 and Rs. 27 respectively. A trained jaggery maker from Coimbatore was engaged for about two months to attend to this work.

(b) Another equally important improvement in regard to sugarcane cultivation which is receiving attention is the substitution of the ridge and furrow system of planting for the local haphazard system of planting on the flat. Figures for the area cultivated according to the improved method are not available. Around Palur and Nellikuppam where sugarcane is extensively cultivated this practice is commonly adopted.

(c) Sugarcane cultivation in South Arcot district has received a considerable impetus through the agency of the East Indian Distilleries Company at Nellikuppam a few miles from Palur. Their agent Mr. Neilson, reports concerning the area under cane in the Nellikuppam locality that "over an area of nearly 600 acres under cultivation for the present season (1914-15) I estimate about 20 tons of cane per acre which should yield approximately 1,500 tons of jaggery. The local area under planting for this season is about 1,800 acres." This is of interest in denoting the considerable increase in sugarcane cultivation which may be expected if present prices of jaggery rule for an extended period. Jaggery is now selling at Rs. 40 to Rs. 45 per candy (500 lb.) as compared with Rs. 25—Rs. 30 last July; and even at pre-war rates a minimum profit of Rs. 150 per acre could be normally expected by the cultivator.

(d) In regard to the distribution of sugarcane setts the Palur Farm has almost entirely ceased to act as a distributing agency owing to superior facilities enjoyed by Messrs. Parry & Co., to whom we are indebted for having undertaken to do the work. There has been such a considerable increase in the local area under sugarcane that it was practically impossible for the department to meet the demand. Provision is however being made at Palur to meet part of next year's prospective demand.

9. A rise in the price of indigo dye was anticipated immediately the war broke out. Provision was made by the department, without interfering with local enterprise, to acquire all the available indigo seed to meet the prospective local demand. A consignment of 2,342 Madras measures was almost immediately disposed of. No further supplies could be obtained. Purchasers have expressed their satisfaction with the germination of this seed. It appears however that some unscrupulous tradesmen have dumped on the market seed of doubtful age and germinating capacity, and the consequent complaints are numerous. In the course of the season the local price of seed rose from six annas to one rupee per Madras measure. A departmental leaflet on the cultivation of indigo for dye extraction was duly prepared and distributed.

10. Attempts were made during the year to organise Cattle Breeding Associations in three different localities,—with what success it remains to be seen.

11. Previous to the outbreak of war the extension of the area under cambodia cotton was a definite part of the programme of the Manager stationed at Chittoor. Subsequent to that date propagandist work regarding cambodia cotton has been temporarily discontinued. Four hundred lbs. of seed were distributed during the year.

12. Work normally expected from the district officers has been somewhat taxed by frequent visits of inspection to a Criminal Settlement at Madanapalle and to the lands of the Raja of Kanaparthi, who has recently undertaken to cultivate a fair amount of his land originally lying waste. The Palur staff likewise inspected the Criminal Settlement at Kammapuram. Cropping schemes are drafted and the Agricultural officer concerned pays frequent visits to see that the proposed scheme is adhered to. Some difficulty has been experienced in the case of the Criminal Settlements owing to the frequent change of Managers,—most of whom know but little about farming. Ten such visits of inspection by the farm officers at Palur and nine by the Farm Manager, Chittoor, were made in the course of the year.

13. Twenty-four crop cutting experiments were conducted by the subordinate officers of this division.

Palur Agricultural Station.

14. *Season.*—This year the farm enjoyed a rainfall of 72.6 inches well distributed over 86 days as compared with an average for the past ten years of 52.6 inches. Though the rainfall was excessive the cyclonic winds which are common to this tract were much fewer and less disastrous than ordinarily. Continuous rains for extended periods proved very beneficial to such crops as paddy and irrigated groundnut which gave record yields; but lack of drainage facilities told considerably on the rainfed groundnut; some of the canes varieties, the onion crop, Cambodia cotton and on Daincha grown for seed purposes. Advantage was taken of the unusual rains of January to sow indigo for dye extraction and gingelly.

15. *Experimental work.*—The experiments conducted were mostly in continuation of those of previous years. Reference is here made to those which have furnished data of interest during the year.

(a) *Groundnut varietal tests.*—Most of the varieties are exotics introduced by the department. Varietal tests are being conducted under both dry and irrigated conditions. In the rainfed tests the West African variety heads the list of averages though it is surpassed by Barbados from Ceylon for the year under report. Madagascar is another promising variety, and it is of interest that this variety and the West African both take a high position in the irrigated tests also. Local Mauritius which is at present by far the most popular variety in the Presidency retains its position at the head of the irrigated varieties but it takes sixth position as a rainfed crop.

(b) *Greenmanure crops grown for seed purposes.*—Up to the present greenmanure crops grown for seed purposes have failed to give satisfactory yields. The work is in its initial stage and conditions of season, soil, drainage, rotation, and immunity from insect attack have all to be considered and the best conditions ascertained separately for each variety of greenmanure.

(c) *Paddy varieties—first crop.*—The local varieties grown in the first crop season are generally very coarse grained. To determine if these may be supplanted by superior paddies a number of varieties have been introduced from the Central Provinces. Almost without exception the time these take to mature is too long to allow of their being grown as first crop paddies, for by so doing it is feared that the second crop paddies would be so displaced from their normal period of transplantation as to affect the yield. This year the season was favourable and high yields were obtained. *Parewa* has done best (8,898 lbs. per acre) which with *Chitrakali* have surpassed the popular local *Swarnawari* variety in point of yield.

(d) *Paddy varieties-main crop*.—Here, again, the yields were heavy. *Sadaisamba* comes first in point of yield both as regards weight and volume. Other varieties which have given good average yields are *Molagusamba*, *Vellaisamba* and *Poombalai*. *Poombalai* has an additional merit in that it takes a fortnight less to mature than the other varieties, but has the disadvantage of shedding its grain rather badly. In point of yield it takes second place.

(e) *Sugarcane varietal tests*.—On analysis the canes were found to be unripe, so a lapse of one month was allowed to pass before they were harvested. The canes were crushed at the East Indian Distilleries Factory, Nellikuppam, by Messrs. Parry & Co., who also analysed the juice of some of the varieties. Of the varieties *B. 1529* has surpassed others both in weight of cane per acre (20 tons) and in coefficient of purity of juice (89.36). The other varieties which have come into favour with Messrs. Parry & Co., are *Fiji B* and *J. 247*.

(f) *New crops*.—Some of the crops now grown on the farm are considered *new* in that they have not in previous years taken a definite rôle in the experiments. These crops include *Cambodia cotton*, *onions*, *chillies* and *tapioca* which are to be included in a definite rotation experiment with groundnut.

Cambodia cotton has given the low yield of 523 lbs. kappas per acre.

Onions gave an outturn of 9,500 lbs. per acre on plots planted with seedling onions, and 8,540 lbs. on plots planted with bulbs. As the latter is the local practice, this experiment to test the merits of the methods of planting is to be continued. In addition to the increased outturn the seedling system entails considerably less initial expense.

Chillies and tapioca are standing crops and figures are not yet available.

Fodder cholam gave an outturn of 5,319 lbs. per acre this year as compared with 1,820 lbs. in 1913-14. The best season for sowing this crop in this locality has not yet been determined.

16. *Distribution of seeds, etc.*—The appended list gives the extent of distribution of seeds implements, etc., from Palur :—

Greenmanure seeds	...	...	...	...	...	...	...	...	LBS.
Paddy	...	...	...	...	...	...	...	...	41,014
Indigo seed	...	...	...	...	...	...	...	...	9,595
Groundnut	...	...	...	...	...	...	...	...	7,385
Miscellaneous seeds	...	...	...	...	...	...	...	...	1,663
									191
									Number.
Scind ploughs	...	...	...	...	...	...	...	...	27
Monsoon ploughs	...	...	...	...	...	...	...	...	22
Triangular harrows	...	...	...	...	...	...	...	...	9
Improved country ploughs	...	...	...	...	...	...	...	...	6

In the preceding year the Ramagarudansamba variety of paddy, which is a Palur single plant selection, had reached the field scale. The whole of the paddy was distributed on seed farm conditions to be transplanted singly. Five thousand Madras measures of seeds were recovered at the end of the season from the Zamindar of Chunampet to be distributed to applicants in the forthcoming season.

17. This year again some difficulty has been experienced in obtaining ample water from the adjoining channel for irrigation purposes. This complaint is constantly recurring. The Revenue officials now propose constructing a dam with vents to ensure fair distribution of irrigation water to the parties concerned. Reliable experimental results cannot be expected on those plots which do not receive their normal supply of water from the channel. A satisfactory solution to the difficulty is an urgent necessity.

18. *Stock*.—Sixteen bullocks were maintained on the farm, three were sold owing to old age, one died, and four young bullocks were bought.

19. *Visitors*.—The event of the year was the inspection of the farm by His Excellency the Governor Lord Pentland who expressed his satisfaction with the work done. It is reported that 557 literate visitors inspected the farm.

20. *Buildings*.—The necessary repairs were executed.

21. *Staff*.—M.R.Ry. S. Subramania Ayyar was in charge of the farm until 28th October 1914, when he was temporarily relieved by Assistant Farm Manager, C. V. Seshachari pending the arrival of Farm Manager M.R.Ry. A. V. Tirumuruganatham Pillai from the Central Farm, Coimbatore, on 12th November. Assistant Farm Manager C. V. Seshachari assisted in the management of the farm until 30th June 1914 when he was posted to District work in South Arcot with Palur as head-quarters. Two newly appointed Assistant Farm Managers K. Ramayya and K. Gopalakrishna Raju joined duty at Palur on 29th May and 1st June, respectively. K. Ramayya availed of leave on loss of pay from 17th July 1914 to 14th August 1914 when he was transferred to the establishment of the Government Economic Botanist. Gopalakrishna Raju who was relieved by Assistant Farm Manager N. V. Visvanatha Ayyar was transferred to Koilpatti farm on 31st October 1914.

ST. THOMAS' MOUNT.
26th May 1915.

R. THOMAS,
Dy. Director of Agr., Central Division.

APPENDIX III.

ADMINISTRATION REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST
FOR 1914-15.

I have the honour to submit herewith my report for the year ending March 31st, 1915.

2. I was in charge of the office during the whole of the year but the following members of the staff were granted privilege leave :—

Name.	Designation.	Period.
M.R.Ry. M. R. Ramaswami Sivan ...	Chief Assistant ...	1 month.
„ P. A. Subrahmanya Ayyar...	Assistant... ..	1 month and 16 days.
„ P. A. Raghunathaswami Ayyangar.	Assistant... ..	1 month.
„ K. S. Subrahmanya Ayyar...	Head clerk ...	2 months.
„ C. V. Iswara Ayyar... ..	Second clerk ...	3 months.

3. There are no changes to report in the personnel of the staff with the exception of that of the second clerk C. V. Iswara Ayyar who was deputed to act as second clerk for a period of six months in the office of the Deputy Director of Agriculture, Southern Division, Trichinopoly. During the interim a substitute was appointed to take his place.

4. The changes introduced by the revised curriculum of studies have had the effect of reducing the work in the Teaching section, and this will continue until the new third and fourth year classes are formed. No lectures were given in General Chemistry during the past year and as a consequence the Chief Assistant M.R.Ry. Ramaswami Sivan was deputed to give the lectures in Agricultural Chemistry which have hitherto been given by myself. At the Diploma Examination in Agricultural Chemistry held in March 1915, eighteen students presented themselves, and out of these eight passed in the first class and ten in the second class, and there were no failures or third-class passes. The tuition given by this assistant is excellent in character and great credit is due to him for the way in which he has carried out his duties during the year.

In conformity with the general scheme of lectures drawn up for the first year students I gave eleven lectures of a popular type on Agricultural Chemistry and sixteen lectures on Physics and Meteorology were given by the second assistant M.R.Ry. P. A. Subrahmanya Ayyar.

5. During the year under review the following samples were analysed and reported upon :—

Soils	...	...	...	...	...	...	...	147
Manures	...	...	...	...	...	...	...	26
Foodstuffs and fodders	...	...	...	...	...	...	...	30
Sugar-cane and cane products	...	...	...	...	...	...	...	1,631
Dairy products	...	...	...	...	...	...	...	495
Oil-seeds	...	...	...	...	...	...	...	27
Water	...	...	...	...	...	...	...	66
Miscellaneous	...	...	...	...	...	...	...	5
Total ...								2,427

This is decrease of 826 on the previous year's total but is accounted for by the fact that it was necessary, for over four months of the year, to take two assistants from routine analytical work and to allocate to them the work of the sugar-cane breeding station and the Guntur survey. In these circumstances it was only found possible to carry out a comparatively small amount of dairy work. Of the samples analysed only 115 were from ex-departmental sources but of these 53 were done on behalf of cultivators. A large proportion of the samples of water were received from the Kistna Delta in connection with an enquiry relating to the suitability of the water in certain drains for irrigation purposes.

6. The soil survey of the Guntur Delta is progressing rapidly and as only a very small number of samples await completion the final report will be available about the end of June 1915. Soil maps based on the analyses of the alternate samples were prepared for the Agricultural and Industrial Conference held in Madras in December last and those of the finished survey will not differ materially from them.

7. During the year a memoir was published dealing with the relationship between the gases present in paddy soil with the organized film found on the surface of the soil. It has been shown that the latter utilized the former in such a way as to lead to an increased amount of oxygen being available for root aeration, and as the gas mainly concerned is produced by

the decomposition of organic matter in the soil the connection between green-manuring and increased aeration of the roots has become apparent. At the same time it has been possible to place the theory of the effect of drainage on a firmer and more satisfactory basis.

8. The experiments instituted to elucidate the source of the gaseous nitrogen in paddy soil have been carried out over a period of several years and may now be said to be nearing completion. It has been shown that this gas only accumulates in quantity when there is a crop present in the soil and that the volume of the gas is largely dependent upon the presence of nitrogenous organic matter. Similar results are obtained when the crop is grown in sand in the presence of organic matter, whereas, when grown in sand in the presence of mineral manures only, no gas is produced although very good plants are raised. These results undoubtedly point to the source of the nitrogen being largely the organic matter present in the soil and manure and lead to the conclusion that the beneficial effect of green manuring lies chiefly in its biological and physical aspects and not in its direct manurial value.

9. A few years ago it was shown that the beneficial effect of drainage on paddy was closely associated with the production of a deeper root system and this observation has been followed up during the past year. In the experiments it has been found possible to induce deep root action, even when the effect of drainage is eliminated, and in every case this has led to increased cropping power. An attempt to apply this principle in actual field practice has failed owing to the unsuitability of the method adopted so that future experiments will be mainly concerned in finding a method suitable for practical application. Incidentally these experiments would appear to show that the toxic effect of decomposing green manure in badly drained soils has been overestimated.

10. The work connected with the carbon cycle in paddy soils is being continued but although very promising and most suggestive results have been obtained it is not possible at present to make any definite conclusions.

11. The study of the coliform bacteria associated with the bud-rot of cocoanut palms has been abandoned. Although these organisms probably accelerate the rate of rotting yet it has not been found possible to find any connection between them and the incidence of the disease. These results are entirely at variance with those of the investigations carried out in the West Indies, which make these bacteria the responsible agent, and it would therefore appear that in India the specific agent is the fungus.

12. Some further progress has been made with the compilation of data referring to the composition of South Indian footstuffs and fodders but not so much as one could wish owing to the urgency of other analytical work. The analytical data will however be added to as opportunity occurs.

13. During the year I spent 42 days on tour and the members of my staff a total of 115 days.

COIMBATORE,
28th April 1915.

W. H. HARRISON,
Government Agricultural Chemist.

APPENDIX IV.

ANNUAL REPORT OF THE GOVERNMENT ECONOMIC BOTANIST FOR 1914-15.

I have the honour to submit my annual report for the year 1914-15.

Staff.—I was in charge of the office throughout the year.

M.R.Ry. G. N. Rangaswami Ayyangar was confirmed as Assistant and Assistant Farm Manager, M.R.Ry. K. Ramayya was transferred from Palur as assistant on probation in the sub. *pro tem* post from 15th August 1914.

Fieldman, N.V. Viswanatha Ayyar was on sick leave from 19th August 1914 to 31st October 1914 when he was transferred to Palur as Assistant Farm Manager. Fieldman, P. V. Raghavendra Rao was granted privilege leave for six weeks.

The Storekeeper's post was abolished and two new posts of Plant Collector and Laboratory Attendant were created and filled.

Tour.—Provision had been made for extensive touring but it was found impossible to carry this out without neglecting important work at head quarters. The large number of different varieties of paddy under observation gave very considerable range in duration with the result that there was a constant supply of fresh material requiring examination daily.

My tours which were confined to paddy tracts amounted to forty full days and those of the staff to 18 days.

Crops.—As reported last year paddy was the main crop to receive attention and cotton was given as much time as possible without handicapping paddy work. This time, as had been

expected, proved to be too little for anything other than a definite restricted field of work as noted below.

Paddy.—Last year's selections provided a mass of extremely interesting material the examination of which kept the whole staff at work continuously for about four months.

The former surmise that extensive crossing takes place proved to be correct. Of the plants selected as variations from the type, 79 lots out of 171 were crosses and showed splitting for various characters. The material specially designed to show the amount of natural crossing at Coimbatore gave the following results which will be seen to vary with the variety:—

	Per cent.
Sadai Samba *	8.7
Swarnavari ... ..	.9
Dodda Birru Bhatta ... ..	.1

A line of Raskadam growing as a border to plots of other varieties showed crossing to the extent of 1.3 per cent., 2 per cent. and 1.5 per cent. for three different varieties respectively. Further material has been taken to show the amount of crossing at Samalkota and Palur.

In the crosses which, as above mentioned, gave splitting families the characters were examined with regard to their method of inheritance. Altogether a very large number of characters was involved of which many were simple and well marked. A preliminary account of some of these characters was given in a paper to the Indian Science Congress on "Some Mendelian characters of the paddy plant." Definite simple Mendelian ratios were obtained for thirteen well marked characters and considerable information recorded regarding more complex characters. A large amount of material has been taken for throwing further light on the latter next season.

The harvesting of small lots for the determination of the probable error in estimating yield was continued and the results were about the same as last year.

The total number of lots to be carried forward next year amounts to 610. Of these about 200 are for studying the inheritance of specially important economic characters, 200 for complex morphological characters, and 134 pure lines.

Last year mention was made of the desirability of taking up a new piece of land for paddy work and this year proposals were submitted and Government sanction obtained for the acquisition of about 17 acres of land for a paddy breeding station. As the full amount of money could not be provided in next year's budget, modified proposals, providing for an area just sufficient for next year's crop, were submitted.

Cotton.—On account of the limited amount of time available for cotton work it was decided to confine attention to Cambodia crosses and selections.

Last year's crosses of Cambodia with Bourbon and Spence grew well and in addition to being very productive gave a lint superior to either parent. Plants were selfed for next year's F_2 generation.

Crosses were made between Cambodia and an annual form of Bourbon, quite distinct from the Erode Bourbon mentioned above which is apparently identical with the Spence supplied by the Cotton Specialist.

The Cambodia single plant selections showed considerable variation in ginning percentage which varied from 31 to 36 per cent. Little other variation was found except for one lot which was splitting and obviously derived from a cross with Sea Island or a similar variety.

Botanical garden.—The planting up of the garden was continued and many fruit trees, ornamental trees and shrubs, borders, etc., were put in. A back entrance for carting purposes was made and a culvert built for this purpose. Irrigation facilities were further improved and a cement channel nearly 200 yards long was put in, which admits of the cotton plots being irrigated without the second lift which was necessary before.

About 400 young trees were distributed for planting on the estate in addition to many cuttings and ornamental plants. The pruning of trees on the estate was carried out by the garden staff.

Seed testing.—Germination tests, which were done before by the Lecturing Botanist's section were transferred to this section. During the year 88 tests were made for other offices in addition to those in connection with the keeping of paddy seed.

F. R. PARNELL,
Government Economic Botanist.

20th May 1915.

APPENDIX V.

ADMINISTRATION REPORT OF THE GOVERNMENT LECTURING BOTANIST
FOR 1914-15.

I have the honour to submit my annual report for the year 1914-15.

2. *Staff*.—The temporary establishment consisting of one assistant, one fieldman and one plant collector continued to work during the year. K. Chinnaswami Pillai who was permitted to take up an appointment in Ceylon was permanently transferred and Ramaswami Raju who entered service as temporary fieldman was made permanent on 1st October 1914. Jobitha Raj who acted for K. Chinnaswami Pillai was placed in temporary appointment from the 1st October 1914 and he continued therein till 5th November on which date he resigned. This place was lying vacant till the 8th January 1915 when K. Raghavachari an assistant farm manager was appointed and he continued in the said office till the end of the year.

3. *Leave*.—The chief assistant was on privilege leave for 21 days, the temporary assistant for 15 days and the temporary plant collector for 14 days during the year.

4. *Tours*.—I was on tour for 53 days in the districts of Chingleput, South Arcot, Salem, Coimbatore, Malabar and South Canara on botanical excursions accompanied by a plant collector and a fieldman. The temporary assistant and the plant collector visited Hassanur and Dhimbam ghats of the Satyamangalam taluk Kollimalais of Trichinopoly, and Golkonda of Vizagapatam and their tour lasted for about 60 days. Mr. Jivanna Rao, the teaching assistant, went on a collecting tour with a fieldman and a plant collector to the Kallakad hills in the Tinnevely district and was in camp for 17 days. The Artist went to Madras during the Christmas holidays for painting the water hyacinth (*Eichhornia speciosa*) for the Director of Agriculture.

5. *Teaching*.—The new course of studies came into force during the year and the first year students received instruction in accordance with the syllabus laid down. There were 28 classes for the first year students. The course in Agricultural Botany for the second year students of the old Diploma course consisted of the study of several crops, plant breeding, plant and its relation to environments, etc., and 57 lectures and 60 practical classes were held during the year for them.

6. The diploma examination was held in December and together with a student from the previous year 18 sat for the examination and 17 passed (2 in I class, 6 in II class, and 9 in III class) and one failed. In the botanical teaching of the college much stress is laid on the physiological aspect and students take much interest in all physiological experiments. But to make the teaching on these lines really interesting and useful an experimental plant house is absolutely necessary. Large number of both dry and spirit specimens have been secured for use in the laboratory and most of the physiological experiments were successfully conducted in the laboratory. A set of 100 weed seeds were prepared for the use of students and about 100 sheets of weeds were added to the collection for the same purpose. The relative weight of 1,000 seeds and the number of seeds in 1 lb. of seed sample for about 43 kinds of seeds of economic use were determined in the laboratory and the results were communicated to the Principal for the Agricultural note-book. Some specimens were prepared for the College Museum.

7. The Artist prepared 95 drawings of farm weeds and other plants and supplemented the collection of drawings in the laboratory and most of the drawings made were found useful for the Manual of Botany now in the press.

8. *Systematic Botany*.—The forwardal of specimens to Mr. Gamble was continued and 3,864 sheets (from *Heynea trijuga* to *Stylosanthes micronata*) from the herbarium were forwarded to Kew together with copies of Dr. Barber's drawings of parts of plants up to Ampelidæ and 39 paintings of Balsam. Further consignments of plants were stopped on receipt of a letter from Mr. Gamble asking not to forward specimens till the sea route is safe.

9. The tours made by the Government Lecturing Botanist and his staff resulted in a collection of about 2,000 specimens including also several fruit samples. During the year 2,746 sheets were mounted from the recent collections and 832 of Mr. Gamble's small sized specimens were mounted on standard sheets; of the sheets mounted 754 from the general collection and 832 of Mr. Gamble's were incorporated during the year.

10. The drawers in the large work table were provided with 800 small tin boxes and about 800 specimens of fruits were identified and arranged in them.

11. Mr. Fischer kindly sent about 70 specimens to the herbarium. Specimens of plants were identified for various correspondents as follows:—21 were identified for the Government Mycologist, 57 for Rev. Munch, 52 for Rev. Pflöiderer, 6 for the planting expert and 44 for

various other correspondents. Short notes were prepared in answer to the queries of various correspondents on *Berberis aristata*, *Albizia moluccana*, *Datura*, *Butsa*, *Marsilea*, *Ocimum viride* and different kinds of reeds used for mats.

12. A list of plants collected in the Kannothe range was prepared and forwarded to the District Forest Officer, North Malabar, at his request. The study of weeds of the Central Farm was completed and the idea of publishing descriptions as leaflets was given up as it would take a very long time to complete it. Instead of this it is proposed to publish the descriptions, etc., in the form of bulletins soon as the study of the weeds of the other farms is completed.

13. The chief assistant Mr. C. Tadulingam prepared a paper on the Madras Flora and read it before the Science Congress at Madras in January. The Government Lecturing Botanist and the Temporary Assistant also attended the Congress.

14. Hon'ble Mr. Cardew visited the Herbarium and the Laboratory during the year.

28th April 1915.

K. RANGACHARIAR,
Government Lecturing Botanist.

APPENDIX VI.

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR 1914-15.

Staff.—The Sericultural Fieldman's post was extended until the end of June 1915. Fieldman D. Ponnayya resigned his post in order to take up an appointment under the Fisheries Department and C. K. Subrahmanyam at that time second clerk was appointed to succeed him.

2. *Tours.*—(i) The Government Entomologist was 76 days on tour in Bellary, Kurnool, Salem, Kollegal, Tiruppur and Mettupalayam. He also visited Pusa to attend the conference of entomologists from various provinces.

(ii) First Assistant spent 89 days on tour in Ganjām, Salem, Kollegal and also accompanied the Government Entomologist to Pusa.

(iii) Second Assistant was on tour for 59 days in Bellary, Kurnool and Anantapur.

(iv) Third Assistant who was in camp during some days of every month was away from head quarters altogether 163 days. The districts visited were Malabar, Coimbatore, Salem and Chittoor.

(v) The fieldmen spent 189 days in camp in Bellary, Kurnool, South Arcot, Pudukkottai, Chittoor, Tinnevely, Salem and the Nilgiris.

3. *Leave.*—(i) First Assistant had privilege leave for 23 days, second Assistant for one month, head clerk for one month and 10 days and head artist for one month.

4. *General Work.*—(i) Only some 35 specimens were received during the year with requests for advice in dealing with insect pests. Demonstrations in methods of destroying insect pests of different kinds were given in Malabar, Kilacheri and Puduceri.

(ii) A big campaign was planned against the Deccan grasshopper but owing to a variety of causes it ended in failure. It may be noted at this point that in the year under review climatic conditions would appear very largely to have done the work of destruction contemplated by the section.

(iii) The problem of the destruction of the mango crop by mango hopper being acute, an experiment founded on the experience gained last year was conducted in the mango tope at Varagambady belonging to the Salem Zamindari. This experiment and demonstration was in every way most successful and a 75 per cent. crop should be assured to anyone using the methods advised. Thanks are due to Mr. E. B. Stevenson, C.I.E., Agent of the Salem Zamindari, for the invaluable assistance given during the experiments in mango hopper control.

(iv) The fish oil soap made by the Fisheries Department was found most useful in this work.

(v) Another success has been the ascendancy which has been established over the mosquitoes on the Agricultural College estate at Coimbatore. The success is not absolute, for it is impossible entirely to eradicate all mosquitoes from the place and the presence of an extremely dirty village tucked into one corner of the estate somewhat prejudices the chances of more complete freedom being attained.

(vi) A prolonged experiment was undertaken to test the efficacy of light traps for checking the paddy stem borer. Though the experiment at the time of writing is not completed, everything points to the fact that some other means must be sought for combating this most serious pest.

(vii) A series of experiments was undertaken and is still in progress at the Government sugarcane farm at Chettipalayam with a view to testing various methods of preventing damage to cane setts by termites.

(viii) In addition to the above various insecticides have been tried but no very startling discoveries have been made.

(ix) Control of pests through baits is indicated as one of the chief factors in Economic Entomology of the future and a certain amount of work on those lines has been done in the present year.

5. *Laboratory and Insectary work.*—(i) The general collection has been added to and the work of reducing the various specimens to order has gone on steadily under the charge of the First Assistant.

(ii) Various insects have been named by the Imperial Bureau of Entomology and the Imperial Entomologist, Pusa, and a collection of Rhyncota very kindly presented by Dr. Campbell of the London Mission. To these gentlemen and to the Director of the Imperial Bureau thanks are due for their assistance.

(iii) In the Insectary the following life histories have been studied :—

Cholam bug, *Calocoris Angustatus* (Complete †)

Cholam bug, *Megacoelum Stramineum*. (Complete. †)

Small unnamed capsid on Cholam. (Partially worked out. †)

Pundaluoya simplicia. (Nearly complete.)

Cholam anthomyiid fly

* Cumbu and Panivaragu } (Complete. †)

anthomyiid fly.

* Anthomyiid on rotting fruit. (Complete. †)

* *Cholam Cecidomyiid*. (Notes made. †)

* *Cumbu Cecidomyiid*. (Notes made. †)

* *Paddy Cecidomyiid*. (Notes made. †)

(Anikombu.)

Cotton Aphis. (Notes.)

Parasa lepida, slug caterpillar. (Complete life history worked out. Already done in Ceylon.)

Parasites and predators of above. (Notes.)

Several parasites on various sp. Read and noted.

Paddy stem borer. (*Schoenobius bipunctifer*.) (Study unsuccessful.)

Amsacta spp. Kumbliipuchi (Breeding Experiments.)

Eupterota mollifera. (Complete.)

Adisura atkinsoni. (Complete.)

In addition to the above observations were made on various sp. including a flea * beetle on panivaragu, erotylid * on thenai, *sthenias grisator*, the twig girdling beetle, *sitotroga cerealilla*, bruchids affecting pods in the field and others. The "Cholam," "Cumbu", and "Tomato" flies were until recently regarded as one species.

6. *Pests during the year.*—(i) The pests which have been chiefly complained of during the year under review are the paddy grasshopper (*hieroglyphus banian*), paddy stem borer (*schoenobius bipunctifer*) and ansikombu disease in paddy. Swarming caterpillars were responsible for some damage in the Nilgiris and Malabar. Hairy caterpillars (*amsacta* sp.) and grasshoppers were also complained of in the southern districts of the Presidency.

(ii) In addition to the new pests noted above a Scolytid beetle has been reported from the Godavari and Negapatam attacking and killing coconut trees.

7. *Publications.*—The following articles have been written by the section :—

(i) Life history of *Calocoris angustatus*, with coloured plate, note of a species of *Fatua* attacking thenai on the Central Farm, Coimbatore, Leaflet on the paddy grasshopper. In addition the First Assistant contributed a note to the Bombay Natural History Journal on the damage done by the moon moth (*actias selene*) to trees in the college compound and the Second Assistant replied to and corrected certain inaccuracies which appeared in an entomological contribution to the Journal of the Madras Students' Union.

8. During the present year the silk work has been concentrated in one village near Kollegal. Disease free seed was raised and sold to the ryots with a guarantee of its fitness. The subsequent rearing was carefully watched and advice given when needed. The results from this brood were good. There was some demand for these cocoons, Rs. 2-8-0 per 1,000 being paid, as much as one rupee above the usual market price. This was an encouraging sign showing that good stock will be bought if it is to be had.

(ii) Out of 38,000 diseased seeds found in seed examined by the sericultural fieldman 29,500 were found to be suffering from pebrine. These seeds were nearly all bought from Mysore dealers and these figures show how pebrine is being disseminated through the villages and threatening the existence of the industry.

* These insects are as far as is known reported as pests for the first time.

† New work.

(iii) Many visitors came to the rearing shed and in time a marked improvement should be made in the methods of sericulture in the village in which it is situated.

(iv) The original idea was for the shed to be in the taluk compound in Kollegal with a mulberry garden of its own near by. However after an outbreak of fire in the rearing shed the taluk compound was judged to be unsuitable. The remains of the burnt shed were abandoned and another rearing shed taken in Dodinduvadi which so far has suffered no mishap.

(v) Much assistance in sericultural work has been received from the Tahsildar of Kollegal, M. R. Ry. Nageswara Ayyar, who has been most helpful.

(vi) Experiments were made with univoltine eggs from France but without success. These will probably be tried again under different conditions.

9. *Teaching.*—Lectures were given by the Government Entomologist to the first year students under the new curriculum in Zoology and Entomology while the First Assistant lectured to the second year under the old scheme.

(ii) The artists were employed to prepare large coloured diagrams of insects for the use in lectures.

1st May 1915.

E. BALLARD,
Government Entomologist.

APPENDIX VII.

ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR 1914-15.

I have the honour to submit my annual report for the year ending 31st March 1915.

2. I was in charge throughout the year. The laboratory staff was strengthened by the addition of a junior assistant sanctioned in G.O. No 226, Revenue, dated 7th August 1914, and he joined on the 28th of November. The two vacant fieldmen's posts were filled in November and both men seem to be of the right stamp. Six temporary fieldmen were appointed for three months during the monsoon for conducting spraying work against Mahali disease on arec-nuts in Malabar and South Canara. The posts of head artist and second artist were filled by men from the School of Arts.

3. The Second Assistant was on Medical leave twice for periods of one month and eleven days and six weeks. The two clerks had privilege leave for periods of two weeks and eighteen days respectively.

4. I was on tour for 107 days, the First Assistant for 127 days, the Second Assistant for 142 days, the Third Assistant for 19 days, the fieldman who was on duty throughout the year for 147 days and the Plant collector for 109 days. During the spraying season the Laboratory Attendant was also out for 90 days. Touring was done in the districts of Gōdāvari, Kistna, Guntūr, Kurnool, Tinnevely, Salem, Coimbatore, Malabar, South Canara and the State of Cochin.

5. The bud-rot of palmyras and coconut palms was kept under observation. During the operations in Gōdāvari district the number of dead trees cut and burned was 28,709 while the number of infected trees operated on was 34,497, of which less than 1,000 died subsequently. In Kistna district the number of dead trees cut and burned was 3,204 while the number of infected trees operated on was 2,755, of which a very few have died subsequently.

In addition to these numbers more diseased trees have been found by examining all the larger trees in the infected parts of certain villages in which the disease is severe. This is a result of the experience gained in the isolated infected area of about 1,000 acres around Chikkala in Kistna district. There all the palmyras were examined by the special staff by stripping off from 10 to 15 leaf bases to detect the disease-spots. By the end of last year the palms wanted by the ryots for tapping had been examined and by the end of June of this year the other large trees (except 500 reserved by the owners for their leaves) had been examined. In all 20,831 trees were dealt with and of these 1,265 were found to have disease though they had not shown any outward symptoms. This proportion was so high that the method was extended to other villages and during the rest of the year in Kistna district 127,769 trees were examined and 9,193 of such cases were found and dealt with. This number is about one and a half times the number dealt with in the ordinary course of the operations in Kistna district. Similar work is being done in Gōdāvari district with like results. The disease is thus being dealt with much more intensively than ever before.

6. As a result of the patrol of the five-mile belt in the uplands round the infected area of Gōdāvari a small outbreak in a village near the coast beyond the known limit was discovered and dealt with.

7. A coliform bacillus isolated from the soft rotting parts of coconut and palmyra palms attacked by bud-rot did not produce any form of rot when injected in culture solution into

the interior of the buds of young coconut palms. This bacillus does not produce a bud-rot. The work was done in conjunction with the Government Agricultural Chemist.

8. The inoculations on coconut and palmyra palms of pure cultures of *Pythium palmivorum* Bult. were repeated and the results confirm last year's experiments. Butler's fungus is the cause of the bud-rot disease and the coliform bacillus in India does not itself produce the disease, though it may have some effect in hastening the putrefaction of the bud of a dead palm.

9. In Malabar district this disease on coconut palms seems to be widespread but only a few palms are infected in the villages examined and nowhere are trees being destroyed wholesale. Only 1,306 diseased palms were discovered by the special staff.

10. The investigation of a new disease of coconut palms that occurs on the West Coast was begun and the Forest Department has kindly put a plot of coconut palms at my disposal for inoculation work regarding it.

11. The demonstration of spraying areca-nuts with Bordeaux mixture as a preventive against the Mahali disease caused by *Phytophthora omnivora* var *arecae* in the infected parts of Malabar and South Canara was again undertaken. More garden owners are interesting themselves in this method of prevention and are becoming more confident in the efficacy of the operation. One garden owner sprayed 5,500 trees entirely at his own expense. Seven sprayers were sold and the fruit bunches of over 29,000 trees were sprayed. The disease was slight this year in the villages in which this work was begun three years ago but is now severe on the coast region. In Hanaar where the gardens are dependent on labour from the coast the work was brought to a stand-still for lack of coolies.

11-A. A fungus on paddy (probably an *Ephelis*) which transforms the loose panicle into a solid carbonaceous spike was brought into pure culture and its biology was studied. Fieldwork will be begun in the coming season.

12. A fruit rot of chillies caused by *Vermicularia capsici* Syd. has almost been worked out.

A bacterium isolated from a black rot of plantains gave no results when inoculated into young plantain shoots.

13. From outside 36 bundles of specimens were received for identification of and advice regarding diseases and 21 applications were made for investigating diseases on crops. Fifty-nine specimens were sent to Herr Sydow for identification and 14 specimens of new fungi were sent to Pusa.

14. A three months' course on plant diseases was given to the students in the last term of the second year. As in the previous year it comprised a study of the life history of a few fungi and of the effects of fungi on their host plants with special reference to the diseases of the more important crops of the Presidency along with a study of the application of preventive measures. At the final examination 17 students presented themselves, of whom nine were placed in the first-class, seven in the second and one in the third. Dr. L. C. Coleman, Director of Agriculture, Mysore State, was the external examiner. The first year students under the revised syllabus also had six demonstrations.

WILLIAM Mc'RAE,
Government Mycologist.

30th April 1915.

APPENDIX VIII.

ADMINISTRATION REPORT OF THE GOVERNMENT SUGARCANE EXPERT FOR 1914-15.

I have the honour to forward the following report of the work done on the Sugarcane Breeding Station during its second year, April 1914-March 31, 1915.

2. I was on combined leave and deputation for 195 days (April 17-October 29) in England, during which time my Botanical Assistant, M.R.Ry. T. S. Venkataraman, was in charge. The Chemical Assistant was on privilege leave for 19 days. A new clerk and artist were appointed during the year and the staff was strengthened by the addition of a new Botanical Assistant, fieldman, plant collector and peon.

3. After my return, I was on tour for 88 days, visiting the Central Provinces and Shahjahanpur in December, and Bengal and Assam in February April. Besides studying sugarcane on the various farms and making excursions into the ryots' fields, I visited the pioneer undertakings near Sindewahi in the Central Provinces and in Kamrup in Assam.

A fieldman and plant collector were in North India for 54 days taking measurements of growing canes and my head peon (since raised to the position of plant collector) was in charge of the arrows at Hebbal for 61 days.

4. The land allocated for cane growing has been heavily dressed with municipal rubbish and tank silt, while madar (*Calotropis gigantea*) has been dug in or crops of green dressing added. For the latter purpose, *Dolichos Lablab* appears to be the most satisfactory on the salt land, and the crop dug in on some fields was as large as 8 tons per acre. The effect of similar treatment in the previous year has been seen in a general improvement of the canes grown. The North Indian canes have become green and healthy and appear now to be thoroughly at home, while the thicker canes have also done much better than before. The road from the Central Farm to the Cane Breeding station has been improved in various ways and has greatly added to the efficiency of the station. The sweet water well has been cleaned and revetted. The rainfall was 24.24", an increase of 6 inches over that in the previous year. Its distribution was not however very good, as the crops suffered a good deal during July and August from drought and the unusual falls of over two inches in January and March did a certain amount of damage. The general result, however, is that the water level is higher than in last year and it is hoped that the well, which is always heavily taxed at this time of year, will hold out until the early monsoon rains relieve it. No use has been made of the Government permission to have the Chitrachavadi water channel turned on for the benefit of the farm.

One package of canes was received from the United States, and numerous varieties were collected by the Government Sugarcane Expert while on tour. Some 150 packages of canes were sent out to different parts of India. There are now nine Madras seedlings being grown in three places in North India for observation purposes.

5. The general planting of the cane varieties and selected seedlings of previous years was completed very late last year, many of the plots not being sown till June. This is undesirable, for to escape the heavy storms of April and May and to save excessive demands on the well during the dry weather, the canes should be reaped by the end of March, that is, planted in February. An attempt has been made to correct this, and all the plots of varieties and selected seedlings (numbering some 800 plots) have already been planted and labelled. It is intended to plant in February next year and thus fall into line with the local practice.

One of the reasons for this late planting is that the cane requires at least a year to mature, and the planting out of seedlings is strictly limited by the arrowing season. The latter occurs between October and December, and the seedlings are not big enough to plant out until April-May and do not mature till rather later in the following year. Those selected for propagation cannot be planted before April to July at the earliest and some are later than this. I propose therefore to replant all selected seedlings each year by taking cuttings from the half grown plants in February and thus, so to speak, forcibly bring their maturing into line with the rest of the canes grown. This will mean the duplication of the selected seedling plots (carrying with it chemical analyses of the canes) in each year, and will involve an addition of some 200 to the already large number. The change will, however, have this additional advantage, that it will be possible to distribute such as are chosen for North India at a time when they can be planted successfully there. Last year, seedlings were sent up in June, an entirely unsuitable time, and these have not as yet matured sufficiently for us to judge as to their behaviour in the north.

6. Besides the general crop of varieties and the previous years' selected seedlings, the current year's harvest of new seedlings appears to be late, so late in fact that we cannot, as we did last year, forecast their character. This lateness has nothing to do with the time of planting, for that is uniform each year, but is probably caused by the heavy and unseasonable rains of January and March, at a time when the cane is usually rapidly ripening. The parents of these seedlings were, as a whole, of a better class than those used in the previous year and we have, therefore, some reason to hope that we shall have a better series all through.

Altogether 2,392 chemical cane analyses were made during the past twelve months, and I have pleasure in recording my indebtedness to the Government Agricultural Chemist for his continued assistance in this matter, nearly half of the year's analyses having been made by his staff.

Of the seedlings selected for further growth, 61 had over 17 per cent. of sucrose in the juice, 37 over 18 per cent., 8 over 19 per cent., and 2 over 20 per cent.

A good deal of work has been done in collecting existing analyses of different parents in various parts of India and a number of curves have been prepared to give us data as to what class of juice to expect from the seedlings of any given cane or combination of canes.

7. Although it is not safe to dogmatise, there are indications that we can draw certain conclusions regarding the behaviour of our seedlings, during the first year or two, when planted out under ordinary crop conditions. The seedlings when first taken from the nursery and planted in the field are put into specially prepared holes and accorded very good treatment. They respond to this and show very remarkable vigour. One case is recorded of a seedling producing 147 mature canes, 16 months after sowing the seed. When, however, they are cut up and planted for the second year in ordinary trenches, they are far less vigorous, but there is often a converse improvement in the quality of the juice. This increase in richness of juice appears to be maintained during the third year.

A further not altogether unexpected change has been noted during the present season when some of the seedlings have been planted for the first time on the Central Farm wet or paddy land. Here, again, there appears to be a further improvement in the quality of the juice, sometimes to a very considerable degree.

These facts, taken together seem to justify the assumption that the chemical analysis of a new seedling does not overestimate the ultimate quality of its juice, while there is certain to be a very marked falling off in its vigour. An effort will be made during the present year to equalise matters, by treating the new seedlings less favourably and giving those planted out under crop conditions larger doses of manure. It is undesirable that the character of seedlings should change to any great extent, as this delays the selection work.

8. Hitherto, there has been little flowering of the canes on the cane breeding station probably owing to the fact that the canes themselves did not grow well, before the land had been got into order. This entailed a considerable amount of labour in that the flowering shoots or "arrows" had to be brought from villages within a radius of ten miles round the farm. Various expedients were accordingly adopted to induce the canes to produce flowers at the farm and a series of "arrowing plots" were put down last year. Canes were also planted under the more normal conditions of the Central Farm wet lands, on a piece of ground kindly placed at my disposal by Mr. Wood, and others were distributed to Samalkota and Taliparamba farms. A good measure of success has attended these efforts, and it was not necessary to collect a single arrow from any village during the season; the arrowing plots were a mass of flowers, and a useful series was also obtained from the Central Farm. The canes also flowered freely at Taliparamba and to a less extent at Samalkota. Added to this, arrows of certain varieties were obtained, as in the previous year, from Dr. Coleman at Bangalore.

One Hundred and twenty-six cages were placed for arrows, 46 crosses were attempted, 280 pans of seedlings were planted and over 23,000 seedlings were raised. The parentage of these seedlings was much more varied than in previous years and, on the whole, the class of parent showed a further general improvement. In one respect our results have, however, been disappointing. Although 12 North Indian canes were induced to flower, some for the first time known, most of these flowers turned out to be in-fertile. The large series of attempted crosses between hardy Northern canes and rich Southern ones have not therefore produced much result. It is hoped that, as these Northern canes become better acclimatised to their novel conditions, the fertility of their flowers will likewise improve. A large proportion of the better varieties among them have now been planted in the arrowing plots and the paddy lands.

9. Special studies were made in various directions as time permitted. Considerable progress was made in the study of the Morphology of seedling canes. A large number of analyses was made, by the Chemical Assistant, of the canes growing on salt lands and certain marked peculiarities in their juice were noted. Sugarcane pollen received a large amount of attention during the short arrowing season, and arrangements were perfected for sending the pollen of arrows from place to place and thus to cross canes at a distance. The depressed habit of certain seedlings was studied as well as the erectness of the young shoots of the different varieties grown on the farm. As a result of a series of sowings, the vitality of cane seed was found to be greater than previously supposed. The Government Entomologist, desiring to make experiments with a view to checking the ravages of white ants, a number of plots were prepared for him from time to time. A series of experiments were made with charcoal, wood and saw dust for the packing and preserving of canes, tins being opened fortnightly for a period of two months; and a number of other pieces of work of greater or less importance were commenced.

The following papers were prepared by the Government Sugarcane Expert during the year, all but the last, which is preliminary, being printed:—

Studies in Indian sugarcane.—1. The Punjab canes—Memoirs of the Indian Agricultural Department.

The sugarcane in India.—International Congress of Tropical Agriculture, London, June 1914.

The classification of Indian sugarcane.—International Congress of Tropical Agriculture, London, June 1914.

Some difficulties in the improvement of Indian sugarcane.—Annals of Applied Biology, January 1915.

Sugar and the sugarcane.—The opening address before the Botanical section of the Madras Science Congress, January 1915.—A somewhat abbreviated form of this address will be printed in the Agricultural Journal of India, July 1915.

The Depressed habit of the sugarcane.—A preliminary note read before the Madras Science Congress in conjunction with M.R.Ry. T. S. Venkataraman, Botanical Assistant.

10. I have, in conclusion, to record my appreciation of the work done by the staff during the year, especially in the scientific section where a good deal of independent observation is being commenced by my assistants.

C. A. BARBER,

Government Sugarcane Expert.

29th April 1915.

APPENDIX IX.

(i)

REPORT BY MR. H. C. WILSON, PISCICULTURAL EXPERT, ON INLAND
PISCICULTURE IN MADRAS PRESIDENCY, 1914-15.

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2. I was in charge of the piscicultural operations during the year under report as Piscicultural Expert and was engaged on tours of inspection and special investigations.

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5. *Sunkesula Fish Farm.*

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The general work at the farm progressed satisfactorily and a large head of fish was secured and kept in the several farm ponds for stocking purposes; but unfortunately owing to the breaching of Tangadencha tank three times, the stocking of Kurnool-Cuddapah Canal was not possible for want of sufficient water and hence only the first 20 miles was stocked. It may however be remarked that the breaching of the Tangadencha tank will have a most deleterious effect on the fishery of the canal for a few years to come. This tank which never ran dry contained a lot of good breeders and the canal was replenished every year with fish from this source. To make good this loss will mean the re-stocking of Tangadencha from Sunkesula for many years. Many thousands of murrel fry, etc., were however removed from the farm and turned out into the Edurur Swamp for growing purposes.

The new and valuable larvicide "*Polyacanthus cupanus*" referred to in my last year's annual report have since bred in the farm. A portion of the Hindri river close to the Kurnool Collector's bungalow and the Markapur tank were stocked with this useful larvicide.

Another interesting item of work done at the farm was the introduction of tench (*Tinca vilgaris*). A small consignment of tench and the English carp were brought from the Nilgiris and turned out into the breeding ponds.

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7. *Hilsa Hatchery.*—During the year under report my Sub-Assistant went to the Lower Anicut to attend to this. He waited for several days and though almost all female hilsa caught were in a gravid state not a single ripe one could be had. As the water in the river went low and there were no further runs of fish, the hatchery work was closed for the year.

8. *Stocking of Tanks and Canals.*

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Daroji tank in the Bellary district and the Markapur tank in the Kurnool district were stocked with fish from the farm in September and October last respectively; the latter tank, however, was again stocked in December with carp and mosquito larvicides.

Besides the above two tanks another tank which holds permanent water, viz., Peddamentrala in Markapur taluk of the Kurnool district was also stocked.

10. *Nellore Fishery.*

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The site selected is in the bed of "Ippur" tank about 11 miles from Venkatachellam station on the Madras and Southern Mahratta line. The water is supplied by an open channel from "Survapelli" tank and the Public Works Department records show that the water-supply in this tank, if carefully guarded, should not fail to supply the fishery excepting in years of great drought.

The construction of a well has been provided for and a small pumping plant to insure against the above danger and for other necessary work. The plans of the fishery and buildings have been perused by the Public Works Department and the works sanctioned by Government in G.O. No. 2997, dated 14th October 1914.

The work is now in the hands of the Executive Engineer of Nellore and will be completed this year.

11. In July I inspected several wells in Tondiarpet, Madras, with Captain Hodgson, I.M.S., in connection with the anti-malarial operations. Many of the wells that had been stocked with larvicides, were examined and found absolutely devoid of mosquito larvæ.

The danger of the present method of stocking with fish larvicides was pointed out to Captain Hodgson, viz., the liability of introducing eggs of predaceous fish with the larvicides.

The present system of gathering the small fish from surrounding ponds is an exceedingly bad method and it is almost a certainty that eggs of predaceous fish, especially the floating eggs of the Ophiocephalidae family, will be accidentally carried.

In some of the wells visited which had been already stocked, we found the small fish larvicides had all disappeared and it was evident that some predaceous fish had been introduced.

On completion of the larvicide farm at Nellore the small fish can be sent for stocking purposes free of all this danger.

12. *Acclimatisation of tench.*—With reference to G.O. No. 1601, Revenue, dated 3rd June 1914, sanctioning the above scheme, a consignment of tench was brought from the Nilgiris in February last and turned out into "Jeejur tank" and another small tank close to Mattigiri near Hosur; as mentioned under "Sunkesula Fish Farm" a small consignment of tench was put in one of the ponds of the fish farm at Sunkesula. The result of the experiment will be reported to Government in due course.

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15. *Nilgiris.*—In May the streams of the Nilgiris were inspected to decide the opening date of trout fishing and the same month the following rivers were restocked with large trout from the reserve stream in Parson's valley, viz., Pykara (upper reaches), Krurmond, Meemund below falls, Kondah river below McIver's bund and Billiter Halla.

16. *Acclimatisation and introduction of live fish food to the Nilgiris.*—In September a valuable consignment of live fish food was brought from the Moyar river near Torapalli to the fish ponds and river at Pykara.

The same month the following new streams were stocked with trout, viz., Tiah Shola stream (Kondas), waterfall stream, Piermede stream, and Bangi tapal stream.

The supply of eggs at the Avalanche hatchery was fairly good and trout were kept for transhipment to the Travancore ranges, etc. The rivers are fully stocked with trout and some very large fish have been seen.

A consignment of tench was sent to Wellington to restock the lake.

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18. During the year under report the Cauvery and the Coleroon fisheries have been taken over by Government paying the District Boards concerned a fixed annual compensation. To improve this fishery it is absolutely necessary to prevent the wholesale indiscriminate slaughter of fish which takes place during the annual fish drive in the Cauvery near Hoginkal (Salem district) as well as dynamiting, etc. With the help of the Collector of the District as well as the District Forest Officer the annual fish drive has been put an end to during the last four or five years, besides dynamiting as well as other illegal methods of capturing fish. Through the co-operation of the District Forest Officer, Salem, fishing licenses will be issued for a nominal fee for capturing fish in the river within the forest boundary and the size of mesh of the nets used will also be regulated.

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21. *Miscellaneous.*—During the year under report correspondence with the Public Works Department has enabled us to compile a list of all the tanks in this Presidency which contain more or less permanent water. These will be inspected as time permits and methods adopted to improve their fisheries and take them over to our department.

Many municipalities were advised as to the best fish larvicides to stock their waters with, but the request of some to be supplied with a stock of larvicides could not be complied with until the "Ippur" fish farm is working.

(ii)

REPORT BY MR. JAMES HORNELL, F.L.S., MARINE ASSISTANT, ON
MARINE PISCICULTURE IN MADRAS PRESIDENCY
DURING 1914-15.

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Considerable advance was made, particularly in respect of fish-farming in backwaters.

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4. Tuticorin fish farm was completed in January 1915 and stocked with mullet, whiting (Sillage sihama) and other quick-growing backwater fishes. Hardly had this been done when an unseasonable and exceptionally heavy rainfall occurred throughout the Tinnevely district

entailing in the river villages very serious losses wherein the fish farm unfortunately participated to the full. A considerable portion of the palisading was damaged and could not be repaired till the floods subsided. The fish fry were scattered and stocking had to be undertaken a second time in March; we cannot therefore expect growth to be so satisfactory or the stock to be so large as it otherwise would have been had normal conditions prevailed in January. The work done has, nevertheless, already added largely to our knowledge of the fauna of the lagoon and of the life histories of several of its more important constituents. A very satisfactory feature is the great abundance of two of our most valuable Indian prawns. Not only do these species grow to a large size and form excellent eating, they also constitute a valuable bait for the line fishermen of the port. These men for years past have been handicapped by a shortage of this bait, so when I found that prawns were thriving greatly in the fish farm, it appeared obviously sounder economically to exploit this resource specifically for the benefit of these men than to dispose of the catches to the general public as food. Accordingly special store baskets were devised in which the catches made during each day are stored till the early morning of the succeeding day when the line fishermen come for their supply; this I hope to put right next season when more normal weather conditions may be expected to prevail than was the case during the past year.

5. The line fishermen greatly appreciate this boon of bait storage and supply. Hitherto it has been a common occurrence for them to be delayed unduly in the mornings as the lack of storage facilities meant that they had to wait the actual daily capture of prawns before they could get to sea; I have seen men sitting on the shore till 9 A.M. waiting for the prawners to catch a sufficiency of bait. Now they can usually get to sea by 6 A.M. as all they have to do is to go to the prawn store and buy what quantity they desire.

6. *Oysterculture*.—Growth of the stock on the beds at Pulicat proceeded most satisfactorily throughout 1914, and at the beginning of January 1915 they had recovered from the set back they annually receive during the ordinary rainy season of October and November. Unfortunately the exceptional and heavy rains which occurred towards the end of January and which, as already mentioned, occasioned ill effects in the Tuticorin fish farm, were equally well marked at Pulicat and this second flood of fresh water threw the oysters back two months in condition so much so that sales had to be suspended temporarily during February and March. Low salinity continued for an unduly long period after the floods subsided and indicates that a backwater with a relatively small area is preferable for oysterculture to one of much greater extent whenever the sea mouth of the latter is restricted in size.

7. *Pearl culture*.—Further steps have been taken towards the acquisition of the necessary site, the preparation of final plans, and the training of the Senior Operator.

8. The opportunity of pearl fishing in Palk Bay in August and September 1914 enabled a number of pearl inducing experiments to be tried; the requisitioning of the Inspection Schooner for war service at Madras brought these to an untimely end and for the present they are necessarily in abeyance.

9. The oysters fished in Palk Bay last year were remarkable for the frequent "smokiness" of colouration in a large proportion of the pearls produced. To some extent the nature of the shell shared in this peculiarity, due it would seem in some way, to the influence of the muddy environment in which these pearl oysters lived; instead of living attached to rocks and stones scattered over a clean sandy bottom as is the characteristic of the best pearl banks in the Gulf of Mannar, the Palk Bay oyster beds consist of a muddy sand, without rocks or stones, the oysters living attached to other bi-valves or to small dead shells.

10. Last year's observations furnish strong evidence that in the Palk Bay oyster beds we have discovered the source whence are periodically derived the spat which are necessary to re-populate the Ceylon and Tinnevely pearl banks. It is now eight years since the last Ceylon pearl fishery (1907) and as no deposits of spat have been found either there or on the Tinnevely beds in the interval, there was a strong presumption that the permanent breeding stock does not exist in the Gulf of Mannar but is located in Palk Bay; there is evidence that these latter beds although never before fished have been persistent for years, particularly one which has been located recently to the north-east of Rameswaram town.

11. Bottle drift experiments have been regularly carried on during the past year and enough material has now been collected to permit of conclusions being drawn. A report is now being prepared on the subject together with another showing in great detail the comparative statistics for the past three years of the fishing industry at Tuticorin selected as a typical East Coast centre. For the first time in the history of Indian fishery investigation the relative abundance and actual catch and value of all the important food fishes at the different seasons are tabulated, together with the different quantities taken respectively by each of the different methods of fishing practised at this port.

12. Two students, one sent by the Government of Baroda and the other by that of Travancore, were given courses of instruction in Marine pisciculture and in oysterculture during the course of the year.

Government of Madras.

REVENUE DEPARTMENT.

Recd. } *Enclosures*
 } 1915.
Reqa. } *Spare copies*

G.O. No. 1949, 26th August 1915.

Agricultural Department

Recording, with remarks, the report on the operations of the — during the year 1914-15.

GOVERNMENT OF MADRAS.
REVENUE DEPARTMENT.

READ—the following paper :—

**Proceedings of the Board of Revenue (R.S., Sur., L. Rds. and Agri.),
No. 215, dated 28th July 1915.**

The Hon'ble Mr. LL. E. BUCKLEY, I.C.S.,
Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.

The Board begs to submit to Government the report of the Director of Agriculture on the operations of the Department of Agriculture for the year 1914-15.

The most notable events of the year were the admission of twice the usual number of students to the Agriculture College as a result of the institution of the new courses, the holding of an Agricultural and Trade Conference in Madras in December 1914 and the receipt of the Secretary of State's sanction to the reorganization of the department. This last provides for seven divisions in the Presidency, the establishment of more district agricultural stations, the recruitment of a trained district staff in every district, the co-ordination of the prospects of assistants in the scientific sections at the College with those of men on the executive staff and a general improvement in the pay and prospects of most of the men in the service.

2. *Staff.*—Mr. Chadwick, I.C.S., was in charge of the office of the Director of Agriculture throughout the year. Mr. Hilson, deputy director of agriculture, northern division, was absent on six months' leave, Mr. Thomas, supernumerary deputy director, being in charge of the division during his absence. Mr. Sampson was single-handed in the southern division owing to the transfer of his assistant director to the northern division to replace the local assistant director who was posted to the agricultural College as assistant principal. Mr. Thomas was reposted to the southern division on Mr. Hilson's return from leave. Dr. Barber was away on leave for a little over six months, and M.R.Ry. T. S. Venkatarama Ayyar held charge of his office. Mr. Mehta's services were dispensed with on the termination of his probationary period at the close of the year.

3. *Buildings and laying out of agricultural stations.*—No new agricultural stations were opened during the year, but an additional area was obtained on lease for the Samalkota agricultural station, while a stretch of waste sand dunes was added to Hagari. Sanction was accorded to the construction of rooms for 40 more students at the college. It is not stated what progress has been made with the construction of these buildings and of the 19 more houses sanctioned for the residence of the employés at the College of Agriculture.

4. *Agricultural stations.*—During the year under report there were ten agricultural stations at work. They had their full share of the vicissitudes of the season. The more recent additions, Anakapalle and Sirvel suffered most, the former from a flood and a cyclone and the latter from a shortage in the supply of water due to a breach in the Kurnool-Cuddapah canal which cut off all supplies for the rest of the year. Notwithstanding this scarcity of water at Sirvel, it is satisfactory to note that the green manure crops proved a success, although the succeeding paddy crop died. This station has been primarily opened to demonstrate the value of green manure in the cultivation of paddy crops under the Velgodu project. In spite of the irregularities of the season, the Director remarks that some very good crops and useful results were obtained. The activities of the department during the year centred mainly on the selection of seed and of the best varieties of crops, the reduction of seed rate with a view to the economic transplantation of paddy, the use of manures and the method of dealing with the diseases affecting the palmyra palm in Gōdāvāri and Kistna and the cocoanut palm in Malabar. A concise summary of what the department has done during the year will be found in paragraph 57 of the Director's report.

Sugarcane.—The year under report showed a considerable expansion of work in connection with this crop especially in Vizagapatam where it was possible to make a beginning by the establishment of the Anakapalle agricultural station. In South Canara, the variety known as the Red Mauritius has now been established in 150 villages, the total area under it being 424 acres as compared with 194 in the previous year and 84 in the one previous to it. Iron crushing mills were unknown in the district six years ago but their use is now rapidly spreading. The cultivation of sugarcane is also reviving in Malabar under the stimulus of high prices. A start has been made in introducing improved furnaces into the Chittoor district, which should enable the raiyats to earn an increased profit of Rs. 15 in converting each acre of cane into jaggery.

Cotton.—Work on this crop was confined to the Tinnevely, Bellary and Kurnool districts. The progress of work in Tinnevely was particularly gratifying. There were 20,000 to 22,000 acres under departmental seed, which is more than double the area obtained in the previous year. In 1913-14 only three villages took the produce from departmental seed direct to the ginning firms without the intervention of middlemen and obtained their own seed back pure. In the year under report the number of these villages increased to 20. The Director anticipates very great possibilities in this system of joint sale both as a means of profit for the cultivator and as a means of spreading new types. The formation of co-operative societies to help this movement has not yet been possible. In the Ceded Districts also the progress was very satisfactory.

Paddy.—There continues to be a very keen demand in the neighbourhood of all the agricultural stations for the surplus seed which is always sold slightly above market rates—a clear index of the excellence of the departmental seed. The practice of reducing the seed rate continues to spread. For the first time since the agricultural department introduced the system of single seedling transplantation, complaint comes from portions of Shiyali and Mayavaram taluks that this system of transplantation affects the fertility of the soil after the first three years and it is reported that the raiyats in these parts are now transplanting seedlings in twos and threes. Even this means a considerable reduction in seed rate. The Director considers that if it had been possible to keep in these taluks the officers who started detailed work in the district in the first instance, no difficulty would have been experienced by the raiyats in obtaining green manure for the proper manuring of the fields said to be exhausted. It has been possible in the year under report to post a man once again in these two taluks, and consequently there has been a much larger sale of green manure seed than was anticipated. The Director observes that in all these operations the importance of preparing the seed-bed carefully in the first instance and sowing it thinly has to be borne in mind. It is possible that the difficulties in Shiyali and Mayavaram may have been due to seed-beds not having been thinly sown.

Green manuring.—This important branch of the agricultural department's work was highly successful in parts of Trichinopoly and in the Sholavandan circle of the Madura district. In the Madura circle work did not progress so well as in Sholavandan, mainly because the area was larger and there was a change of officers. In Malabar the cow-peas were grown for green manure although they were adversely affected by the absence of the rain in April-May. It is satisfactory to note that daincha is getting a start around Mangalore.

Palm disease.—The altered method of combating this disease in Kistna and Gōdāvari referred to in the last year's review has been persevered with. Under this method, not only are dead and diseased trees operated upon but a system of examining all the trees in the infected area has been introduced first in Kistna and then extended to Gōdāvari. Although this is a large undertaking, it is calculated to produce more satisfactory results than any previously obtained, as is evidenced by the fact that at the end of the year 27 villages in Kistna were removed from the infected list. As remarked last year the disease affecting the cocoanuts in Malabar, though widespread, is not so virulent. In view of this fact and the fact that the methods of dealing with the disease have been amply demonstrated to the raiyats, it is in contemplation to withdraw altogether from these operations in Malabar.

5. The above is a brief retrospect of the work done in the districts. But a very great deal of exceedingly useful work is being done in the scientific sections at the College. Mr. Harrison's investigations on the effect of green manure crops on paddy deserve particular mention, as also the completion by him of the soil survey of the delta portion of the Guntūr district.

6. *Sugarcane breeding station.*—Very careful work has been going on at this station. Some 150 packages of selected cane were sent to the stations in Northern India. These included some Madras seedlings which were sent specially for observation purposes. The analysis of last year's seedlings shows that 61 of the Madras seedlings gave over 17 per cent. sucrose, 37 over 18 per cent., 8 over 19 per cent. and 2 over 20 per cent. The Director observes that these figures are very satisfactory because the sucrose contents of some of the best varieties of recently imported canes ranged between 16 and 20 per cent.

7. *Agricultural instruction at the College of Agriculture.*—The year was noticeable for the introduction on the 7th June 1914 of the revised curriculum already referred to. Under this, instruction in the first two years is devoted mainly to general agriculture and its allied occupations such as dairying, cattle feeding and rearing, care of implements, etc. It is possible to take in ordinarily 40 students a year for this course. Those who wish to prosecute their studies further may be taken for an additional 18 months' course devoted mainly to the sciences as applied to agriculture. As a fact, 42 students were admitted. The year thus opened with a total strength of 74 in the college and closed with 70 in residence. The spread of improved methods of agriculture has been hitherto impeded by lack of qualified men in the department. Under the new scheme now in force at the College, the department will have a much larger annual supply of qualified men to carry on its labours and those of them who are not absorbed in the department will revert to their own farms and will, it is hoped, become centres of influence for the propagation of improved agricultural methods. Fifteen students went up for the diploma examination and all of them were successful.

8. *Agricultural associations and exhibitions.*—Of the old district associations Ganjām continues to do good work as also Coimbatore and Madura. The village associations in Malabar, about 25 in number, have also done well. Five co-operative agricultural societies have been formed for the joint purchase of manure, etc., but most of them have not as yet had a full year's work so that it is premature to express any opinion about them. Cattle shows were held at Ongole, Tiruppur and Madura.

9. *Meteorology.*—The rainfall registered at the various rain-gauge stations in the Presidency was tabulated as usual and the results were published by the Meteorologist, Madras, and the Deputy Director of the Madras Observatory. The total number of rain-recording stations in the Presidency at the end of the official year 1914-15 was 477 inclusive of 83 in the Native States and Coorg against 475 at the end of the previous year. Of these 388 were inspected during the year.

10. *Statistics.*—The following returns were published in connection with local enquiries under provincial direction: (i) monthly season reports in three sections, rainfall, cultivation and prices of food-grains and salt, and (ii) two half-yearly reports of cattle mortality.

11. The year has been one of undoubted progress both in the districts and at the college. The Board endorses the Director's appreciation of the work of the officers named by him, and desires to express also its recognition of the good work done generally throughout the department, a result of the hopefulness, energy and determination to succeed which characterize the Director.

(True Extract.)

T. RAGHAVIAH,
Secretary.

Order—No. 1949, Revenue, dated 26th August 1915.

Recorded.

Miscellaneous.

2. Mr. Chadwick's report contains a full and interesting narrative of the activities of the Agricultural Department and of the results achieved during the year 1914-15. The outstanding features of the period under review are summarised in paragraph 57 of the report and have been touched upon in the Board's Proceedings and the Government note with pleasure that there has been continued progress and development in several directions.

3. The introduction of the revised course of studies at the College and the reorganisation of the department have already formed the subject matter of separate press communiqués. These events mark the beginning of a new stage in the agricultural development of the Presidency and with the growth of the staff available for work in the districts a more rapid and widespread improvement in agricultural practices and methods may reasonably be anticipated.

4. The scientific sections at the College have, as usual, conducted important investigations and experiments and the Government are pleased to observe in particular that Mr. Harrison's researches on the gases emanating from paddy soils have earned for him the degree of D.Sc. from the University of Leeds.

5. The Government have once again to express their appreciation of the good work done generally by the Director and the other officers of the department.

(True Extract.)

L. DAVIDSON,
Secretary to Government.

To the Board of Revenue (Revenue Settlement).

„ Director of Industries (through Educational Department).

„ Honorary Director of Fisheries.

„ Educational, Local and Municipal, Public, Judicial and
Public Works Departments.

„ Agricultural Adviser to the Government of India.

Copy to the Government of India, Department of Revenue and Agriculture

„ „ Department of Commerce and Industry

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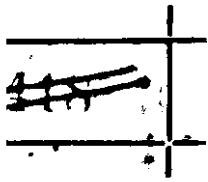
Editors' Table.

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Government of Madras



DEVELOPMENT DEPARTMENT



G.O. No. 1437, 30th October 1922

(7)

Agriculture—Administration Report—1921-22

*Read—Letter from R. D. Anstead, Esq., M.A., Officiating Director of Agriculture,
Madras, dated the 19th/30th August 1922, No. R.O.C. D-45-Pdl.*

In forwarding herewith the report of the operations of the Department of Agriculture for the year 1921-22, I have the honour to inform you that it has been compiled by my predecessor, Mr. H. C. Sampson, C.I.E., and that I have merely corrected the proofs and seen it through the Press. The sole credit of the report belongs to Mr. Sampson.

Order—No. 1437, Development, dated 30th October 1922.

Recorded.

2. By the death of Mr. G. A. D. Stuart, I.C.S., in August 1921, the Agricultural Department have lost a sympathetic administrator, and the Government one of their ablest officers. The year under report has witnessed further progress in the accepted policy of employing Indians in the higher branch of the Imperial Agricultural Service, Indians having been selected for all the seven appointments filled during the year. Of 21 posts in the Madras cadre of this service sanctioned and filled at the close of 1921-22, 11 were held by Europeans and 10 by Indians.

3. The financial difficulties under which the Province as a whole has been labouring are reflected in due degree in the Agricultural Department and must, it is to be feared, continue to retard its development, especially in respect of the adequate equipment of the department with buildings urgently required. Among pressing needs still to be satisfied are the provision of additional accommodation for the students and staff of the Agricultural College, Coimbatore, and the quarters for the Deputy Director, Northern Tracts, and his staff at Nandyal. It has been hitherto impossible to give effect to the strong recommendation of the Cotton Committee for the appointment of a special officer for want of accommodation. Of works for which it has been found possible to provide funds, progress has been made with the new Teaching College and quarters at Coimbatore, but the Government have noted with regret the slow advance in the sheds and other buildings at the Chintaladevi Cattle Farm, the want of which, it is reported, has been seriously detrimental to progress in achieving the objects of that scheme. It is, however, satisfactory to note that various works of lesser magnitude (including one of some importance—the Taliparamba Agricultural Middle School buildings) were executed by departmental agency with promptitude and economy.

4. The most important topics calling for notice under the head of Agricultural Education are the affiliation of the Agricultural College to the University and the reorganization of the college courses. The former step will, it is hoped, render the study of Agriculture more popular by enabling students to take up

the degree of B.Sc.Ag. of the Madras University. As regards the latter, it appears that the chief practical result of the changes introduced in 1920, by which the lower (or "certificate") course was entirely separated from the higher (or "diploma") course has been to deter men of the class which follows, or takes an interest in, practical agriculture from coming to the institution, while attracting to the diploma course the type of student of the literary class whose interest in the study of Agriculture is rather intellectual than practical. The changes since made have for their object (1) to throw open the higher (diploma) course to selected students who have been through the lower course, and (2) to constitute it an avenue to the Upper Subordinate and Provincial Agricultural Service.

5. Part III of the report deals with research and experiments and is of considerable interest, though the character of the season was to some extent unfavourable to the successful conduct of experiments. The work of paddy breeding, of evolving improved strains, has steadily continued and the results attained do credit to the Economic Botanist and his assistants. The Government note with special satisfaction that the merits of the new strains evolved are appreciated by the ryots: "not only," it is stated, "was all the seed available with the department rapidly taken up but many of those who tried them reserved their produce either for sale as seed or for extending their own areas under them." The experiments in the Gōdāvāri delta referred to in paragraph 55 of the report may, if successful, be of great importance to the district, as tending to solve the difficulties arising from the frequent shortage of water in the second crop season. The Government await with interest the result of the further investigations now in hand.

6. Under the head of Cotton Research, the investigations which have been made as to the causes of the large percentage of flower buds and immature bolls shed are of interest. In other respects the work on cotton pursued accepted lines and has yielded satisfactory results. In several centres improved strains and selections have been placed at the disposal of the ryots and have proved in several respects markedly superior to the ordinary strains.

7. As regards dry grains, special research may be said to have only just begun. The Millets Specialist has taken up his duties only from 25th November 1921. The importance of Sorghum (chulam or jonna) in extensive areas of the Presidency, especially in the Deccan districts where it forms a staple food for a large proportion of the population, is very great and the Government desires that special attention should be paid to this branch of the department's activities.

8. As regards coconuts, valuable information has been obtained at the Kasaragod coconut stations on the West Coast regarding the method of cultivation and improved methods for the manufacture of jaggery. The continued study of the coconut is fully justified by its economic importance. The Government note with interest that the Pomological station at Coonoor has been satisfactorily developed and bids fair to be of value in assisting the establishment of a regular fruit industry. They note also with satisfaction that a similar result may be hoped from the scientific cultivation of pineapples which has been inaugurated at Taliparamba. In this connexion they desire that the question may be investigated of utilizing for the cultivation of the pineapple a part of the Government Experimental Gardens at the foot of the Nilgiris near Kallar. Valuable work is being done at the Nanjanad Potato Farm in testing different varieties of potato and in affording a supply of seed to the cultivators of the district to whom the potato is of very great importance. There was a marked and satisfactory increase in the receipts of the farm from the sale of potato seed.

9. Under the head of Livestock, the difficulties arising from the absence of proper buildings at Chintaladevi, which is devoted to the cultivation of an improved strain of Ongole cattle, have already been referred to. The Government observe with regret that the attempt which has been made to improve the Madras milk supply by the importation of pedigree Ayrshire bulls has proved a failure. It must be admitted that the work of the department in this branch has

disappointed expectations and the Director, at the request of the Government, has investigated the whole subject and has submitted a revised programme of operations which is at present under consideration.

10. Under the head of Chemistry, the Government have read with interest the reference to the experiments which have been initiated by Doctor Norris in treating paddy straw, prickly-pear and other waste products with the object of producing "artificial farm yard manure." If a means can be found of utilizing prickly-pear, which, in many districts, constitutes a pest, the results may be of far-reaching importance and value.

11. It is to be regretted that lack of funds has prevented the starting of a new Central Sericultural Farm at Kollegal. Valuable results, however, have been achieved at the Coonoor Silk Farm in connexion with the breeding of improved silk worms, the introduction of improved methods of selecting cocoons for seed, of treating worms, and of reeling silk which have been very beneficial to the industry. The Government attach importance to the extension of the silk growing industry and have observed with the more satisfaction that it has been successfully introduced in the Bellary district. They desire that further efforts should be made in the ensuing year to foster it in other areas.

12. Not less important than the work of the department under research and agriculture are their activities in demonstration. As a considerable amount of misapprehension exists as to the methods adopted, which has given rise to some uninstructed criticism, a preliminary explanation seems desirable to indicate briefly what those methods are. At present the staff of demonstrators available is so small and the area to be covered so large, that visits to each village are out of the question. Each demonstrator is, as a rule, in charge of more than one taluk at present, and in all districts some taluks still remain untouched for want of staff. Demonstration to be of any effective value implies far more than a single visit to a village and merely talking to the ryots. Before the ryots will take up any new improvement advocated by the department, which they often look on as an unnecessary innovation and with a certain amount of suspicion often attributing false motives to what the department is trying to do for their benefit, the demonstrator must win their confidence by constant contact with them. This is especially the case at the beginning. An agricultural propagandist does not meet with a ready following as a rule. He must often visit a village many times before he can persuade a single ryot to promise to carry out an improvement, and must then pay more visits to see that this promise is translated into actuality, and after that still more visits to advise and supervise the operation if the ryot's interest is to be kept alive and the operation is to prove a success. Otherwise it will fail from apathy and neglect.

For these reasons it is necessary at present, unless a very much enlarged staff can be employed, to concentrate on comparatively small areas and few localities and actually get certain definite improvements adopted so that others can see them. The system aims at carrying out the demonstration on the ryot's own land and by his own labour or that of his employees, working under the guidance of the agricultural officers; he is thus in touch with the actual process from start to finish and the result is far more convincing to him than if the crop had been grown on a demonstration farm and not under his own eye and hand. Once they see an improvement a demonstrated success, neighbouring ryots and villages readily follow the example; knowledge spreads from these centres, and new centres and localities can then be tackled.

13. The object of these methods is mainly to convince the actual cultivator or farmer of the value of the improved methods of agriculture, etc., which are brought to his notice. Little has been done in the way of more extended propaganda directed to enlightening those who are not directly connected with the agriculture as to the activities of the department, the value of its methods and the results which it has achieved, although, under existing conditions, it is scarcely less important to convince the non-agricultural class of the utility of the department than it is to convince the agriculturists themselves. Much may be done by

way of shows and lectures to interest what may be called the politically minded class in the agricultural movement. The monthly digest of operations published by the department since January 1921 is a step in the right direction. The Government desire that greater attention should be paid to this aspect of the matter in future than has been done in the past. They note, however, that this form of propaganda has not been entirely neglected and that, besides the Tiruppur cattle show, a successful large scale demonstration was held at Kovilpatti with lantern lectures and other attractions. They much appreciate the public spirit of M.R.Ry. R. Appaswami Nayudu Garu, M.L.C., Zamindar of Illavarasandal, who presided upon that occasion.

14. Turning now to the account which Section IV of the report gives, of the activities of the department under the head of Demonstration, the Government observe that it may justly be said to show that the department has been doing valuable work and that its work is appreciated by the cultivating ryots for whose benefit it is intended. The necessary but unpopular measure for the prevention of disease, namely, the application of the Pest Act, appears to have proved successful in materially decreasing the cotton pest known as Pink Boll worm, with the result that the cotton of this year has been of specially high quality. The Act has also been used with benefit in combating budrot in the Kistna and Gōdāvari districts, in certain taluks of the Guntūr district and in parts of the Agency division; and it is especially satisfactory to note that tree owners in some cases are beginning to take action of their own accord to apply the remedies required and appear to realize their value. The method of treating Sorghum seed with copper sulphate as a preventive against smut appears to have commended itself to the ryots in the Kurnool and Bellary districts, while in the Chicacole and Berhampur taluks and in the First Circle generally a new variety of disease-resisting sugarcane has been demonstrated and appears likely to be popular. Similarly in the Third Circle and Eighth Circle an improved furnace for jaggery making, which effects considerable economy in fuel, has been introduced to the notice of the ryots and bids fair to be largely adopted while in the Seventh Circle in the South Kanara district the methods demonstrated by the department have become the ordinary local practice.

15. So too under cotton the sale of improved seed to individual ryots and to seed unions has gone on satisfactorily in all the important cotton circles with the result that the work of cotton improvement taken in the Presidency as a whole has this year more than paid its expense. In Tuticorin, again, both cotton dealers and growers appear now to have realized the truth of the doctrine, so long urged by the department, that it pays better to grow and to gin pure Karunganni than a mixture of Karunganni and Uppam. The results of the paddy demonstration also indicate the value of the past activities of the department in popularizing improved strains.

16. Scarcely less important than the introduction of new and improved strains, is the popularizing of the use of green manure and it is satisfactory to note that this subject has continued to receive attention. The Government attach very great importance to it in view of the fact that it is becoming increasingly difficult, with the expansion of cultivation, to meet the demand for leaf manure from the available forest areas. It is particularly satisfactory, as observed by the Director, to note that in the areas served by the Bhavāni, private enterprise has now begun to compete with the department in the supply of seed of Kolinji for use as green manure, indicating that the agricultural population themselves are convinced of its value.

17. The activities of the Agricultural Engineering section have been hampered to some extent by the absence of an office and workshop at which improved implements can be designed and experiments made; this it has hitherto been impossible to provide for want of money. The results of the motor ploughing experiments with tractors appear to indicate that a type of tractor suitable for Indian conditions has yet to be evolved. The Government agree with the

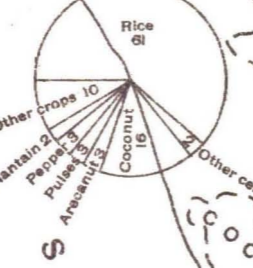
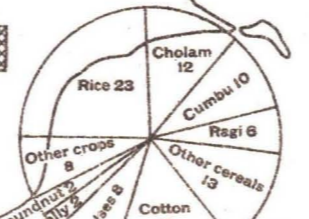
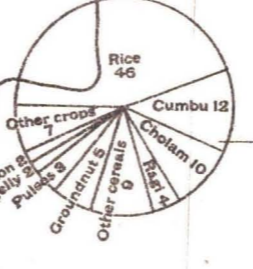
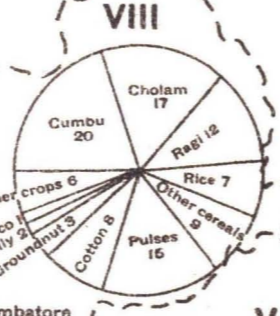
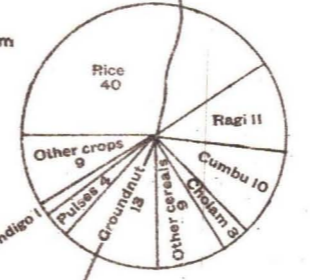
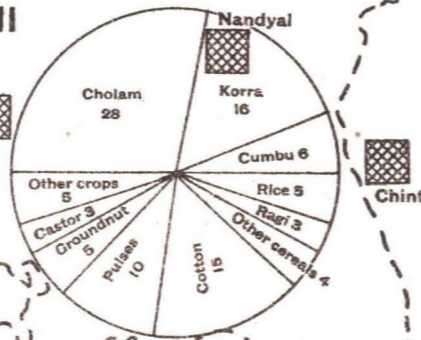
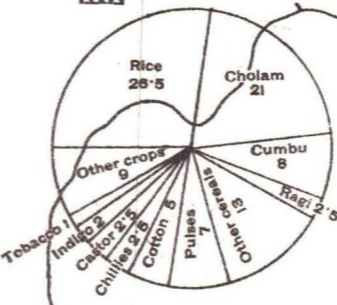
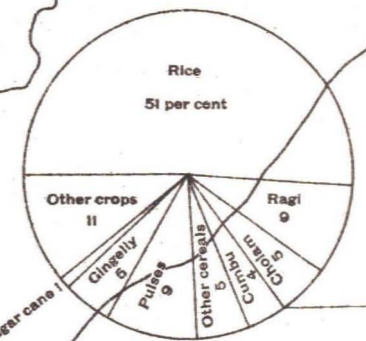
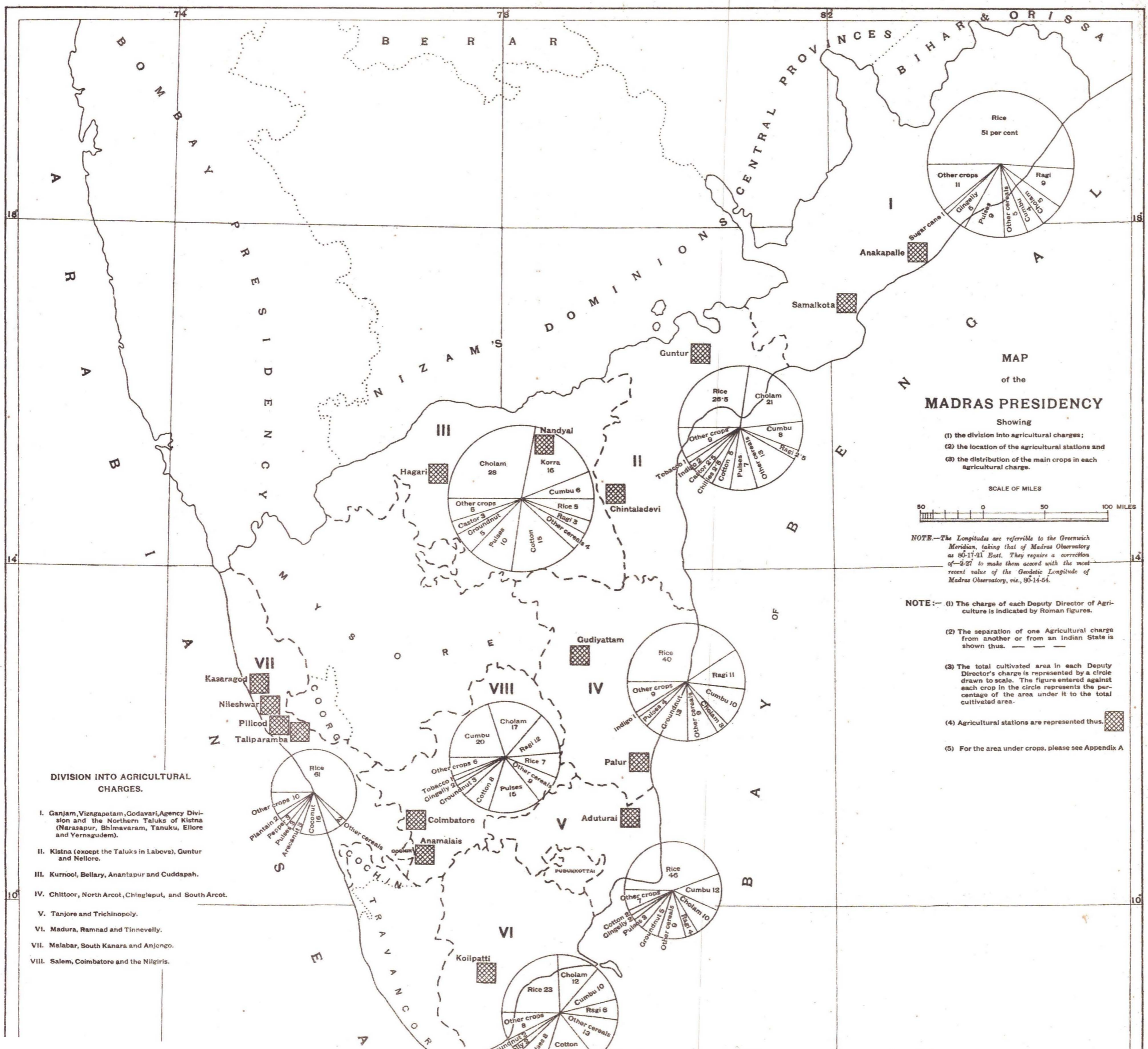
Director that the Agricultural Engineer may well pay attention to devising improvements in the indigenous implements of cultivation, such as ploughs and water lifts.

18. The report under review is the work of Mr. H. C. Sampson, C.I.E., and, owing to his impending retirement, is the last which the Government will receive from him. The Government desire to take the present opportunity to place on record their high appreciation of the value of his past services, and of the great benefit which the Department of Agriculture and the agricultural classes of the Presidency have derived from his great abilities.

(By order of the Government, Ministry of Development)

H. G. STOKES,
Acting Secretary to Government.

Editors' Table.

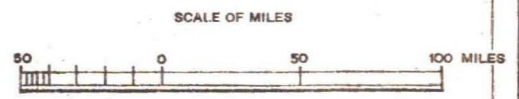


DIVISION INTO AGRICULTURAL CHARGES.

- I. Ganjam, Vizagapatam, Godavari, Agency Division and the Northern Taluks of Kistna (Narasapur, Bhimavaram, Tanuku, Ellore and Yernagudem).
- II. Kistna (except the Taluks in I. above), Guntur and Nellore.
- III. Kurnool, Bellary, Anantapur and Cuddapah.
- IV. Chittoor, North Arcot, Chingleput, and South Arcot.
- V. Tanjore and Trichinopoly.
- VI. Madura, Ramnad and Tinnevely.
- VII. Malabar, South Kanara and Anjengo.
- VIII. Salem, Coimbatore and the Nilgiris.

MAP of the MADRAS PRESIDENCY

- Showing
- (1) the division into agricultural charges;
 - (2) the location of the agricultural stations and
 - (3) the distribution of the main crops in each agricultural charge.



NOTE.—The Longitudes are referrible to the Greenwich Meridian, taking that of Madras Observatory as 80°17'21" East. They require a correction of -2'21" to make them accord with the most recent value of the Geodetic Longitude of Madras Observatory, viz., 80°14'54".

- NOTE:—
- (1) The charge of each Deputy Director of Agriculture is indicated by Roman figures.
 - (2) The separation of one Agricultural charge from another or from an Indian State is shown thus: — — —
 - (3) The total cultivated area in each Deputy Director's charge is represented by a circle drawn to scale. The figure entered against each crop in the circle represents the percentage of the area under it to the total cultivated area.
 - (4) Agricultural stations are represented thus: [grid pattern]
 - (5) For the area under crops, please see Appendix A.

OFFICE OF THE
DIRECTOR OF AGRICULTURE, MADRAS,
Madras, the 7th August 1922.

From

H. C. SAMPSON, Esq., B.Sc., C.I.E.,
OFFICIATING DIRECTOR OF AGRICULTURE,
Madras.

To

THE SECRETARY TO GOVERNMENT,
DEVELOPMENT DEPARTMENT,
Madras.

SIR,

I have the honour to submit the report on the operations of the Department of Agriculture for the year 1921-22.

I.—ADMINISTRATION.

2. During the year, the Honourable the Minister for Developments visited the Agricultural College and Research Institute, Coimbatore, and the Anakāpalle, Nandyal, Sirvel, and Pālūr agricultural stations. Of the honorary visitors to the Agricultural College, Mr. L. C. Smith, of Nellore, and M.R.Ry. K. Brahma Sastri Garu, of Bellary, paid official visits to that institution.

A.—STAFF.

3. The late Mr. G. A. D. Stuart was Director of Agriculture till the 7th August, when Mr. G. R. Hilson assumed charge of that office till I relieved him on the 14th September. Since then till the end of the year, I officiated as Director of Agriculture. Mr. R. C. Wood returned from long leave on 1st November 1921 and resumed the duties of Principal, Professor of Agriculture, and Superintendent of the Central Farm. Dr. Norris returned from long leave on 14th November 1921 and resumed the duties of Government Agricultural Chemist.

4. M.R.Ry. P. H. Rama Reddi Garu and Mr. R. C. Broadfoot completed their probationary period and were confirmed in the Indian Agricultural Service on 15th May 1922.

5. Messrs. D. G. Munro and A. C. Edmonds, probationary officers in the Indian Agricultural Service, on completing their training at Coimbatore, were posted to the V and I Circles, respectively, on 1st June 1921. Mr. Munro was subsequently transferred to the Agricultural College and Research Institute, Coimbatore, as Assistant to the Principal, Professor of Agriculture, and Superintendent, Central Farm, on 4th February 1922.

6. *Indian Agricultural Service.*—The following officers were promoted to this service on probation on the date noted against each:—

(1) M.R.Ry. D. Ananda Rao Garu, acting Professor of Agriculture and Superintendent, Central Farm, was appointed Deputy Director of Agriculture on

10th June 1921. He continued to act as Professor of Agriculture and Superintendent, Central Farm, till relieved by Mr. Wood on 1st November 1921, when he acted as Assistant to that officer till 19th January 1922. On that date, he was posted to the IV Circle as Deputy Director of Agriculture.

(2) M.R.Ry. Rao Sahib M. R. Ramaswami Sivan Avargal, acting Government Agricultural Chemist, was appointed to be Government Lecturing Chemist on 10th June 1921.

(3) M.R.Ry. D. Balakrishnamurti Garu, acting Deputy Director of Agriculture, was appointed substantively to that post on 29th October and he continued in charge of the II Circle.

(4) M.R.Ry. Rao Sahib T. S. Venkataraman Avargal became Government Sugarcane Expert on 10th June 1921, in which post he was acting before.

(5) M.R.Ry. S. Sundararaman Avargal likewise became Government Mycologist with effect from 29th October 1921.

(6) M.R.Ry. G. N. Rangaswami Ayyangar Avargal, Assistant Economic Botanist, was appointed on 29th October 1921 to the post of Millets Specialist.

(7) Mr. Saadat Ullah Khan was appointed to the Indian Agricultural Service by the Secretary of State and he reported himself for duty on 24th January 1922 and he was sent to Coimbatore for training.

It will thus appear that all the seven appointments to the Indian Agricultural Service made during the year were conferred upon Indians, which is in consonance with the policy of Indianizing this service recommended by the Royal Commission on the Public Services in India and approved by the Right Honourable the Secretary of State for India.

7. *Madras Agricultural Service.*—M.R.Ry. B. Viswanath Garu, Assistant Agricultural Chemist, and M.R.Ry. Rao Sahib Y. Ramachandra Rao Garu, Economic Assistant to the Government Entomologist, were confirmed in this service; while M.R.Ry. K. S. Viswanatha Ayyar Avargal was appointed to it as Assistant Agricultural Chemist on probation and he joined duty on 3rd January 1922.

The following Upper Subordinates were promoted to this service on probation :—

- (1) M.R.Ry. K. Krishnamurti Rao Garu on 10th June 1921.
- (2) M.R.Ry. K. Gopalakrishna Raju Garu on 10th June 1921.
- (3) M.R.Ry. S. R. Venkatakrishna Mudaliyar Avargal on 29th October 1921.
- (4) M.R.Ry. K. Ramayya Avargal on 29th October 1921.

8. *Non-Gazetted services—Upper subordinate service.*—Ten officers were appointed during the year on probation and five resigned.

Lower subordinate service.—Eighteen were appointed on probation, three resigned, and two died.

Inspector of Agricultural Offices.—As the work of inspection of subordinate offices, agricultural stations and depots was found more than one Inspector could cope with, an additional Inspector of Agricultural Offices was sanctioned temporarily for one year.

The new time scales of pay sanctioned for the non-gazetted executive and ministerial officers were given effect to during the year.

9. Messrs. R. C. Wood, R. D. Anstead, and I attended the meeting of the Board of Agriculture held at Pusa on the 13th February 1922 and following days as members, while Messrs. E. Ballard, P. H. Rama Reddi, and R. W. Littlewood attended it as visitors.

10. The touring of officers of this department during the year was, on the whole, restricted consequent upon the reduced allotment under travelling allowance and the enhanced rates of railway fares.

B.—BUILDINGS AND LAYING OUT OF FARMS.

11. The building programme at the Agricultural College and Research Institute and elsewhere was cut down considerably for financial reasons.

12. Preliminary sanction of Government was obtained during the year for the construction of—

(1) Quarters for four Imperial officers and for the Government Agricultural Engineer at Coimbatore;

(2) Quarters for the Deputy Director of Agriculture at Trichinopoly;

(3) Residential accommodation and office buildings for the Deputy Director of Agriculture, Northern Cotton tract, and his staff at Nandyal. Detailed plans and estimates for these buildings, and also for the workshop and office of the Government Agricultural Engineer, which received the administrative approval of Government in February 1921, are still under preparation by the Public Works Department.

13. Detailed plans and estimates were submitted to Government during the year for the construction of bull sheds at Madras and five Provincial officers' quarters at Coimbatore, but their construction was postponed for lack-of funds.

Technical sanction for quarters for the Deputy Director of Agriculture at Madras was received during the year.

14. The need for additional quarters for the subordinate staff at Coimbatore became very acute, and a building programme has been sanctioned since the close of the year.

15. The hostel accommodation at Coimbatore was severely taxed by the number of students and it was found necessary to convert certain store rooms into students' quarters. Proposals were submitted to Government for the construction of additional rooms for students.

16. The new Teaching College, quarters for two Imperial and five Provincial officers, and quarters for the subordinate staff at Coimbatore, which were under construction during the year, made fair progress. Very little advance was made by the Public Works Department in the construction of buildings in the Chintaladevi cattle farm.

17. The overseer's quarters and fruit store at the Burliyar experimental garden, the workshop, the Indian visitors' quarters and the farm clerk's quarters at Koilpatti, which were undertaken by the Public Works Department, were completed during the year and handed over to this department.

18. A small laboratory for the Government Entomologist, and the new seed store at Samalkota, a chemical laboratory at Kasaragod, new cattle-sheds at Nileshwar, Taliparamba, and Kasaragod, the buildings for the agricultural middle school at Taliparamba, the officers' mess building, and a new office building for the Deputy Director of Agriculture, Planting districts, and the Government Agricultural Engineer at Coimbatore were undertaken departmentally and completed during the year.

19. The construction of quarters for the farm manager and an assistant at the Paddy-breeding station at Coimbatore was started towards the end of the year and nearly finished.

20. Among other works carried out at the Agricultural College during the year were improvements to the dry cow sheds, pipe-line irrigation channel, and repairs to the college, hostel, and the farm school and Indian rest-house.

21. The buildings for the agricultural middle school at Taliparamba were estimated by the Public Works Department at Rs. 85,000. This was considered too high and this department prepared revised estimates for the work for Rs. 12,335, a reduction working out to nearly Re. 1 per square foot of plinth area. The work was completed before the close of the year with a further saving of Rs. 1,300.

Great credit is due to M.R.Ry. M. Govinda Kidavu Avargal, Deputy Director of Agriculture, and his subordinate officers immediately responsible for this work for the expedition and economy effected and for the excellent way in which the work was done.

22. Again, the Government Economic Botanist was able to effect substantial economy in his work of construction at the Paddy-breeding stations at Coimbatore and at Aduturai. I would instance the case of timber where a saving of nearly 10 per cent has been effected by purchasing it in the West Coast.

23. The year witnessed the closure, or the preliminaries thereto, of several agricultural stations, and the opening of others. The Manganallur station was closed on the 14th March 1922. The closure of the Bantanahal Sheep and Seed farm and the Sirvel agricultural station before the next crop season, which was ordered by Government, was completed in January and February, respectively, and since the expiry of the official year under report, the winding up of the Buffalo-breeding station at Samalkota has been ordered.

24. On the other hand, a scheme for a dry land farm in the Guntūr district consisting of 300 acres in the Lam and Gorantla reserves for the study of "Cocanadas" cotton and tobacco, the two principal dry crops of the district, was submitted to Government in December 1921. The sanction of Government has been received since the close of the year, and rapid progress is being made with the lay out of the farm, much of both the dead and live-stock and the building materials on the Bantanahal and Sirvel agricultural stations being transferred to it.

25. An extent of 23.81 acres of land to the north of the Central Farm, Coimbatore, was acquired for a Cotton-breeding station for the use of the Cotton Specialist and the land was taken over by him on the 17th March 1922.

26. A Paddy-breeding station comprising 52.87 acres was opened at Aduturai, Tanjore district, for testing improved strains of paddy in the Tanjore delta. The work here will be in continuation of that at the Manganallur station and all the available material at the latter station was transferred to Aduturai. Sanction was obtained for the construction of quarters and for putting up an ideal wire fencing, laboratory and cattle-sheds, but not much progress was made till after the close of the year.

27. Coconut station No. 1 in the Kasaragod taluk was extended by 16.10 acres and the boundary wall was partially constructed all round. The acquisition of about 4.6 acres and the assignment of certain waste lands for further extension of the Coconut stations in this taluk were also sanctioned by Government but were pending at the end of the year.

28. The retention of the Potato farm, Nanjanad, in its present site was sanctioned by Government. A permanent fence with ideal wire fencing was also sanctioned in order to prevent damage by wild pigs. The question of a road to the farm is receiving attention.

II.—AGRICULTURAL EDUCATION.

29. *Course of studies.*—There has been no conspicuous change during the year in the College curriculum. Teaching continued on the lines of the previous year when the new Diploma Course was instituted. Much difficulty was felt in accommodating the students as six classes were in residence, viz., two Certificate classes, two Diploma classes (Old Regulations) and two Diploma classes (New Regulations).

30. *Affiliation.*—In April 1922, the Government sanctioned the affiliation of the Agricultural College, Coimbatore, to the University of Madras as a new department of science in the existing faculty of Arts and Science, and the institution of a degree in Agriculture to be known as B.Sc.Ag. The question of constituting a Board of Studies in Agriculture is now under consideration by the Madras University.

31. *Admission, strength, and stipends (certificate course).*—There was a distinct falling off in the number of applications received for admission to the certificate course, there being 95 as against 252 in the previous year, and as against 359 in 1919–20. Of these, only 23 were admitted. There was also a marked drop in the intellectual standard of the applicants. Both this and the decrease in the number of applications are due to the complete separation of the certificate and diploma courses from the outset, with different qualifications for admission to the two courses. The certificate course leads now, either back to the land, or only to the lower subordinate services of the Agricultural Department. The unpopularity of the course shows that its attractions for the aspirant to Government service are gone, and that there is still practically no demand for agricultural education for its own sake.

32. *The new diploma course.*—For the higher course, 93 applications were received as against 107 last year. Nineteen were finally selected, out of whom 16 have been granted stipends. The choice was somewhat limited, as of the 93 applicants only 47 appeared for personal interviews with the Principal, who held these at Coimbatore, Madras, and Samalkota. Of the 47, forty-three were Brahmans (and therefore not of the agricultural classes).

33. The stipulation that the intermediate examination shall be the minimum qualification for entrance to the diploma course adversely affected recruitment. The students for the diploma course are drawn from the non-agricultural, or what might be styled the official, class whose leanings are intellectual rather than agricultural. It was thought at first that a better class of students would be attracted to the College if scholarships were offered. But, the offer of scholarships and the prospect of a degree at the end of the course, when combined with the intermediate qualification, made it impossible to recruit the right kind of men.

34. All the 20 students recruited in the first year, and 17 of the 19 students of the second year received scholarships. A course dependent on the grant of so many scholarships to keep it going can hardly be on the right lines.

35. The inadequacy of the present course and the necessity for reverting to the old arrangement existing prior to the issue of Government Order No. 1016, Revenue (Special), dated 29th May 1920, has been brought to the notice of Government since the close of the year under report and they were pleased (1) to permit the students and officers in the lower subordinate service to join the degree course, and (2) to direct that the University be addressed to declare the certificate course with the addition of English a qualification for appearing for the B.Sc.Ag.

36. *The old diploma course.*—The men with this training are decidedly superior to the new diploma course men on account of the thoroughly practical training they got in the certificate course, and they will have to be more fully utilized for responsible work in the future.

37. The number of students on the rolls during the year was as follows:—

	Certificate class.		Old diploma class.		New diploma class.		Total.
	I.	II.	I.	II.	A.	B.	
Beginning	28	22	20	17	19	17	118
End	22	22	20	...	19	17	100

38. *Examination.*—The diploma examination was held in December 1921 and all the 17 students who sat were successful, two being placed in the first class.

39. For the certificate examination, 22 students presented themselves and 19 passed. The class, as a whole, did exceedingly well, the marks obtained being much above those of previous years. This result is probably due

to the small size of the class (22 as against over 40 in previous years), which permitted more individual tuition.

40. The College Day and Conference was held in December 1921, under the Presidentship of Mr. N. Macmichael, I.C.S.

41. *Agricultural Middle Schools.*—The Taliparamba agricultural middle school has been started by the Education Department in the newly completed buildings with 18 pupils on the rolls. M.R.Ry. M. K. Nambiyar, one of the two agricultural diplomates who had undergone training in the Teachers' College, Saidapet, was posted as headmaster.

42. An agricultural middle school at Anakapalle was sanctioned by Government in February 1921. Plans and estimates for the necessary buildings were also sanctioned during the year and a sum of Rs. 3,000 was spent towards the purchase of building materials. Pending the acquisition of a site for the school, proposals for which have been submitted to Government, arrangements were made to accommodate the classes in the farm buildings, and to board and lodge the pupils in a rented building. Two officers of the department were deputed for training in the Training College at Rajahmundry for a period of about four months. One of them, M.R.Ry. D. Panakala Rao, was appointed as headmaster and the school was opened on 15th May 1922 with six pupils on the rolls.

43. Text-books on (1) agriculture and nature study, and (2) mathematics were prepared by M.R.Ry. K. T. Alwa Avargal, Assistant Director of Agriculture, and M.R.Ry. V. Raghunatha Ayyar, of the Education Department, respectively. The former book was prepared under the personal directions of the late Mr. G. A. D. Stuart and is an excellent production capable of adaptation to the needs of other parts of the Presidency. Both books are in the press. The text-book on geography was more difficult to prepare. The original draft prepared by an officer of the Education Department was subsequently revised by an officer who is a native of Malabar, and the book is now with the Director of Public Instruction to be got into a final form.

44. *Vocational education.*—With reference to the recommendations of the committee on rural education, a draft syllabus in rural science in secondary schools was prepared by Mr. Wood.

45. M.R.Ry. K. Unnikrishna Menon, an officer trained for the Taliparamba agricultural middle school, and an educational officer were deputed to prepare text-books on nature study for the use of teachers in the elementary schools of the Coimbatore district. Their labours had not concluded at the end of the year.

46. *Farm schools.*—The schools for juvenile and adult labourers on the farms at Coimbatore, Palur, and Anakapalle continued to work during the year. A special report on these schools has already been submitted to Government, their cost being Rs. 1,707-2-0. The results, however, were not commensurate with the expenditure. These schools can only be characterized as an expensive luxury.

III.—RESEARCH AND EXPERIMENTS.

A.—AGRICULTURE.

47. *Season and rainfall.*—The south-west monsoon was generally heavy, though it was late in the Circars and in the south. The north-east monsoon was generally a failure and there was little rainfall after November. At Anakapalle, the failure of the early hot weather rains caused the sugarcane and plantain crops to wither, but the subsequent good rainfall was favourable to the paddy crop. At Samalkota, the season was exceptionally good for the harvest of the paddy main crop, but the second crop was poor owing to the abrupt close of the

north-east monsoon early in November. In the Ceded districts, the season commenced favourably with timely rains but the drought in August caused the early crops to wither and the late crops to be sown so late that the yield of all crops was poor. The early advent of the hot weather in 1922 caused the premature bursting of cotton bolls in the Westerns tract, with the result that the cotton crop was below normal and of unusually weak staple. At Palur, 8.44 inches of rain were received in November to January as against an average of 26 inches, and this failure of the north-east monsoon spoilt the agricultural prospects of what promised to be a very good year. At Manganallur, the season was not very favourable to paddy as the drought in August and September affected the kuruvai crop and as the rains in January and February interfered with the main paddy harvest. In the south and in the Coimbatore district, the season was generally favourable. On the West Coast, the south-west monsoon was badly distributed and this, together with the long break in July, was detrimental to wet land paddy, while the early cessation of the north-east monsoon in November was unfavourable to the second crop paddy, pepper, and coconuts in Malabar.

CROPS.

(a) *Sugarcane.*

48. *Varietal.*—Varietal tests have been carried out not only on the agricultural stations, but also in co-operation with cane growers in the districts. Some of the varieties of thick canes imported by the Government Sugarcane Expert show great promise. J. 247 is the most promising in the Circars, and extended trials throughout the Ganjām, Vizagapatam, and Gōdāvāri districts have established its superiority in that area over previous importations. At Sirvel agricultural station in the Kurnool district, it also showed its superiority. The variety Java (Hebbal) has proved itself equally promising in the South Arcot cane area as well on the West Coast.

49. *Manurial.*—Trials at Anakapalle comparing fish guano at one ton per acre against 4,000 lb. of wild indigo leaf and half a ton of fish guano have shown that the former is definitely superior as a manure, the increased crop amounting to 736 lb. of jaggery per acre. Given the price of fish guano and of jaggery, it is now possible to state whether this can be recommended.

Trials at Samalkota comparing fish guano and castor cake applied in equal quantities again show that these manures are weight for weight of equal value as a manure for this crop. This is of importance considering the limited supply of castor cake available in these districts and the high prices which growers are often forced to pay for the manure.

50. *Cultural.*—A method of propping canes by utilizing galvanized wire in place of bamboos has been evolved at the Central Farm and has proved satisfactory. Propping is in many districts one of the main items of expenditure in the cultivation of this crop and any means by which the cost of this operation can be reduced should be welcomed.

Publications.

(1) *Germination and Preservation of Sugarcane Pollen* (contributed to *The Agricultural Journal of India* by T. S. Venkataraman).

(2) *Sugarcane Root Systems—Studies in Development and Anatomy* (read before the Indian Science Congress by T. S. Venkataraman and R. Thomas).

(3) *Some Suggestions to the Grower of Sugarcane* (written for the *Villagers' Calendar* by T. S. Venkataraman).

(b) *Paddy.*

51. The work on the Paddy-breeding Station at Coimbatore was continued by Mr. Parnell on the same lines as in previous years which comprised the raising and testing of improved strains; the study of inheritance of characters and the crossing of different strains for both of the above lines of work. Of the new strains already distributed from here, good reports continue to be received from Deputy Directors, V and VIII Circles. Not only was all the seed available with the department rapidly taken up, but many of those who had tried them reserved their produce either for sale as seed or for extending their own areas under them.

52. Similar work of testing improved strains was also continued at the Mangallur agricultural station under the charge of the Government Economic Botanist and some with definitely better cropping powers than the local varieties have been produced in the case of White Ottadam, Red Ottadam, White Samba and Kuruvai. This, as well as more definite plant-breeding work, is now being transferred to the new Paddy-breeding Station at Aduturai. Selection work has been taken up on three of the most important district varieties of Coimbatore, viz., Anaikomban, the Sadai Samba of Gobichettipalayam, and that of Coimbatore, and a large number of single plant selections have been made.

Work on linkage of characters has furnished further interesting results, some of which are of distinct economic value.

53. Selection work and the testing of varieties have also been carried on in the I Circle at Samalkota as well as in the IV Circle at Palur under the respective Deputy Directors of Agriculture.

54. At Samalkota, very careful varietal tests have been conducted with short, medium, and late duration varieties. A large number of single plant selections have been under detailed study and 17 of these have been retained for further work next season. Some of these varietal tests are intimately associated with the problem of solving the irrigation question of the Gōdāvāri delta.

55. The practice in the Gōdāvāri delta is to raise a long duration variety in the first crop season. After this is harvested, the land lies fallow until December when a short duration second crop is grown. This second crop is always liable to suffer from water scarcity. For some years, experiments were carried out to see whether other varieties which could be planted soon after the first crop could not be grown; but the results of these trials showed that the setting of grain was a matter of climate rather than of variety, and that no variety set well if flowering took place in the cold weather. It was thought that a solution of the difficulty might be obtained by adopting the practice of the southern rice tracts where the first crop was a short duration variety and the second crop which immediately followed it was a variety of long duration. Several short duration varieties have been tested and some of these have been found to yield quite well within a period of 130 days from the time of sowing the seed-bed. Several second crop varieties introduced from the south have been grown and four of these are distinctly promising when transplanted soon after the harvest of a short duration first crop. These, when sown in the seed-bed at the end of August, which means transplanting at the beginning of October, gave their harvest this year in the month of January, i.e., a period of five months from the date of sowing. All of them have yielded over 3,300 lb. of grain per acre and one of them—*Iswarakora*, a variety introduced from Nellore—has yielded over 4,000 lb. These results are most encouraging and more extended trials will be made next year.

56. Varietal tests conducted at the Palur agricultural station have shown that the Government Economic Botanist's strain Poombalai No. 91 when planted in the main season has yielded about 10 per cent more than ordinary Poombalai.

57. *Pathological.*—Investigations into the life-history and the control of *Siga* (*Schoenobius incertellus*), the "paddy stem-borer," were carried out in detail at the Samalkota agricultural station, where a small temporary laboratory in charge of

an entomological assistant, has been set up. The results obtained here have confirmed those at Podalada in many important points, and it has been found that the pest can, to a great extent, be controlled, although not completely, by the examination of the seedlings removed from the seed-beds and the destruction of any of those which are attacked.

58. The study of two important diseases of rice are still being continued by the Government Mycologist, viz., *Helminthosporium* and *Pericularia*. In connexion with the former disease, soil infection experiments were conducted to find out whether the fungus spreads by means of the seed or by infection from the soil. Cross inoculation in the case of the latter disease between *Pericularia* found on paddy and other plants of the same natural order is being made to ascertain how far these are related.

59. *Manurial*.—Mr. Ramaswami Sivan, now Government Lecturing Chemist, continued his research on the availability of Trichinopoly phosphate when applied as a manure for paddy. This work has reached a stage when conclusive results can be said to have been obtained. Experiments conducted in the pot-culturehouse showed that where a green manure alone is applied, an increase of 13 per cent in the weight of the crop is obtained; where nitrogen is used in conjunction with green manure, the increase is 32 per cent; where nitrogen and phosphate were both applied in conjunction with green manure, the increase was 51 per cent. These experiments also showed that, if nitrogen was applied with increasing quantities of phosphate, an increased crop yield was obtained up to a certain point. In order to test these results in the field, Mr. Sivan sought the help of the Deputy Directors of Agriculture, IV, V, and VIII Circles, who secured the co-operation of private landholders to carry out field experiments with the use of mineral phosphate applied along with green manure. The results of these experiments show that where the soil already contained 0.01 per cent of available phosphoric acid, no appreciable increase in the crop was found; but where the amount of phosphoric acid was less than this, an increase of from 271 lb. to 412 lb. of grain was obtained when phosphate was applied. This averages an increase of 11 per cent. Further work will be carried out next year in order to test the residual value of phosphate left in the soil.

60. Progress has been made with the soil survey of our principal rice areas. In addition to those of Guntūr, Kistna, and Tanjore, which have already been published, that for Gōdāvāri has been completed and is now in the press and the maps of the Periyar area have been finished. Both these surveys indicate a deficiency in phosphates and nitrogen which is marked in the case of Periyar but much less in the Gōdāvāri than in the other deltaic areas.

61. Experiments conducted at Samalkota to test the availability of phosphate in bone-meal when applied in conjunction with green manure show that a soil of poor fertility gives a marked increase; but in soils of high fertility its effect is not appreciable. This, however, may be due to the marked increase in straw which causes the crop to lodge rather badly and thus masks the effect of the manure on the yield of grain.

62. Similar experiments conducted on the heavy deltaic soils at Managanallur have shown that, unless the physical texture of the soil is such that the proper fermentation of the green manure can take place, the effect of the phosphate is likely to be slow. This is further confirmed by another experiment where oil-cake has been substituted for green manure. In this case, the effect of bone-meal, mineral phosphate, and super applied in conjunction with oil-cake has been most marked.

63. The average yields show that where groundnut cake only has been used there has been an increase of 38 per cent of grain and 47 per cent of straw; where bone-meal has been added to the groundnut cake, there has been an increase of 62 per cent of grain and 92 per cent of straw; where mineral phosphate has been applied in conjunction with cake, there has been an increase of 65 per cent of grain and 76 per cent of straw; and where super-phosphate is applied in conjunction with oil-cake, the increase in the grain has been 87 per cent and straw 143 per cent.

64. Now that the Manganallur agricultural station has been closed, the Deputy Director of Agriculture, V Circle, is writing a *resume* of the experiments carried out there which will be published in the form of a bulletin, and also in a simplified form in the shape of a leaflet.

65. *Cultural*.—Experiments were conducted at Samalkota in order to ascertain how far heavy seed is superior to light seed for sowing. The results are unexpected and show that light seed has produced a heavier acre yield than heavy seed. The experiment, however, needs to be repeated. The poorer germination of the light seed may have caused more space to the seedlings in the seed-bed and this would give them an advantage when planted out.

66. Another experiment was carried out in order to test the superiority of seedlings raised from a thin seed-bed over seedlings raised in a thick sown seed-bed where four times the quantity of seed has been raised from the same area. The results show that seedlings on the thin sown seed-bed fared much better and gave an increased yield equivalent to 12 to 13 per cent.

Publication.

The Inheritance of Characters in Rice, II (Pusa Memoir) by F. R. Parnell.

(c) *Cotton.*

67. Mr. G. R. Hilson continued his work on Cambodia cotton. After detailed examination of some 800 plants last year, 17 were selected for sowing this season, and four of them promise to be useful commercial types. Further work this year on these has consisted in keeping careful record of plant characters. Different characters of these selections have been carefully recorded on the growing plants, but much has still to be done in the examination of the lint in the laboratory before the next sowing season.

68. He has also continued the study of the inheritance of characters of crosses between *Gossypium Roseum* × *Gossypium Indicum*, and between *Gossypium Indicum* × *Gossypium Roseum*. These crosses were made last year and the seed obtained was sown in the year under report. Unfortunately, a large number of the seedlings were destroyed by a heavy shower of rain, but sufficient survived to provide both material for examination this year and for continued work next year.

69. The question of bud and boll shedding has received the attention not only of Mr. Hilson but of other sections at the Research Institute. In his notes regarding the characters of different selections of Cambodia cotton, Mr. Hilson in each case has worked out the percentage of flower buds formed, the percentage which flowered, the percentage which set, the percentage which dropped after setting, and the percentage which finally ripened into bolls. The proportion of the latter to the former is very small indeed. The causes for this shedding have been investigated in collaboration with the Government Agricultural Bacteriologist and the Government Entomologist. During the examination of bolls when estimating the amount of boll-worm attack by the Entomological section, it was noticed that a considerable number of immature bolls had been shed. The interior of the bolls showed that these were infected with disease and the Government Agricultural Bacteriologist found that this was caused by bacteria. It was ascertained that infection was caused by one or more species. Among sucking insects, *Ragmus morosus* (*Miridae*) is certainly responsible for causing such infection, but other species are also suspected. Some 60 per cent of the bolls which were shed prematurely were found to be infected by this disease, but whether insects are entirely to be blamed for this infection or not has yet to be investigated. The question of bud and boll shedding has also been investigated from a purely botanical point of view by an assistant working under the

Government Lecturing Botanist. His investigations show that a large quantity of the pollen formed is sterile and that the amount of this sterility varies in individual plants.

70. In collaboration with the Cotton Specialist, the Government Entomologist has discovered considerable variation in the amount of stem weevil (*Pemphres affinis*) infection. The selections of Cambodia cotton are attacked in varying degrees and one of the selections has been found which is much more immune from attack than the rest.

71. The Government Entomologist has continued his work on the incidence of boll worm. It is gratifying to note that the "pink boll worm" infection has shown a remarkable diminution and, at the time of writing this report, the percentage of attack is very much less than usual at this season of the year. The American boll worm (*Chloridea obsoleta*), which is known in India as the "Bengal gram caterpillar" and which was never reported as a pest of cotton until 1920, threatens to be an annual factor in the cotton crop under pest conditions. Another boll worm, at present unidentified, but which resembles the red boll worm of Africa in its habits and in the damage it does, has also made its appearance in the Coimbatore district. This, if it comes into pest conditions, is likely to prove as serious a pest as, if not a more serious one than, the "pink boll worm," and the necessity for the continued enforcement of the Pest Act in order to combat these cotton pests is very great.

72. The Government Agricultural Chemist has continued his work on investigating how far the plant food available in the soil is responsible for the quality of cotton. It is hoped that the results of this work will render it possible to formulate a manurial scheme for cotton which, even though it may not increase the quantity of cotton per acre, may add considerably to its value in the improved length and fineness of its staple.

73. Research has also been carried on by the Deputy Directors of Agriculture who are responsible for cotton work in the III and VI Circles. At the Hagari agricultural station, Bellary district, where work on "Westerns" cotton is carried on, one plant out of 500 examined was selected for good qualities of staple as well as for a high percentage of lint. The seed from this plant was sown this year, the flowers were selfed and *kapas* from each plant has been kept separately for examination in the laboratory. It is gratifying to note that, in the yield tests made at Hagari to compare H. 25 with the local mixture, the former has given an increased yield corresponding to 34 per cent. A large number of plants chosen at random from the Mungari cotton of this tract (i.e., the crop which is usually grown on the lighter soil in the earlier season) have been selected and the *kapas* of each of these is now being examined in the laboratory.

74. At the Nandyal agricultural station, where work on the "Northern" cotton is carried out, the seed of 14 plants, which were selected last year for their length of staple and other qualities of lint, was sown separately this year. All the flowers of the plants raised were selfed and the *kapas* from each plant has been kept separately for further examination. Careful experiments conducted this year on a field scale showed that the selected seed of "Northern" cotton so far distributed to the ryots gave a higher yield of *kapas* than Gadag cotton, Company No. 2 or Company No. 3, and also a better ginning percentage. It gave 15 per cent more *kapas* than the local cotton.

75. At the Koilpatti agricultural station, several of the recent selections from the types now distributed have shown a marked superiority in yield over those which have already been given out to ryots for cultivation, and not only this but they have shown themselves considerably superior in their spinning qualities.

76. At the Anamalai station in the Coimbatore district, strain No. 15, Cambodia cotton, has shown itself to be a considerably heavier cropper than the plants grown from seed locally available. This superiority amounts to over 43 per cent, but some of this may be due to the better germination of No. 15.

Where this has been grown on our seed farms, this superiority over crops grown from local strains has also been very marked and spinning tests have shown its marked superiority over local Cambodia.

Publication.

Measurement of Lint Length and the Determination of Seed Weight and Weight of Lint per Seed (Pusa Memoir) by G. R. Hilson.

(d) *Dry grains.*

77. M.R.Ry. G. N. Rangaswami Ayyangar Avargal was appointed Millets Specialist on the 25th November 1921. So far, his time has been spent in visiting the most important sorghum areas, where he has made a detailed examination of various types of the plant represented in the crops of local varieties. He is now making further examination of these types in the laboratory. Owing to the complete failure of the crop in 1919-20, it was impossible to carry out comparative tests of the different selections of sorghum at the Hagari agricultural station. Fortunately, old seed of each of these selections was retained and it was sown this year under irrigation to replenish the stock. Ample seed has now been obtained to enable comparative tests to be carried out next year. The selections of sorghum made at the Nandyal farm on comparative strip tests show that all these are superior in grain yield to the local variety. T-1 has again proved the heaviest cropper, giving an increase of nearly 15 per cent in yield. This strain has been grown on a field scale for distribution at the Bantanahal seed farm and has given a yield of 876 lb. of grain per acre which, considering the complete failure of the early rains, may be considered to be most satisfactory.

(e) *Groundnut.*

78. Several single plant selections of groundnut made last year at the Palur agricultural station from varieties under cultivation were grown separately, but their characters have still to be studied. Owing to poor germination, no reliable results have been obtained this year from the variety tests which were made at the sub-station at Naduvirapattu.

(f) *Coconuts.*

79. The methods of cultivation adopted at the Kasaragod coconut station have made a wonderful change in the condition of the plantation, as is shown by the progressive yield of nuts for the last four years. These are as follows:—

1918-19	...	...	...	...	...	28,886
1919-20	...	...	...	...	...	46,773
1920-21	...	...	...	...	...	50,026
1921-22	...	...	...	...	...	53,310

Although all the trees on the station were of sufficient maturity when the station was acquired, only 907 trees were bearing in 1918-19 against 1,164 trees bearing in 1921-22. Sufficient data have now been obtained of the yielding capabilities of each tree and a series of experiments have been laid down in order to test the manurial requirements of the coconut. Prior to this, much preliminary work had been done which involved close collaboration with the Government Agricultural Chemist, who has made more than a thousand analyses of different parts of the coconut tree at each stage in its growth. These clearly show the important part played by phosphate and potash in the physiological processes of the tree. Preliminary trials with the use of manures have also been made in the coconut station which indicate how the manure should be applied.

80. In collaboration with the Government Agricultural Chemist, experiments have also been conducted in tapping trees and in the manufacture of coconut jaggery. Considerable information has been obtained. Frequent analyses have been made of the juice of a large number of trees in order to ascertain what variation occurs at different seasons, at different stages of the growth of the tree and

at different stages in tapping individual spathes. The ordinary jaggery made on the West Coast, besides containing many impurities, is very dark in colour and rapidly becomes liquefied. The dark colour is due to the excess of lime with which the collecting vessels have to be treated to prevent the fermentation of the juice. The juice also has a much higher chlorine content than that of the sugarcane, and this combining with the lime to form calcium chloride, a highly deliquescent body, explains the cause of the deliquescent nature of the jaggery. Improved methods of jaggery-making have been investigated. Suitable simple sand filters have been devised for removing impurities from the juice and a method has been worked out for removing the lime by the addition of a small quantity of alum. As a result of this, jaggery of excellent colour and satisfactory keeping qualities can readily be prepared. The average yield of jaggery is 14 per cent of the weight of the juice collected. It has also been found possible to prepare brown sugar of good quality from the coconut juice and the yield obtained amounts to $9\frac{1}{2}$ per cent of the weight of the juice treated. An article on this subject has been accepted for publication in the *Agricultural Journal of India*.

81. At the other three coconut stations which were planted up in 1919 and 1920, excellent results have been obtained from the methods of cultivation adopted and already many of the trees have formed boles above ground. The main difference between the method adopted and the local method consisted in surface planting, in place of the usual practice of planting in deep pits, and in the maintenance of a soil mulch for the whole area which has enabled the trees to maintain their vigour through the dry seasons.

82. A leaflet has been prepared by the Mycological section on the treatment of bleeding disease on coconuts.

83. An outbreak of bud-rot has been reported in North Malabar by the district staff. The presence of this disease has been confirmed by the Government Mycologist and the matter has been reported to the district revenue officials who have taken steps to have the attacked trees destroyed. An illustrated leaflet on this disease has been republished both in Malayalam and Kanarese.

(g) Fruit culture.

84. The Pomological station which was opened at Coonoor in 1920 has now been fully planted up with varieties of apples, pears, quinces, peaches, apricots, nectarines, almonds, Japanese plums, persimmons, lemons, figs and loquats, as well as small fruits, such as strawberries, raspberries, cape gooseberries, Chinese guavas, tomatoes, and tree tomatoes. Among the new importations, some of the apples, peaches, Japanese plums, quinces, figs, and persimmons are already fruiting.

85. There is scope for much research work, not only in methods of pruning which have to be adopted, but also in nursery work in finding suitable stocks, testing methods of grafting and budding, etc.

86. A satisfactory beginning has been made towards developing the fruit industry and at the close of the year under report more than 1,600 grafted fruit trees were ready for sale to the public. The cultivation of cape gooseberries has been found to be a most profitable crop. The yield obtained on the station amounted to 20 lb. of fruit for each cent of land cultivated, i.e., 2,000 lb. of fruit per acre. These find a ready sale at 3 annas a lb. and there are signs of the cultivation extending. A large quantity of seed of cape gooseberry and of the ordinary tomato has been offered for sale to the public.

87. Experiments with plantains are being conducted at the Samalkota agricultural station and a collection of the more important varieties grown in the northern districts has been made and better methods of cultivation have been introduced. The result of this work has shown that plantains can become a very much more profitable crop than they are at present in the better drained areas of the Gōdāvāri delta.

88. The cultivation of pine apples at the Taliparamba agricultural station promises to provide a profitable industry for the West Coast. These are found to thrive exceedingly well on the ordinary hill land there. After the preliminary earthing up and manuring at the time of planting, the pine apple requires very little attention except to protect it from wild animals. Very fine fruits of varieties such as Kew and Cayenne, some of them weighing over 10 lb., have been produced. The results of these trials seem to indicate the possibility of a canning industry being established for preserving these fruits when they will find a wider market than is possible at present.

(h) *Miscellaneous crops.*

89. *Pepper.*—The pepper crop completely failed at Taliparamba this year. Heavy hot weather rains started new growth and flowering too soon and the ensuing bright weather and high temperatures caused the vines to shed all their fruits.

90. *Potato.*—Thirty-two varieties of potatoes were tested this year, including 25 varieties obtained from England, five varieties obtained from Australia and two different lots of seedlings raised on the Nanjanad Potato farm. Out of the varieties tested, three of those received from Australia have proved to be the heaviest croppers, but they are not likely to prove of value as the individual potatoes are too large, and the “eyes” are too deep to suit the Indian market. Experiments with different manures show that fish guano is an excellent substitute for cattle manure, and since the latter cannot be obtained on the hills in sufficient quantity for the potato crop, the introduction of this concentrated manure is decidedly useful. Comparing the addition of lime to cattle manure, the crop obtained yielded 6.9 fold against 4.6 fold when only cattle manure by itself is used. Early blight (*Alternaria solani*) as usual made its appearance on the first crop, and attempts to check this disease by spraying gave no appreciable results. Bangle disease (*Bacillus solanacearum*) has made its appearance on the farm for the first time and every effort has been made to prevent its spreading by burning the affected plants and tubers. A Mycological assistant examined the tubers in the store, but found little or no trace of the disease. The second crop last year was very poor on account of the failure of the rains, but as almost all the local crops failed, there was a very keen demand for our seed, this being one of the only crops in the neighbourhood which survived. Considerable damage has been caused by several insect pests, notably a beetle of the genus *Gonicephalum* which did considerable damage to the second crop. This was kept in check by placing poison baits where these beetles were found to congregate and as a result of this large numbers of them were destroyed. The caterpillar of the potato moth caused much damage to tubers both in the ground and after storage. Observation indicates that the damage can be kept in check by proper earthing up, as only those tubers near the surface of the soil are found to be affected. The cut worm (*Euzoa agrotis*) caused considerable damage when the first crop was planted up by eating the tubers as well as the young shoots before the latter appeared above ground.

91. Receipts of the farm from the sale of seed potatoes amounted to Rs. 6,000 against Rs. 2,000 odd in previous years.

(i) *Fodder crops.*

92. The trials with elephant grass (*Pennisetum purpureum*) at the Central Farm have been extended and an area of 12 cents gave in five cuttings a total weight of 20,500 lb. of green fodder. Samples have been analysed and this grass compares favourably with Guinea grass. It is certainly a valuable addition to our fodder crops as it has given double the yield of green fodder when compared with Guinea grass grown on the Central Farm.

(j) *Live-stock.*

93. This work is under the charge of the Deputy Director of Agriculture, Live-stock. The main lines of work carried on are:—(1) the improvement of the Ongole breed of cattle and (2) the improvement of the Madras milk supply. As

regards the former, the work was centred at the Cattle farm established at Chintaladevi. Here, a herd of Ongole cattle is gradually being collected and now consists of 50 cows, 2 breeding bulls, 29 bull calves and 18 heifer calves. Twenty-five calves were born during the year, of which 16 are bull calves. Two calves died and one of the breeding bulls and one cow succumbed to black quarter last October. Efforts are still being made to get a really good breeding bull, but so far without success. None of the breeding bulls on the farm have been found to show any marked prepotency as judged by their calves. Many of the cows are found to be very irregular in coming into heat and this has been remedied by adding a handful of fish meal to their daily rations. In the case of nine cows which had gone for 200 days without coming into heat, six of these came into heat shortly after this ration of fish meal was started. As this is one of the main reasons why the Ongole cattle are so uneconomical, this treatment should prove of value to dairymen.

94. As a result of the inquiry made into the Madras dairy trade, it was decided that the most rapid means of improving this industry was by the importation of pedigree Ayresshire bulls of known milking strain. Four Ayresshire bulls were accordingly imported and originally stationed at Guindy. One of these was transferred temporarily to the Military Dairy Farm at Bangalore as it would not serve cows in Madras. Of the other three, two have died, and, owing to the difficulty of acclimitising these animals to Madras, it was decided to transfer the remaining bull together with the one at Bangalore to Ootacamund after having them protected by serum simultaneous inoculation against rinderpest. The buffalo station which was opened as a temporary measure at Samalkota has been closed down and all the bulls considered suitable for breeding purposes have been distributed. Two are now at stud in Madras and the rest are located at agricultural stations in the I and III circles. Land has been obtained adjoining the new agricultural station at Lam in the II circle suited for a permanent buffalo-breeding station and a survey has been commenced of the chief localities where buffaloes are kept for dairy purposes.

B.—CHEMISTRY.

95. The Chemistry section was in charge of M.R.Ry. Rao Sahib M. R. Ramaswami Sivan Avargal till 14th November 1921 when Dr. Norris returned from leave and resumed charge of it. In addition to a very large number of analyses carried out in connexion with the researches in progress in the laboratory, 554 samples were analysed during the year. Of these, 34 were for the United Planters' Association of Southern India, and 19 for other private parties, a sum of Rs. 810 being collected as fees. In addition to the research work connected with crops which has already been referred to, experiments have been carried out on the utilization of calcium cyanamide and its mode of decomposition in the soil and the by-products formed under the conditions prevailing in Southern India. So far, these experiments have been confined to the laboratory and to pot-cultures. The following results, which generally confirm those obtained in Europe, have been obtained:—

(1) If the manure is thoroughly incorporated in the soil, no harmful results are to be feared and there is little evidence of any formation of dicyanodiamide.

(2) The process of decomposition takes place in two stages, first, the chemical change converting the cyanamide to urea, and secondly, the further conversion of urea by bio-chemical agency into ammonia and nitrates.

(3) The results obtained by growing paddy and ragi as wet and dry crops, respectively, in pot-cultures have given distinctly encouraging results. Dr. Norris states as his opinion that the inconclusive results obtained by the use of cyanamide in the trials made at several experimental stations have been due either to the land being already highly manured and containing a liberal supply of nitrogen, or to the lack of phosphate in the experimental plots having been a limiting factor in crop production. A considerable number of field trials with this manure will be conducted in the coming season on specially selected land.

96. Experiments to ascertain the rate at which different oil cakes become available in Madras soils are being continued, but this work here not yet been completed.

97. Further researches have also been carried on with cholam in order to ascertain the conditions of malting leading to a malt capable of giving a high extract and hence suitable for brewing, and these have been partially successful. There is some evidence that the high fat content in the sorghum grain has a detrimental effect on the resulting malt.

98. Some interesting work has been done relating to methods of testing the ripeness of cane. A few drops of juice are extracted by means of the modified hypodermic needle and the refractive index of this sample determined. The results indicate that the cane ripens joint by joint and if samples when taken from the top and bottom joints show refractive indices the ratio of which is close to unity, the cane is at the most suitable state for cutting; if the ratio is below this, the cane is not matured, and if it is much above this, the cane is over-ripe. If these results are confirmed, as they seem likely to be, this will form a useful method for adoption in experimental work on cane. The results further indicate that the "co-efficient of purity" is not a reliable criterion upon which to judge the ripeness of cane, as has generally been supposed.

99. Dr. Norris collaborated with the Government Agricultural Bacteriologist in drawing up a scheme of experiments on the storage of farm-yard manure in order to ascertain whether it is possible to devise a method which is not costly and which will reduce the loss of plant food to a minimum. This work is being done in co-operation with the Deputy Directors of Agriculture in charge of the agricultural stations where the methods are being tested.

100. There have been several references of late in the Press to the manufacture of "artificial farm-yard manure," and experiments have recently been taken up to see what are the possibilities of this in India. The result of the first experiment is distinctly promising, a well-rotted manure having been prepared from paddy straw using nitrolim as a starter with a loss of less than 10 per cent of the nitrogen. The work has been extended to prickly-pear and other waste products, but Dr. Norris is not yet in a position to discuss these results.

101. Mr. Sivan, who is now the Lecturing Chemist, is conducting experimental work in connexion with improvements in chemical analyses of soils and in the estimation of potash.

Publications.

- (1) *A Soil Survey of the Gōdāvāri Delta*, by Roland V. Norris.
- (2) *Improvement of the Coconut Jaggery Industry on the West Coast*, by the same author.
- (3) *The Availability of Trichinopoly Phosphate as a Manure for Paddy*, by M. R. Ramaswami Sivan (read before the Science Congress).
- (4) *Scope and Limitations of Agricultural Research*, by the same author (read before the Science Congress).

C.—BACTERIOLOGY.

102. Reference has already been made to the investigation made into the cause of the premature fall of cotton bolls and the possible insect agency which is responsible for spreading the disease. A repetition of the work has been conducted this year and a statistical record has been kept of the amount of boll fall in which the bolls show symptoms of the disease. It seems very likely that the specific organism finds its way into the bolls by insect agency. It is possible that an insecticide rather than a bactericide will be required to control this disease. In collaboration with the Deputy Directors of Agriculture, III and VI Circles, an investigation was carried out to test the value of ammonium sulphate as a manure for cotton. This was suggested by the late Mr. Stuart having regard to the results

reported from the Central Provinces. The results obtained in Madras have not been encouraging and have not borne out the experience of the Central Provinces. A considerable amount of soil analysis has been carried out by this section in order to determine the fluctuation in nitrogen content in the soil of different localities at different seasons of the year. The general conclusions arrived at indicate that, no matter what the locality is, the maximum nitrogen fixation occurs during the hot weather, it diminishes through the monsoon, and reaches a minimum in the cold weather.

D.—GENERAL BOTANY.

103. M.R.Ry. Rao Bahadur K. Ranga Achariyar's *Handbook of Some South Indian Grasses* as well as the second edition of his *Manual of Elementary Botany for India* were published during the year. A considerable amount of work has been done in studying the weeds on agricultural land. The preparation of the Madras Flora at Kew by Mr. Gamble is still in progress and a few new species have been described and named.

Publications.

- (1) *A Handbook of Some Common South Indian Grasses*, by K. Ranga Achariyar.
- (2) *A Manual of Elementary Botany for India*, second edition, by the same author.
- (3) *Proliferation in Opuntia* (*Journal of Indian Botany*), by P. S. Jivanna Rao.
- (4) *On Pollen Sterility in relation to Vegetative Propagation* (read before the Agricultural section of the Science Congress), by the same author.
- (5) *Nature Study* (*Madras Agricultural Students' Union Journal*), by the same author.
- (6) *On the Cause of Bud and Boll Shedding in Cotton*, by the same author.

E.—ENTOMOLOGY.

104. Reference has been made to the work of this section under the major crops already described. A considerable amount of systematic work has been done and a very large number of insects have been identified by various specialists. The Government Entomologist specially engaged himself in studying the *Miridæ*. It is encouraging to note that a much larger number of the public are interesting themselves in the work of this section, and during the year under report, some 200 reports of insect pest damage have been received and remedial measures suggested. A large number of these relate to paddy and cholam pests.

Publications.

- (1) *The Pink Boll Worm, 1920-21*, by E. Ballard.
- (2) *Further Notes on Pempheris affinis, Fst.*, by the same author.
- (3) *Siga (Schoenobius) incertellus, Wlk.*, by the same author.
- (4) *Two new Species of Ragmus from South India* (*Indian Museum Notes*)—E. Ballard.
- (5) *Bacterial Infection of Cotton Bolls*, by E. Ballard and Mrs. D. Norris. (*Agricultural Journal of India*).
- (6) *Triphleps tantilus, Motsch* (*Agricultural Journal of India*), by E. Ballard and Mrs. D. Norris.
- (7) *Helopeltis theivora* (*Planters' Chronicle*), by E. Ballard and Mrs. D. Norris.
- (8) *Weevil Fauna of South India* (*Bulletin*), by T. V. Ramakrishna Ayyar.
- (9) *The Entomologist's Crop Pest Calendar* (*Departmental Bulletin*), by T. V. Ramakrishna Ayyar.
- (10) *Bird Friends and Foes of the Farmer* (*Departmental Bulletin*), by P. Susainathan.

F.—MYCOLOGY.

105. Reference has already been made to the work which is being done on diseases of paddy and sugarcane. In addition to this research work is being done with the germination of the Oospores of *Sclerospora graminicola*, a disease which causes the shedding of leaves of cholam, in order to ascertain how this disease spreads. Field experiments have been laid down to determine the causes of cotton wilt and how it spreads. Cross inoculations with *Rhizoctonia* found on cotton and its hosts, black gram, cow pea, linseed, lucerne, sunnhemp, and *Tephrosia candida*, are being tried in order to ascertain whether this disease can be spread when the fungus occurs on plants of other species.

106. The Rubber Mycologist has been investigating many diseases connected with rubber. As regards the secondary leaf-fall, experiments have been laid down to see how far soil treatment with different manures will lessen this trouble. Investigations into the shedding of leaves conducted in the field and in the laboratory have established the fact that trees which were previously considered to be disease resistant are severely attacked but do not shed their leaves. Investigation has also been undertaken in connexion with the dieback of shoots of young rubber, patch canker, stripe canker, and brown bast.

107. In addition to purely mycological work, much work of an agricultural nature has been done in order to improve soil sanitation, etc. Attempts will also be made to propagate better yielding and leaf-fall resistant varieties of *Hevea* by the method of grafting. Experiments in tapping in order to reduce the cost of this process, which is especially important in these days of low rubber prices, were conducted last year. These were designed to ascertain the relative yields and to decide the economy involved in tapping both morning and evening. Although the afternoon tapping showed approximately 15 per cent less rubber than when trees were tapped only in the morning, it was found that, if the labour force were concentrated on both morning and evening work, the cost of harvesting is halved and there is a reduction of only $7\frac{1}{2}$ per cent in the yield. This has meant a great saving to many estates which have thus been enabled to carry on, when otherwise they would have had to close down owing to the fall in the price of rubber.

108. Mr. Ashplant has also during his course of investigation discovered a process whereby rubber can be directly vulcanized from the latex, and it is possible that this may prove of considerable commercial importance.

Publications.

- (1) *A new Ginger Disease in Gōdāvāri district caused by Vermicularia.*
- (2) *Bleeding Disease of Coconuts.*
- (3) *Helminthorium Disease of Rice.*
- (4) *The Spraying of Grape-vines against Mildew.*
- (5) *Leaflets on Red-rot on Sugarcane and Bleeding Disease of Coconuts for the Publicity Bureau.*

G.—SERICULTURE.

109. The work in this section has been hampered by lack of funds. It has not yet been possible to start a central farm at Kollegal. The benefit of breeding worms at a high altitude in order to induce increased vigour in the case of cocoons required for seed has been amply demonstrated this year. Seed obtained from cocoons reared from the Coonoor silk farm has been found not only to give more silk but to command a higher price. The rearings from every 1,000 seed cocoons gave a maund more than the average yield in weight and the cocoons command a price of Rs. 2 a maund more than the market price owing to their better size and quality. Notable improvements have taken place in the rearing of silk worms in Kollegal, of which the following may be mentioned. More careful selection of cocoons for obtaining seed; gentle brushing of newly hatched worms; limiting the number of worms to each tray; better methods of cleaning the litter from the

trays; better handling of ripe worms before spreading them in the spinning tray; better ventilation of rearing rooms. As regards reeling of silk, the importance of changing the water frequently to give better lustre to the silk and regulating the number of cocoons to produce even thread has been demonstrated.

110. Considerable attention has also been paid to the disposal of silk waste, which if kept in a cleaner state commands a better price.

111. At the instance of the Revenue Divisional Officer, Rayadrug, the cultivation of mulberry and silkworm has been successfully introduced into the village of Hudem in the Kudligi taluk of the Bellary district. It has been so successful that arrangements have been made to extend its cultivation in this and surrounding villages to an area of 35 acres, and many ryots are being taught the rearing of worms and silk reeling.

Publication.

A pamphlet on *Sericulture* in Kanarese by K. T. Achayya.

IV.—DEMONSTRATION.

A.—OPERATIONS AGAINST DISEASE.

112. *Application of the Pest Act to Cambodia cotton.*—There is no need to go into details as to the necessity for the enforcement of this Act, as this has been fully described in previous reports. The Act was applied in the taluks of Omalur, Tiruchengodu, Salem, Namakkal, and Rasipuram in the Salem district; Karur, Kulittalai, Musiri, Trichinopoly, and Lalgudi in the Trichinopoly district; and the whole of the Madura district and of the Coimbatore district except the Kollegal taluk. The usual propaganda work was carried out by means of posters, lantern lectures, and demonstration at important centres and at jamabandi camps. Cases did occur last year where the Act might be considered a hardship, especially in places where sowings were continued as late as January. These were made possible by heavy rains in that month. But, on the whole, there was little difficulty in having the crop removed by the appointed date. It is satisfactory to note that the high quality of the cotton of this year is largely due to this unpopular measure, and there are signs that the pink boll worm itself is decreasing in numbers.

113. *Application of the Pest Act to Palm disease in the Northern Circars.*—The Pest Act was in force for the second year against the budrot of palmyra palms attacked by the fungus known as *Pythium palmivorum* in the Kistna and Gōdāvari districts, the Kēpalle and Tenali taluks of the Guntūr district, and the Polavaram, Yellavaram, and Chodavaram taluks of the Agency division. The operations were carried out by a special staff of one tahsildar, one deputy tahsildar, and twelve revenue inspectors; and a Special Deputy Collector was also employed for four months in the year, first to start this staff on right lines and afterwards, at the height of the working season, to stimulate the said staff and village officers, to supervise the operations generally, and to report on the progress made. The usual work of propaganda and inspection of diseased and neighbouring trees was followed, with no material change in the methods adopted in eradicating the disease. As in the previous year, the brunt of this work was borne by the special revenue inspectors, but village officers displayed some activity in detection work at the close of the season and they co-operated with the special staff in their inspection, inducing tree-owners to take prompt action against the disease. There were no claims for compensation and the Act worked smoothly on the whole. In the Gōdāvari district, only two appeals were preferred for extension of time under section 6 (2) of the Act and one individual was convicted for non-compliance with the notice issued under section 6 (1) of the Act and sentenced to a fine of Rs. 50, the civil suit filed by him having been dismissed. In the Kistna district, an obstinate defaulter was fined Rs. 20 and a few more prosecutions were

sanctioned during the year. It is satisfactory to note that in some cases action was taken by tree owners *suo motu* in pursuance of the general notification under section 4 of the Act and in a considerable number of cases the remedial or preventive measures were taken on the oral requisition of the inspecting officers, i.e., without a written notice under section 6 (1). The disease, which since 1916 has been steadily on the downward move, showed during the year under report a marked decline despite the heavy rainfall followed by the cold weather, conditions favourable to its spread, this decline being particularly noticeable in the Gōdāvari district, which is at once its birth-place and stronghold.

114. *Mahali disease of arecanuts*.—A serious recrudescence of this disease was reported by the garden owners of Honnavar Magane of the Coondapur taluk in the South Kanara district and assistance had again to be rendered by the department in supplying materials for spraying, spraying machines, etc. Very careful demonstration work was carried out at this place by the Mycological section in the years prior to 1913 when the methods of dealing with this disease were fully demonstrated and understood, and it is disappointing to note that further help should again be required in an area where the garden owners are fully conversant with the necessary remedial measures. This disease remained more or less in abeyance in the arecanut gardens in the south of the Malabar district, but at the time of writing I hear that it has broken out again in a virulent form on account of the early and heavy monsoon. The garden owners here, however, fully appreciate the remedial measures which have been demonstrated in the past and are making their own arrangements to carry out the necessary spraying which has to be done to keep the disease in check.

115. *Cholam smut*.—The sale of copper sulphate for treating sorghum seed as a preventive against smut has now become a regular item of demonstration work in the Kurnool and Bellary districts. Sufficient copper sulphate was sold in 212 villages to treat the seed required for over 45,000 acres. Similar work has been started in the Coimbatore district, where much loss is incurred annually on account of this disease. This is specially serious in districts like Coimbatore, where much of the crop is raised under well irrigation.

116. *Rice hispa*.—The Entomological section has done good work in the South Kanara district in demonstrating methods of keeping under control the rice hispa. The remedies demonstrated were simple and effective. But until there is closer co-operation among the different growers, it is impossible to expect that much can be done. It is no use clearing one man's field of this beetle if the owner of the next field refuses to have his crop treated in the same way. A note on this work has already been communicated to the Publicity Bureau.

117. *Spraying demonstrations*.—Small spraying demonstrations have been conducted in the Mycological section in the case of diseases attacking a few crops of minor importance. The benefits of spraying against a disease known as *vermicularia*, which affects turmeric, have been successfully demonstrated along the Cauvery valley in the Erode taluk. Spraying grape vines against mildew has also been successfully demonstrated in the villages in the Madura district where these crops are of comparatively recent introduction. Several of the owners of these vineyards have now provided themselves with the necessary apparatus to carry on the work without departmental help.

B.—CROPS.

118. *Sugarcane*.—In the I Circle, three demonstration coolies were employed to demonstrate line planting of sugarcane as well as improved methods of jaggery manufacture in the Vizagapatam district. Demonstration plots of Java 247 were established on ryots' lands in three new centres in the Vizagapatam district and in five new centres in the Chicacole and Berhampur taluks of the Ganjām district. In the Aska taluk, there has been a large increase in the area introduced under Java and Barbados varieties, and as a result of this, there has been a considerable extension in the cane area amounting to 80 acres, grown by the Aska Sugar Factory. All these centres will be used this year for supplying setts for planting.

to those who require them. Close on one lakh of setts of these varieties have been distributed from the agricultural stations of this circle, over 90 per cent of these being Java 247, which is very disease-resistant and adaptable to different soil conditions.

119. In the III Circle, trials of new varieties of cane have been carried out at Hospet and Kampli in the Bellary district and at Cumbum in the Kurnool district. None of these varieties have been found to be better than the local cane, but as the season was very adverse, further trials are again being made this year. A number of demonstrations were carried out in the Hospet taluk with improved methods of making jaggery, but the difficulty experienced here is that jaggery making is usually done by a professional class coming from Hyderabad and not by the owners of the crops themselves. It is very difficult, therefore, to introduce new methods to people who are not materially interested in the crop. There has been a considerable increase in the area under improved varieties of cane in tracts outside the Cuddalore taluk of the IV Circle. The area under these varieties has risen from 39 to 116 acres. Much of this extension is due to ryots obtaining seed from crops of others who had grown them in the previous year. The department was responsible, however, for the distribution of a lakh and a quarter setts. Trench planting of cane has been successfully demonstrated near Gudiyattam in the North Arcot district and 30 acres were planted under this system in the neighbourhood of the demonstration farm there. The Sindewahi furnace is becoming popular as a result of demonstration and assistance was given in the erection of 34 of these furnaces. In the VII Circle, the department still keeps an eye on the work of cane improvement in the South Kanara district. Practically the whole of the crop here as well as the present methods of dealing with it are the result of demonstration work by the department and this has now become the ordinary local practice. Two new varieties, viz., Fiji B and Java Hebbal, show great promise and all the available setts have been distributed on seed farm conditions this year. In the VIII Circle, over 30 new furnaces on the Sindewahi model are now in use chiefly in the cane areas round Singānallūr, and these are becoming extremely popular as they are so economical of fuel.

120. *Cotton*.—In the I Circle, several crops of Cambodia cotton were grown by ryots under the careful supervision of the demonstrators of this department, so that the cultivation of this crop should be based on sound lines before any extended distribution of seed was contemplated. The failure of the season last year seriously checked the progress of our cotton work in the "Northerns" and "Westerns" areas. In spite of this, however, it was possible to arrange for the distribution of 130,000 lb. of H. 25 seed in the Bellary district both to seed unions and private growers, which was sufficient for sowing some 13,000 acres. Though this is a very small increase over last year's area, it is most encouraging, considering how poor were the season prospects in 1921-22 in this Circle, and even this area would not have been possible if permission had not been granted to sell this seed on credit: so great was the poverty of the ryot throughout the tract. In the Kurnool district, the season was not at all favourable to the cotton crop, which is shown by the fact that the area sown in the tract is only 50 per cent of the normal. Most of the sowings were very late and many people were afraid to sow the seed of N. 14 which the department are issuing as they feared that this might prove too late in maturing in such a late season. As a matter of fact, this cotton has yielded very much better than the local mixture and its popularity seems now to be established. In all, some 8,500 acres were sown with this strain, most of it by seed unions who had managed to get their previous supply of seed mixed. In the VI Circle, the area under departmental seed farm was a little over 200 acres. The greater portion of this seed has been sold to seed unions, several of which are now working satisfactorily and which last year sold sufficient seed to sow over 44,335 acres.

All these seed unions in the past had been encouraged by a small bonus which was paid according to the amount of seed sold by each. Opportunity was taken of the distribution of these bonus amounts to hold a large scale demonstration at

the Kōilpatti agricultural station, and improved implements were shown at work, lantern lectures were given at night and catering and other arrangements were made for the comfort of visitors. This year, M.R.Ry. R. Appaswami Nayudu Garu, M.L.C., Zamindar of Illavarasanendal, presided over the event. There has been a slight increase in the area brought under drill cultivation and it is quite encouraging to note that the bulk of the area cultivated in this way has been done by the farmers without any departmental assistance.

121. Pulichai cotton again made its appearance this year, but as far as can be ascertained in most cases the sowing of this variety was unintentional. In places large areas had to be re-sown and people had to use what seed they could obtain. It is gratifying to note that the cotton dealers in Tuticorin have at last realized that it is to their advantage as well as to the advantage of the growers to grow pure Karunganni. Many a cotton dealer had his fingers burnt by paying too high a price for *kapas* in the belief that this would give him a reasonable ginning outturn, and when he ginned his *kapas*, it was found that it consisted almost entirely of Uppam and ginned at nearly 25 to 26 per cent; whereas Karunganni will gin at 32 and 33. Such losses must make the dealer careful as to what price he can pay for *kapas*. As long as a mixture of Uppam and Karunganni is grown, he cannot pay the full market value as he would if pure Karunganni were grown. In this way, producers themselves are bound to lose money on this crop. The Tuticorin Cotton Dealers Association has, therefore, gone in for a widespread propaganda advocating the sowing of pure Karunganni.

122. In the VIII Circle this year, an area of 485 acres of Cambodia cotton was grown on seed farm conditions for the department by ryots of the Avanashi taluk. All this crop was grown on garden lands. This area represents the cotton crop of 93 ryots in 14 different villages. A new strain, No. 15, was grown on 50 acres of this area and is likely to become very popular not only as a heavier crop but as a cotton of superior quality. Although nearly 270,000 lb. of seed was stocked for sale, only a little over 100,000 lb. was sold for seed purposes, as it was found that they had to compete with the seed merchants in the district who sold their seed on lower rates than that of the departmental seed. In addition to this work, some 40,000 lb. of Karunganni seed was imported from the Tinnevely tract for sale distribution in the Coimbatore district and it is gratifying to note that Karunganni cotton is now fairly established here and is regularly quoted in the weekly market reports. The work of cotton improvement in the VI Circle is now self-supporting and a gain of about Rs. 4,000 is made on an expenditure of Rs. 12,000. In the VIII Circle, on account of the large quantity of the seed which was left over at the end of the season, there was a slight loss of Rs. 2,400 over a net expenditure of over a lakh. In the III Circle, there was a slight loss of Rs. 370 over an expenditure of a little over Rs. 19,000. Taking the whole work of cotton improvement in the Presidency, it has this year more than paid for itself.

123. *Paddy—Varieties.*—Over 54 tons of selected strains of paddy seed were distributed during the year by the department from the seed available at agricultural stations and seed farms. The major portion of this seed was distributed in the IV and V Circles. This quantity is sufficient to transplant over 6,700 acres of wet land. At first sight, this may appear insignificant considering that there are over 11 million acres under rice in the Madras Presidency, but it must be remembered that this work has been going on for several years and that now a very large proportion of the crops raised from this seed is reserved for seed purposes and that each acre of land grown with such seed may be estimated to supply seed sufficient to sow some 120 acres. As an example of how a new strain spreads, it may be mentioned that two years ago strain No. 24 was tested on ryots' lands by the Deputy Director of Agriculture, VIII Circle, near Erode, and so successful did this trial prove to be that very large areas under the Kalingarayan channel are now grown with this strain. Similar extensions are reported where this variety has been tested in the Attur taluk of the Salem district, in the Trichinopoly taluk of the Trichinopoly district, and along the Amaravati valley in the Coimbatore

district. It is impossible to keep track of the rate at which selected strains of seed spread, but this gives some indication of the possibilities of the improvements possible in improving the varieties of rice now grown in this Presidency.

124. *Green manures.*—The work of popularizing the use of green manures grown on wet land after the harvest of paddy still occupies a prominent place in the district work of this department. This work, however, has its ups and downs. The cultivation of dhaincha (*Sesbania aculeata*) as a green manure crop has received a serious check in the IV, V and VIII Circles. The reason for this is that the rainy season last year was very early and all the dhaincha crops grown were ploughed in before they had set seed. The consequence was that, when the time came to grow such crops in the following season, seed was not available and we had once again to indent on the Bengal Presidency for a supply of seed at a very high cost. In the Gōdāvāri and Kistna deltas, dhaincha as a green manure crop is finding favour with the agricultural population and it is replacing Teegapesalu and Sunn-hemp. Now our attention has been concentrated on experiments to see how far it is possible to raise this seed on dry lands. If this proves to be profitable, it will solve our difficulties in regard to seed supply. Last year, some 16,000 lb. of dhaincha seed was sold to the public for growing green manure crops.

125. The practice of growing *kolinji* (*Tephrosia purpurea*) as a green manure crop is becoming increasingly popular, and the department is responsible for selling last year some 144,000 lb. of seed sufficient to sow some 16,000 acres of land. This, however, by no means limits the area grown with this green manure crop. The cultivation of *kolinji* is becoming a regular agricultural practice in those parts of the Cauvery delta where the soil conditions permit it to be grown. The Deputy Director of Agriculture, V Circle, estimates that some 300,000 lb. of *kolinji* seed was collected in the Vedaranniyam tract of the Tanjore district. Over two-thirds of this quantity were privately sold, either to co-operative societies or to landholders or dealers. But a major portion of this was utilized in the Cauvery delta by the ryots for growing their green manure crops. Similarly in the Periyar area, cultivation with *kolinji* green manure is now an established practice and a major portion of this seed is supplied by private dealers who purchase it in the zamindari areas at the foot of the ghats in the Tinnevely and Rāmnād districts.

126. It is some nine years ago since the Agricultural Department first demonstrated the use of *kolinji* as a green manure crop under the ayacuts of the Bhavani river. I recently had the opportunity of inspecting this area and was very gratified to see that extensive stretches of this ayacut are now grown with *kolinji* for green manure. It is also gratifying to note that in this area private enterprise last year competed with the department to supply seed and it is anticipated that in the future this work can be left to private enterprise which will enable our district staff to take up fresh fields of work.

127. Some 12,000 lb. of sunn-hemp has also been distributed this year by the Agricultural Department for growing as a green manure crop.

128. In the Planting districts also, the use of green dressings and cover crops is becoming established as a regular practice, as a result of the operations of the department, and replacing the more general system of clean weeding which leads to loss of soil by erosion in these rain soaked areas during the monsoon. Thousands of acres of rubber are now under *Tephrosia candida*, while in the tea estates various species of *Crotalaria*, *Desmodium*, and *Cassia*, and selected weeds like *Omalis corniculata* have been found useful to prevent loss of soil. The systematic use of leguminous trees like *Erythrina* and *Leucaena* as secondary shade and to supply green manure is being adopted on coffee estates and the possibilities of growing green manure crops on waste lands are also under investigation.

129. *Other manures.*—The necessity for utilizing the available concentrated manures for rice cultivation is being forced upon the country and the results of the experimental work on our agricultural stations, as well as the soil surveys which have been made by the Government Agricultural Chemist, indicate that the chief

requirements of our wet land areas are phosphates and nitrogen. This is especially the case on old established wet lands where, as one would expect, the phosphates in the soil are usually deficient. The basis of most of our manurial propaganda is this shortage of phosphate. One of our main difficulties in popularizing these concentrated manures which contain phosphates is that (1) these seldom bring more than 50 to 100 per cent profit on the money invested on their purchase, and (2) when phosphatic manures are applied to rice lands, only a portion becomes available to the crop in the first year of application. As a result of research work carried out at the agricultural stations and by the Government Agricultural Chemist at Coimbatore, it has been ascertained that phosphatic manures such as bone-meal and Trichinopoly phosphate become much more readily available when applied in conjunction with organic manures like green manure and oil cakes, and a large portion of our demonstration work in manures has been concentrated on popularizing the use of such phosphatic manures applied in conjunction with organic manures.

130. The farmer naturally likes to see a very marked increase in the yield on the application of manures and it is unfortunate that his education is so limited that in many cases he is unable to work out the profit and loss from their use, and as the first step of our demonstration, it has often been necessary to advocate the use of more expensive manures such as fish guano in order that the farmers may themselves see that these concentrated manures are capable of giving improved and greatly increased yield. Considerable progress in the use of such manures has, however, been made both in the Gōdāvāri and Kistna deltas and in the Cauvery delta. Many other difficulties in popularizing these manures are experienced, especially in the south, where such large areas are farmed by the agents of absentee landlords. A manure mixture based largely on the results of our experiments at Manganallur, has been popular. Our greatest success, however, has been not on the Tanjore delta proper but in the Lalgudi taluk of the Trichinopoly district, and in the Tanjore taluk of the Tanjore district, at the head of the delta. Here a much larger portion of the area is directly farmed by the owner ryot and it is this class of farmers who really appreciate the use of such manures. The work done in this direction is really appreciated and the results are sound, although for propaganda purposes they may not be advertised so well as when the better educated and larger land-holding classes adopt such improvements in their cultivation.

131. *Coconuts*.—There has been a considerable awakening in the South Kanara district to the possibilities of coconut topes. When the coconut trees were once established, it was the practice to give no further attention to them. The methods adopted at the Kāsaragōd station, where a large increase in crops has resulted from after treatment, have led to considerable interest and imitation and the district staff stationed in this district have done all in their power to bring our improved methods to the notice of the cultivators. During a recent inspection of the coconut station at Kāsaragōd, I had the opportunity of reading the visitors' book. I noticed in this that several gentlemen had pointed out that very few of our neighbours had adopted the methods which had been found so successful. I made a careful inquiry into the causes of this and discovered that wherever it had been possible the tenants had willingly adopted the improvements which they could see yielding good results at the station. In most of the gardens, however, the tenant is not in a position to alter his present methods. In most cases, the houses in these gardens were rented out to one individual, the ground in the garden to another, and the *usufruct* of the tree rented to a third person. I mention this to illustrate some of the difficulties which are met with in carrying out demonstration work by our district staff.

132. *Implements*.—Three disc, 21 vitis, and 88 monsoon ploughs were sold during the year mostly in the IV, VI and VIII Circles, and 7 Meston ploughs sold in the VII Circle. All the iron ploughs on hand and 39 drilling implements

were sold in the VI Circle, where a good demand exists for suitable iron ploughs for use in the black cotton soils. Eleven mhote buckets were sold in the I Circle. A loan of Rs. 200 was sanctioned to a ryot in the VI Circle for the purchase of a disc plough.

133. *Live-stock*.—It is gratifying to note that the breeding bulls at the agricultural stations are becoming exceedingly popular, as is demonstrated by the fact that a substantial sum was collected for service. The grant of a premium of Rs. 100 for the second year was made to the Honorary Secretary, Ramasamudrakadu Panchayat Committee, Karkal, in the South Kanara district.

134. *Poultry Show*.—The usual poultry show was held at Ootacamund and the Central Farm won prizes for their exhibits.

135. *The Tiruppūr Cattle Show*.—This show was opened on the morning of the 10th June 1922 by the District Collector, and on the 12th the Hon'ble the Minister for Developments distributed the prizes which had been won. The entries in some of the classes at the show were disappointing, especially the small ryots' section. There were some good animals in the fair and prices for a good pair of working bullocks ranged from Rs. 400 to Rs. 600. The Pattagar's cattle were, as usual, the best at the show and it was a pleasure to see his rows of cattle all with the same characteristic type and appearance. The animals were turned out in an excellent show condition and would have done credit to any stock breeder in England.

The Agricultural Department conducted an exhibition at this show for the benefit of the visitors. Different varieties of improved cotton, paddy, ragi, and green manure seeds were shown and were on sale. Bulletins, leaflets, etc., published by the department were also displayed and were on sale. Improved agricultural implements were exhibited, each being labelled to show its use and price. In a field near the show, demonstrations were given with Vitis and Victory ploughs and their advantages explained. A model Sindewahi furnace was set up and officers on duty explained its advantages and how it economized fuel. Demonstrations were also given of the best methods of preserving cattle manure so as not to waste the urine. Model sheds were erected with bullocks actually tied in them, while samples of the manure to be obtained were there for inspection. Both the Entomologist and the Mycologist had exhibitions, the former of insects which damage Cambodia cotton and other crops, and the latter of fungoid diseases of various sorts with descriptions of how to deal with them. In the evening, lectures illustrated by lantern slides were delivered by officers of the department. The first lecture was given by the Entomological Section and dealt with cotton insects, the necessity for, and the benefits which have accrued from, the introduction of the Pest Act. The second lecture was by the Mycological Section and dealt with crop diseases and their remedies, and the third lecture dealt with improved agricultural methods such as the economic seed rate, single planting of paddy, the use of green dressings, drill sowing, inter-cultivation, improved implements, and methods of improving the cattle.

A complete exhibition of the silk industry from the silk-worm seed to the woven cloth, with worms in all stages and practical silk reeling going on, was also given by the Government Sericultural Expert. A special lecture on cotton pests was given.

A great deal of interest was taken in the department's exhibition at which officers were constantly present to explain things, and the lantern lectures were well attended.

136. *Miscellaneous*.—The Deputy Director of Agriculture, II Circle, inspected the lands of the Kavali Agricultural Criminal Settlement in the Attur swamp of the Nellore district and came to the conclusion that owing to defective drainage the probability of improving and reclaiming these lands was difficult, if not impossible. He has advised the manager of the settlement to try dhaincha for green manure. The same Deputy Director also inspected the Stuartpuram

settlement in connexion with the supply of farm-yard manure for the additional land to be brought under cultivation and the purchase of small cheap cattle for the purpose.

V.—AGRICULTURAL ENGINEERING.

137. The main work of the Agricultural Engineering Section during the year related to the supervision of all machinery and installations and departmental construction and repairs on the estate. The instruction of the students continued to be in the direct charge of the Lecturer in Engineering. Work in the workshops was handicapped for want of timber. Final plans and estimates for the new office and workshops are not yet ready.

138. The motor lorry was doing good work and found to be extremely useful on the estate. It was sent to Guntūr in February 1922 to serve for military transport and was returned to Coimbatore only in June 1922.

139. The Government Agricultural Engineer carried out trials with the Ramachandra plough. None of the officers who attended the trials gave a favourable opinion of this plough. The Government Agricultural Engineer made a plough himself which he is trying to improve further before testing it against other patterns of plough.

140. *Motor ploughing.*—None of the tractors owned by the department have been found to be of much use. They are too light and too low-powered and they are not strong enough for deep ploughing. Consequently, breakdowns are frequent. The "Fordsons" are, besides, much too extravagant of fuel and oil. They are also dangerous as they are apt to kick up when the plough sticks. Owing to their low power, they can do the ploughing required of them only on the low gear and this causes the engine to heat. The Fordson at the Central Farm, Coimbatore, ploughed 14.21 acres of black cotton soil and that at Koilpatti ploughed 16½ acres. The cost per acre, exclusive of interest and depreciation, came to Rs. 16-6-3 at the former and Rs. 14-15-0 at the latter. Arrangements are being made to sell these tractors. The Austin was *hors de combat* throughout the year. The Austin Motor Company, Birmingham, undertook to replace the broken differential free of cost, but spare parts were not obtained till after the close of the year. The Cleveland tractor ploughed 31½ acres in two villages near the Central Farm. The trials cannot be said to have been successful as the mere cost of fuel and oil per acre at these trials amounted to Rs. 8-2-10 in one case and Rs. 11 in another. The tractor was used to harvest 23 acres under cholam and the running expenses were Rs. 2-11-0 per acre.

141. Mr. R. C. Wood attended the tractor trials at Shrawardine near Shrewsbury in September 1921 and submitted a report on them. His report shows that no adequate structural alterations in tractors have since been made which will render them more suitable for Indian conditions. The subject of motor tractor cultivation came up before the Board of Agriculture this year.

142. The trials made with motor tractors have not been altogether successful. The main use of cultivation by power is the eradication of deep-rooted weeds in black cotton soils. This necessitates the land being ploughed deeply when it is in as dry a condition as possible, and the period when such ploughing is possible coincides with the hottest parts of the year. None of the tractors which have so far been tried are sufficiently powerful to draw the plough except on low gear. This necessitates the engine being continually run at a high speed. What with this and the heat radiated from the ground, it is difficult to keep the engine sufficiently cool for continuous running. This is naturally a severe strain on the tractors and none of those so far tried have satisfactorily come through the rather exacting conditions which are required of them. Tractor trials, therefore, for preliminary cultivation have been held in abeyance until more suitable types of engines are evolved. This has enabled our Agricultural Engineer to devote more time to his legitimate duties of investigating the possibilities of improving the

indigenous implements for cultivation. He is at present investigating modifications of our country plough and the various improvements suggested for seed drill and inter-cultivation implements.

VI.—PUBLICATION AND SUPPLY OF INFORMATION.

143. *A Handbook of Some south Indian Grasses* by M.R.Ry. Rai Bahadur K. Ranga Achariyar Avargal, Government Lecturing and Systematic Botanist, was published during the year, while a second, revised and enlarged edition of his *Manual of Elementary Botany for India* was also brought out, for which he was granted an honorarium of Rs.750.

144. Particulars of the leaflets and bulletins issued by the department during the year are shown in the subjoined statement :—

Number.	Subject.	Prepared by	Language.	Number of copies.
Leaflet No. 13.	The present state of the Mulberry Silk-worm Industry of the Madras Presidency and its possible improvements.	M.R.Ry. K. T. Acharya Avargal, Sericultural Expert.	Kanarese ...	2,500
Leaflet No. 14.	Note on the monsoon Plough ...	M.R.Ry. T. Venkatappayya Chetti Garu, a ryot of Markapur, Kurnool district.	Telugu ...	7,800
Leaflet No. 15.	Coconut Stem-bleeding Disease.	M.R.Ry. S. Sundararaman Avargal, Government Mycologist.	English ... Tamil ... Telugu ... Malayalam ... Kanarese ... Tamil ...	1,600 10,100 4,100 4,100 2,300 1,000
Leaflet No. 16.	Note on Mildew on Grapes and how to prevent it.	Do.		
Leaflet No. 17.	Prickly-pear as Fodder ...	M.R.Ry. P. H. Rama Reddi Garu, Deputy Director of Agriculture, III Circle.	English ...	2,500
Bulletin No. 80.	The Entomologist's Crop Pest Calendar for the Madras Presidency.	M.R.Ry. T. V. Ramakrishna Ayyar Avargal, Teaching and Systematic Assistant to the Government Entomologist.	Do. ...	1,500
Bulletin No. 81.	Bird Friends and Foes of the Farmer.	M.R.Ry. P. Susainathan, Assistant to the Government Entomologist.	Do. ...	500
Bulletin No. 82.	A Note on Casuarina Plantations in the Visagapatam district.	M.R.Ry. G. Jogi Raju, Farm Manager, Samsikota.	Do. ...	1,500
Bulletin No. 83.	A Soil Survey of the Godāvāri Delta.	Dr. Roland V. Norris, Government Agricultural Chemist, M.R.Ry. B. Viswanatha Garu, Assistant Chemist, and M.R.Ry. S. Kasinatha Ayyar, Assistant to the Government Agricultural Chemist.	Do. ...	400

145. The Villagers' Calendar for 1921-22 was, as usual, printed in English, Tamil, Telugu, Malayalam and Kanarese, the total number of copies in all the languages being 107,400. These were distributed by the Publicity Officer, Madras, as heretofore.

146. The Library Catalogue of Bulletins, Pamphlets and Reports under subjects, corrected up to December 1918, and a supplemental Catalogue of Books received in the Library at Coimbatore up to the 31st December 1921, were also printed during the year.

147. Realizing the necessity for advertising the operations of the department, a monthly digest thereof prepared by an officer of the department is being published by the Publicity Officer, Madras, with effect from January 1922.

VII.—STATISTICS.

148. My Statistical Assistant inspected the statistical records in the taluk offices at Karur, Erode and Tiruchengodu in April 1921. It is not possible for him to do much work of this kind and the condition of these records is bound to deteriorate more and more as my proposals for an inspecting staff of four officers have not been sanctioned by Government.

149. The usual forecasts on the important food and industrial crops were issued during the year. The fact that there is an increasing demand for our forecasts not only from this Presidency but also from other Presidencies, shows the growing reliance placed by the trade on them.

150. Government sanctioned the issue of a fifth forecast on cotton in April. This was accordingly published for the first time in April 1922.

151. The weekly returns of raw cotton received at mills and presses were, as usual, published. The value of these statistics has been repeatedly acknowledged by the trade. It is interesting to note that our returns are fairly complete though the corresponding all-India returns were abolished on the ground that the returns from other Provinces were found incomplete.

152. The transfer of agricultural statistics referred to in previous administration reports was given effect to on 1st June 1922. Weekly season reports and statistics of retail prices were also transferred from the Board of Revenue on the same date in accordance with the recommendations of the committee on the improvement of the statistics of prices.

153. Orders have not been received on the report of the committee appointed in 1920 to suggest improvements in the method of recording and publishing rail-borne statistics.

VIII.—MISCELLANEOUS—ACCOUNTS.

154. The expenditure and receipts for the year under report and the corresponding figures for the previous year are given below:—

	1920-21.	1921-22.
	RS.	RS.
Expenditure	12,92,471	13,86,005
Receipts	3,42,026	3,64,494
Net expenditure	<u>9,50,445</u>	<u>10,21,511</u>

155. The figures for 1921-22 are taken from the final accounts for March 1922 furnished by the Accountant-General. The cost of acquisition of land for opening a Paddy-breeding Station at Aduturai and a Cotton-breeding Station at Coimbatore accounted for the increase in expenditure.

156. The increase in receipts was mainly under "Agricultural Stations" and "Sale of Cotton Lint and Seeds."

I have the honour to be,

Sir,

Your most obedient servant,

H. C. SAMPSON,

Officiating Director of Agriculture.

APPENDIX A.

Area under main crops in each agricultural division (average of five years ending 1920-21).

(Figures in thousands of acres, i.e., 000 being omitted.)

Crops	I division.	II division.	III division.	IV division.	V division.	VI division.	VII division.	VIII division.
Rice (<i>Oryza sativa</i>)	3,523	1,303	386	1,863	1,405	1,036	1,472	293
Cholam (<i>Sorghum vulgare</i>)	319	1,064	2,081	151	291	541	...	699
Cumbu (<i>Pennisetum typhoideum</i>)	218	388	398	487	354	461	...	845
Ragi (<i>Eleusine coracana</i>)	679	119	225	496	138	267	...	517
Korra (<i>Setaria italica</i>) ... ..	...	...	1,165	...	...	...	...	...
Other cereals	333	642	279	388	269	570	86	386
Pulses	635	338	744	199	100	365	72	640
Gingelly (<i> Sesamum indicum</i>)	875	...	...	...	54	112	...	65
Groundnut (<i>Arachis hypogaea</i>) ... ..	...	...	354	591	168	82	...	187
Coconut (<i>Cocos nucifera</i>) ... ..	...	...	...	...	...	...	381	...
Castor (<i>Ricinus communis</i>) ... ..	...	123	199	...	...	...	...	...
Chillies (<i> Capsicum, sp.</i>) ... ..	...	126	...	...	...	...	...	...
Pepper (<i>Piper nigrum</i>) ... ..	...	...	...	...	...	...	71	...
Sugarcane (<i>Saccharum officinarum</i>)	47	...	...	...	...	...	...	...
Cotton (<i>Gossypium, sp.</i>) ... ..	...	242	1,116	...	55	720	...	322
Indigo (<i>Indigofera tinctoria</i>) ... ..	...	95	...	56	...	...	...	...
Tobacco (<i>Nicotiana tabacum</i>) ... ..	...	66	...	...	...	...	...	87
Arecanut (<i>Areca catechu</i>) ... ..	...	...	...	...	...	...	88	...
Plantains (<i>Musa sapientum</i>) ... ..	...	...	...	...	...	...	43	...
Other crops	780	450	349	406	199	364	243	249
Total	6,959	4,956	7,246	4,685	3,083	4,518	2,408	4,190

Government of Madras

DEVELOPMENT DEPARTMENT

G.O. No. 366, 10th March 1925

Administration Report—Cinchona Department, 1923-24—Reviewed.

READ—the following paper :—

Letter from A. Wilson, Esq., M.A., B.Sc., Deputy Director of Agriculture (Cinchona), to the Secretary to Government, Development Department, dated Ootacamund, the 12th February 1925, No. 7.

I have the honour to forward herewith a copy of the Administration Report of this department for 1923-24 and to state that a copy of the same with the necessary enclosures has been sent to the Superintendent, Government Press, Madras, for printing the required number of copies.

ENCLOSURES.

ADMINISTRATION REPORT OF THE GOVERNMENT, CINCHONA DEPARTMENT FOR 1923-24.

GENERAL REMARKS.

In recent years emphasis has been laid on the necessity of increasing the supplies of Indian grown cinchona bark for the quantity on the Madras Government Plantations is strictly limited and there is little prospect of the Malaria problem being resolutely tackled until large quantities of cheap quinine are at hand. Unlike many planting products it is wellnigh hopeless to expect the cinchona tree to yield a remunerative return save on very high grade land and while criticism is often levied against the policy of growing the State requirements of bark on State plantation it is forgotten that few planters in these days care to risk their capital in cultivating such an exacting plant as cinchona when tea, coffee and similar plants can be grown with certain promise of a return. Now cheap quinine—which is of paramount necessity in India—implies cheap bark from which to extract the alkaloid and cheap bark can only be obtained by cultivating large and extensive areas. To those who are interested in the problem of checking India's greatest scourge—Malaria—it must come of interest to learn that the question of opening large plantations of cinchona in the Anamalai Hills received the active support of a special committee at Delhi. The area was visited by His Excellency Lord Willingdon in December 1923 and in the following February, Sir Arthur Knapp, the Member of Council in charge of Cinchona, made a detailed inspection of the ground, when opportunity was taken to explain the method of inaugurating the proposed plantation. The acreage of the land amounts to 22,000 acres which when planted up will yield a large quantity of quinine for Malaria propoganda, and in the next report it is hoped that a record of the actual commencement of planting will find a place.

During the year only about 1½ lakhs of rupees of bark was on offer from private plantations and as most of this came from areas uprooted for the purpose of growing tea, the opening of the new plantations referred to above cannot any longer be delayed.

In South India there is only one private plantation, namely, Oosimalai, which is solely devoted to cinchona growing but no considerable stock has yet been harvested. The area is planted with high grade seed and the bark which has so far been harvested is of very encouraging quality. As it has been represented that Government deliberately discouraged the growing of cinchona bark, it is as well to state that only in recent years has bark been imported from Java when the supplies from private estates and the relatively small area of the Government plantation have been insufficient for the Quinine Factory. During the past 30 years bark to the value of 34 lakhs has been purchased from private planters in South India, and for 20 years at least payment has been made at the rate prevailing in the London market with a bonus for quality. The commanding position which Java holds in the production of cinchona bark is due to the suitability of the soil, rainfall, and perhaps more particularly to the fact that that Island holds large tracts of land at that elevation on which cinchona ledgeriana of high grade can be grown with marked success. In South India however other than Anamalais there is no easily accessible land known to the writer which holds out any promise of success which will challenge the results of the Dutch.

Noteworthy in the year is the success which the standardized preparation of cinchona febrifuge—to which the name “Malarene” has been given—has obtained. Trials were made in various hospitals in the Presidency, under the control of the Surgeon-General and the report of that officer indicates that for certain forms of Malaria, this drug is most efficacious. In some districts so surprisingly good have the results been that “Malarene” has all but ousted quinine from pride of place. Efforts are being directed to augment the production of “Malarene” which is fortunately obtainable from cinchona bark more easily grown than the quinine yielding species—ledgeriana.

POINTS OF INTEREST IN THE YEAR'S WORK.

(a) *Cinchona plantations*.—The rain fall on the Government plantations was as follows:—

Dodabetta 42.36 inches, Naduvattam 120.04 inches, and Hooker 108.22. Between Dodabetta and Naduvattam there is perhaps not more than 16 miles in a straight line but while the former recorded a rainfall over 12 inches below the average, the precipitation at Naduvattam was the highest for 14 years. Up to October the rainfall was 117 inches but in the succeeding six months only some 3 inches fell. This period of drought makes it necessary to grow cinchona under shade which is reduced by means of the pruning saw as the cinchona attains maturity. Grevillia is the principal tree used for shade but *Alnus Nepalensis* is being experimented with for it grows excellently at Naduvattam. As far as funds are available, deep forking was done and on the areas of old grass land over 30,000 bushel baskets of cattle manure were spread. Over 1,000 bags of ash from the factory furnaces were applied to block 1900 while on a portion of block 1918 where the trees are not too robust basic slag was lightly forked in. It is proposed to continue experiments in manuring. The amount harvested from the plantations during the year was as follows:—

Dodabetta 39,468 lb. and Naduvattam 218,239 lb. the produce of over 86 acres, leaving an area under a full compliment of cinchona of 1,397 acres. As a check against the recorded number of acres, a tree count will be made and if considered necessary the entire area will be surveyed. The table below gives the figures showing the area of the plantations as at the beginning and the end of the year.

Plantation.	Division.	Acreage on 1st April 1923.	Uprooted in 1923-24.	Acreage on 31st March 1924.
Dodabetta	Dodabetta	229.0	13.0	216.0
	Kukal	17.6	0.6	17.0
Naduvattam	Naduvattam	409.67	22.51	387.16
	Hooker	827.25	50.2	777.05
	Total ..	1,483.52	86.3	1,397.2

Quinine Factory.—On account of short supplies of bark only four digesters out of six were working and the products were quinine sulphate 22,496 lb. quinine, bisulphate 6,905 lb., quinine hydrochloride 220 lb.; quinine bi-hydrochloride 240 lb., cinchona Febrifuge (Matarene) 17,432 lb. making in all, a total of 47,293 lb. It was a new departure to make quinine bi-sulphate on a large scale and the salt produced was of excellent quality. The quality of the bark used was of an average of 3.39 per cent quinine sulphate against 3.61 per cent in the past year and this low figure makes the production of a pure white salt a matter of great difficulty. Necessary replacements such as new enamelled boiling pans were erected in position and steps were taken to renew other factory equipment which has deteriorated. Towards the end of the year a fire occurred in the grinding room and this accounted for a loss of Rs. 2,605. Recommendations have been made which when carried into effect will assist in making the factory more fire proof than it can be under present conditions. For the British Empire Exhibition the Manufacturing Chemist prepared an interesting series of quinine products.

Financial results.—The financial working of the department for the year can be gauged from the balance sheet submitted with the report and certified by the Government Auditors, Messrs. Fraser & Ross. Accurate detailed costing presents many difficulties in a chemical factory but it was felt that the flat rate of cost of manufacture formerly adopted for cinchona febrifuge of one rupee per pound was too low and in the year two rupees per pound has been shown. This has assisted in reducing the recorded cost of production of quinine sulphate which in the year was Rs. 13.07. The profit for the year's working was Rs. 2,52,519 which is very satisfactory as it represents a higher percentage on the turnover than last year even though the profit of that year was Rs. 3,55,486. The fall in profit is due mainly to the fall in price in the market rate and also to a smaller quantity of quinine sulphate sold. The Auditors' report attached hereto is self-explanatory and no attempt need be made here to refer to the points raised by them.

Staff.—No member of the superior staff was on leave during the year, but various alterations felt to be made after the retirement of Mr. E. Collins at the end of last year. To the charge of the Naduvattam Cinchona Plantations Mr. W. H. P. Collins was transferred from Dodabetta Cinchona Plantation and in his place Mr. C. M. Packiam Pillai was posted. Mr. C. Chinnaswami Nayudu was promoted as Head Overseer, Hooker division. In the head office the post of a storekeeper was abolished owing to retrenchment.

OOTACAMUND,
3rd March 1925.

A. WILSON,
Deputy Director of Agriculture, Cinchona.

APPENDIX A.

Table showing the number of acres of cinchona cultivation according to age of acreage in the Government Cinchona Plantations, the Nilgiris, on 1st April 1924.

Particulars.	Plantations.					Name of species of plants.	Nurseries.		
	Age of acreage.	Number of acres in the permanent plantations on the 31st March 1923.	Number of acres uprooted or coppiced in 1923-24.	Number of acres planted in 1923-24.	Number of acres in the permanent plantations on 31st March 1924.		Number of seedlings and rooted cuttings in the nursery beds for the permanent plantations.	Number of rooted plants in seeds and cutting beds.	Total nursery stock on 1st April 1924.
Dodabetta plantations.	0-5	29.04	..	..	9.50	C Offieianalis..	50,000	50,000	100,000
	6-10	76.47	..	..	96.01		..	..	..
	11-15	9.13	..	..	9.13		..	..	..
	16 & over	114.36	13	..	101.36		..	..	..
	Total	229.00	13	..		216.00	50,000	50,000	100,000
Kukul division	6-10	17.60	6	..	9	Ledge Hybrid Alums	..	..	..
	11-15	..	..	..	8		..	..	..
	Total	17.60	6	..		17
Naduvattam plantations.	0-5	140.00	..	..	40.00	Ledge Hybrid Alums	50,000	450,000	500,000
	6-10	46.00	..	..	146.00		5,000	..	5,000
	11-15	77.42	1.73	..	69.49		..	60,000	60,000
	16 & over	146.25	20.78	..	131.67		..	..	..
	Total	409.67	22.51	..		387.16	55,000	510,000
Hooker division	0-5	505.00	..	..	400.60	Ledge Hybrid Alums	230,700	..	230,700
	6-10	55.50	12.00	..	148.50		200,000	..	200,000
	11-15	..	..	..	..		17,000	..	17,000
	16 & over	266.75	38.2	..	228.55		..	..	..
Total ..	..	827.25	50.2	..	777.05	447,700	..	447,700	
Grand total ..	..	1,483.52	86.3	..	1,387.2	552,700	560,000	1,112,700	

APPENDIX B.

Statement showing the details of sales and issues of factory products for the year 1923-24.

Particulars.	Quinine sulphate.	Cinchona febrifuge.	Quinine hydrochloride.	Quinine bi-hydrochloride.	Cinchona bark.	Quinine sulphate Tablets.
	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.
Medical Stores Depot, Madras ..	1,000 0	558 0	120 0	60 0	..	..
Penitentiary Jail ..	2,060 0	..	..	..	..	..
Government Hospitals ..	786 0	483 0	21 8	7 0	14 0	170 1 1/2
Local Fund Dispensaries ..	872 0	416 8	15 0	..	97 8	1 3/8
Municipal Dispensaries ..	520 8	178 0	7 8	..	112 0	..
Medical Stores Depot, Bombay ..	2,020 0	100 0	70 0	148 12	250 0	..
Yervada Jail, Bombay ..	800 0	..	..	..	..	..
Burma ..	..	4,000 0	..	..	..	..
Central Provinces ..	1,000 0	300 0	15 0	..	..	..
United Provinces ..	1,960 8	2,491 14	4 0	..	..	..
Baluchistan ..	220 0	170 0	..	..	..	..
Alipore Jail ..	..	2,000 0	..	..	..	..
<i>Indian States.</i>						
Hyderabad State ..	600 0	300 0	..	..	..	..
Mysore ..	697 12	600 0	..	..	..	..
Baroda ..	1,403 0	108 0	..	..	..	..
Travancore ..	1,000 0	..	..	..	..	..
Cochin ..	100 0	..	..	..	..	..
Gwalior ..	250 0	502 0	..	..	..	..
Coorg ..	80 0	102 0	..	..	..	..
Bombay, Baroda and Central India Railway ..	..	73 6	..	..	50 0	..
Sales to Public ..	..	280 0	..	..	..	..
* Unassigned ..	55 0	18 6	0 8	..	1 8	1 8
Total ..	15,424 12	12,681 4	253 8	215 12	525 0	173 1 1/2

* These represent issues against claims for short delivery admitted by the Superintendent

CINCHONA DEPARTMENT, OOTACAMUND.

Report on the accounts to 31st March 1924.

ASSETS.

Buildings—Factory.—A sum of Rs. 500 has been written off on account of the portion destroyed by fire, as estimated by the Deputy Director, Cinchona Department.

Machinery—Factory.—Similarly a sum of Rs. 1,800 being the depreciated value of the grinding machines destroyed has also been written off.

Both these figures have been debited direct to capital account and not passed through profit and loss account.

Plantations.—The amounts spent on the plantations have been allocated to blocks developed and blocks in development according to the particulars furnished by the Superintendents in charge, and a valuation on a bark basis is shown at the foot of each account for purposes of comparison.

In the case of Naduvattam plantations, the Superintendent in his report on the working of 1923-24 points out that block No. 1898 has been harvested, in so far that all trees have been cut down to ground level; this block has been coppiced. He estimates the bark on the tree stumps to be 50,229 lb. and on this estimate the bark yield on block No. 1898 is 89,568 lb. short of the original estimate on which the plantation was valued. The shortage makes the original valuation too high by Rs. 12,763-8-11 and we have shown this shortage in the balance sheet as a deferred revenue loss to be written off over a period of years. We suggest that it should be written off over the next five years. As each block is finally harvested any shortage or excess should be treated in this way, so that no one year should unduly gain or lose by the mistakes of the original values placed on the blocks.

We have written off no portion of this loss to the current year, as no bark harvested this year has been taken into production, and so that the present suggested write-off over five years may be considered.

The figure must be brought into the account as it is necessary to reduce the value of the plantation, but the accounts are so framed that anything which reduces the value of the plantation at the same time must increase the cost of production of bark of the year unless treated as we suggest above.

Depreciation at 8 per cent on buildings and at 7 per cent on plant and machinery has been charged to the respective accounts by credit to depreciation reserve accounts.

We have written off depreciation at the rates specified against each of the following :—

- Furniture at 7 per cent.
- Live-stock at 20 per cent.
- Carts and vehicles at 10 per cent.

In the case of live-stock, we have also written off a sum of Rs. 300 being the value of bulls which died during the year less depreciation to end of last year.

We have seen the stock-ledgers and verified their balances with the inventories taken as on 31st March 1924 by the Superintendents in charge of the plantations for the plantations, stores, stock and by the Manufacturing Chemist for the factory stores stock, bark and chemicals, etc., lying at the factory, and by the Deputy Director, Cinchona Department, for packing materials. All valuations are at cost.

Laboratory equipment and loose tools balances represent the stock on hand at 31st March 1924, as per inventories taken on that date.

Manufactured products - were valued at cost of production. The total outturn of the products are as per details below :—

Quinine sulphate—

	LB.	OZ.	LB.	OZ.
Stock as on 1st April 1923 . . . . .	..	..	22,777	2
Manufactured during the year . . . . .	..	..	22,496	1
			45,273	3
<i>Less</i> —Sent to Darbar Physician, Trivandrum, on 21st July 1923 on account of shortage admitted by Deputy Director	40	0		
Packets issued to Superintendent, Dodabetta.	0	4½		
Shortages in bulk consignments received from Chemist at Deputy Director's Office	83	8		
			123	12½
Carried forward			45,149	6½

<i>Quinine sulphate—cont.</i>	LB.	OZ.	LB.	OZ.
Brought forward			45,149	6½
Less—Consignments to Penitentiary	15,141	0		
Consignments in transit to Penitentiary	2,100	0		
			17,241	0
Stock at Deputy Director's Office as on 31st March 1924			27,908	6½
 <i>Quinine hydrochloride—</i>				
Stock as on 1st April 1923			2,172	9
Manufactured during the year, but not despatched to Head Office			220	0
			2,392	9
at the factory	220	0		
Stock at Deputy Director's office as on 31st March 1924	2,172	0		
	2,392	9		
 <i>Quinine bihydrochloride—</i>				
Stock as on 1st April 1923			101	0
Manufactured during the year			240	12
			341	12
Consignments to Penitentiary	341	12		
 <i>Quinine sulphate tablets—</i>				
Stock as on 1st April 1923			235	3
Manufactured during the year .. .. .			..	..
			235	3
Consignments to Penitentiary	120	0		
Consignments in transit to Penitentiary	80	0		
Loss due to dryage	0	11		
			200	11
Excess reported by Penitentiary			34	8
			0	4½
			34	12½
Stock at Deputy Director's office	34	8		
Stock at Penitentiary due to excess shown as on 31st March 1924	0	4½		
	34	12½		
 <i>Quinine bisulphate—</i>				
Manufactured during the year			6,780	9
Stock at Deputy Director's office as on 31st March 1924	6,780	9		
 <i>Quinine bisulphate tablets—</i>				
Manufactured during the year			125	0
Stock at Deputy Director's office as on 31st March 1924	125	0		
 <i>Cinchona febrifuge—</i>				
Stock as on 1st April 1923			7,945	15
Work in progress, 1922-23			3,000	0
Manufactured during the year			14,388	0
Carried forward			25,333	15

	LB.	OS.	LB.	OS.
Brought forward			25,333	15
<i>Less—</i> Consignments to Penitentiary—				
During the year	18,124	8		
Shortage in transit		7	8	
Issued for Malarial test		14	0	
			18,146	0
Stock at Deputy Director's office as on 31st March 1924			7,187	15
<i>Cinchona febrifuge tablets—</i>				
Manufactured during the year			54	0
Stock at Deputy Director's Office as on 31st March 1924		54	0	
<i>Details of stock at Penitentiary—</i>				
<i>Quinine sulphate—</i>				
Stock as on 1st April 1923			4,369	12
Receipts from the Cinchona Department			15,141	0
			19,510	12
<i>Less—</i> Issues	13,309	12		
Issues for pice packets	2,060	0		
Dryage in breaking bulk		13	4	
Shortages accepted by Deputy Director, Cinchona.		41	12	
			15,424	12
Stock as on 31st March 1924			4,086	0
<i>Quinine hydrochloride—</i>				
Stock as on 1st April 1923			563	8
<i>Less—</i> Issues	253	0		
Dryage in breaking bulk		0	8	
			310	0
Stock as on 31st March 1924				
<i>Quinine bihydrochloride—</i>				
Stock as on 1st April 1923				
Receipts from the Cinchona Department			341	12
			341	12
<i>Less—</i> Issues			215	12
Stock as on 1st April 1924			Lb. 126	0
<i>Quinine sulphate tablets—</i>				
Stock as on 1st April 1923			53	1
Receipts from the Cinchona Department	120	0		
Excess found thereon		0	4½	
			120	4½
<i>Less—</i> Issues	171	9½		
Dryage in breaking bulk		1	8	
			173	5½
Stock as on 1st April 1924			0	4
<i>Cinchona febrifuge—</i>				
Stock as on 1st April 1923			2,468	4
Receipts from Cinchona Department			18,124	8
			20,592	12
Carried forward				
<i>Less—</i> Issues	12,662	14		
Dryage in breaking bulk		8	4	
Shortage accepted by Cinchona Department		14	2	
Shortage at Penitentiary		1	0	
			12,681	4
Stock as on 1st April 1924			Lb. 7,911	8

Superintendent, Penitentiary—Rs. 5,976-9-0.—We have reconciled the Accountant-General's statements of credits with the sales at the Penitentiary and the balance shewn is as per table below—

	RS.	A.	P.	RS.	A.	P.
Quinine supplied in 1922-23—credit not yet given to this department by the Accountant-General ..	2,286	6	0			
Quinine supplied in 1923-24—credit not yet given to this department by the Accountant-General ..	6,993	8	0			
					9,279	14 0
<i>Loss</i> —Credits given by the Accountant-General in 1922-23—quinine not yet supplied ..		75	2 0			
Credits given by Accountant-General in 1923-24—quinine not yet supplied	3,228	3	0			
					3,303	5 0
					5,976	9 0

Advances—Rs. 8,260-4-3 made up of—

Advances to the sundry estates for the purchase of bark	7,167	0	0
Advance to Superintendent, Naduvattam, for purchase of Bulls	1,052	8	0
Walker & Sons, Colombo	40	12	8
	8,260	4	8

The Rs. 40-12-8 is a mistake made in paying Walker & Sons twice and will be adjusted against future supplies or refunded in cash.

LIABILITIES.

Accountant-General—Rs. 2,76,352-3-3.—We have reconciled the receipts and payments of the Cinchona Department with the monthly statements received from the Accountant-General. The balance includes the value of Europe stores imported of Rs. 4,233-4-0, exchange at 1/14.

Provision for expenses.—Interest was charged on all opening balances of assets at the rate fixed by the Auditor-General and has been credited to reserve by charge to profit and loss account. Statement attached showing calculation.

Rent of land and buildings.—Rents were credited at the same rates as last year by charge to plantations account in the case of land and to profit and loss account in the case of rent of buildings.

Profit and Loss account.—Since all the items shewn in Sundry Debtors in last year have been fully recovered during this year, we have transferred the bad and doubtful debts reserve amount of Rs. 1,464-4-0 to profit and loss Account. A sum of Rs. 1,692-12-0 has been collected towards old outstandings (i.e., prior to 1920) and shown as miscellaneous receipts in the profit and loss account. These old outstandings were not shewn as outstandings in the accounts at 31st March 1923.

Cinchona febrifuge has been valued at Rs. 2 per pound in place of Rs. 1 per pound in the previous year to conform to the valuation used by the Bengal Cinchona Department as suggested by the Deputy Director of Agriculture, Cinchona Department.

Although the total profits of the year are considerably less than those of last year, the percentage of profit in the sales has increased and the decrease can be reconciled.

Subject to the foregoing remarks, we certify that we have obtained all the information and explanations we have required and that the balance sheet signed by us as relative hereto, in our opinion exhibits a true and correct view of the state of the affairs of the Cinchona Department, Ootacamund, according to the best of our information and the explanations given to us and as shewn by the books of the Cinchona Department.

MADRAS,
24th November 1924.

FRASER & ROSS,
Commercial Accountants and Auditors to the Government of Madras.

CINCHONA DEPARTMENT, OOTACAMUND.
Schedule of Fixed Assets on which interest is payable.

No. 866, DEVELOPMENT, 10TH MARCH 1925

	Direction.		Dodabetta Plantation.		Naduvattam and Hooker Plantations.		Factory.	
	Expenditure up to 1916-17.	Subsequent to 1916-17.	Expenditure up to 1916-17.	Subsequent to 1916-17.	Expenditure up to 1916-17.	Subsequent to 1916-17.	Expenditure up to 1916-17.	Subsequent to 1916-17.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Buildings	10,000 0 0	..	17,000 0 0	..	28,500 0 0	..	41,639 0 0	88,861 0 0
Machinery and plant .. .. .	..	..	365 0 0	..	..	1,518 0 0	20,000 0 0	84,000 0 0
Live-stock and carts .. .. .	..	..	..	..	..	..	1,126 0 0	2,142 0 0
Laboratory equipment	602 0 0	22 0 0	145 0 0	..	120 0 0	..	424 0 0	224 0 0
Office furniture .. .. .	..	..	..	824 0 0	..	3,270 0 0	3,989 0 0	2,896 0 0
Tools and stores .. .. .	..	..	..	..	4,04,184 0 0	..	..	..
Plantations .. .. .	..	..	75,276 0 0	..	..	..	..	..
	10,602 0 0	22 0 0	82,786 0 0	824 0 0	4,32,804 0 0	4,788 0 0	66,158 0 0	1,27,622 0 0
Interest at 3-3252 per cent	353 4 0	..	3,085 9 0	..	14,391 8 0	..	2,200 8 0	..
Interest at 5-69 per cent .. .. .	..	1 4 0	..	48 14 0	..	272 7 0	..	7,241 11 0
	854 8 0	..	8,132 7 0	..	14,663 15 0	..	9,442 8 0	..

866, Dev.-3

CINCHONA DEPARTMENT—OOTACAMUND.

Balance Sheet as at 31st March 1924.

CAPITAL AND LIABILITIES.

	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.	
Capital—										
Government of Madras—										
As per Schedule D .. .. .	..	..	..	..	..	..	..	..	..
Add Profit for the year .. .. .	..	..	..	..	..	..	..	..	..
				12,84,069	1	4				
				2,62,519	4	4				
				<hr/>						
				14,86,588	5	8				
 Add Provision for expenses—										
Interest on fixed assets;	86,008	11	6							
Rent of land	8,785	9	0							
Rent of buildings	8,600	0	0							
Repairs to buildings	1,925	0	0							
Audit fee	2,500	0	0	1,02,819	8	8				
 Erroneous credits—										
To be adjusted by the Accountant—										
General							6,862	0	8	
 Liabilities—										
For expenses								942	0	0
							15,89,407	9	2	
							6,862	0	8	
							942	0	0	
							<hr/>			
Total ..				16,96,711	9	5				

PROPERTY AND ASSETS.

	RS.	A.	P.	RS.	A.	P.		
Fixed capital expenditure—								
Buildings—								
As per Schedule A				1,28,480	0	0		
Plant and machinery—								
As per Schedule B				83,481	0	0		
Plantations—								
As per separate accounts—								
Dodabetta division				75,739	5	7		
Naduvattam division				3,73,799	13	8		
				<hr/>				
				4,49,589	8	8		
Office furniture—								
As per Schedule C						1,684	0	6
						<hr/>		
				6,57,184	8	9		
Live-stock, at valuation				2,155	8	0		
Carts and vehicles, at valuation				766	0	0		
Laboratory equipment, at valuation				2,893	0	0		
Loose Tools, at valuation				9,345	11	9		
Stores, at cost				554	8	0		
Deferred Revenue loss—								
Ascertained shortage of bark on block No. 1898 on final harvesting.						12,768	8	11
Raw materials, at cost—								
Bark				2,18,377	7	7		
Chemicals				31,872	15	3		
				<hr/>				
				2,74,750	6	10		
Packing materials, at cost						1,192	1	9
Manufactured products—								
At the factory				3,906	15	2		
In transit				28,427	6	10		
At the Deputy Director's office				5,08,816	13	8		
At the Penitentiary				76,948	4	11		
				<hr/>				
				6,18,099	9	2		
Work in progress, at valuation						7,055	0	0
Sundry debtors—								
Superintendent, Penitentiary				5,976	9	0		
Advances				8,260	4	3		
				<hr/>				
				14,236	13	3		
Cash and other balances—								
Permanent advances				500	0	0		
Cash in hand				265	2	0		
				<hr/>				
				765	2	0		
				<hr/>				
Total ..				16,96,711	9	5		

10
No. 366, DEVELOPMENT, 10TH MARCH 1925

CINCHONA DEPARTMENT—OOTACAMUND.

Production account, Naduvattam factory, for the year ending 31st March 1924.

	RS.	A. P.	RS.	A. P.		RS.	A. P.	RS.	A. P.
To stock on 1st April 1923—					By products taken to trading account—				
Bark	3,34,782	15 2			As per cost sheet—				
Chemicals	48,011	4 5			Quinine sulphate, 22,496 lb. at Rs. 12-0-7-7	2,98,350	11 5		
Tools and stores	5,864	11 6			Quinine hydrochloride, 220 lb. at Rs. 17-12-1-7	3,908	15 9		
Work-in-progress	2,250	0 0			Quinine bi-hydrochloride, 240½ lb. at Rs. 18-4-9-5	4,405	9 5		
			3,85,908	15 1	Quinine bi-sulphate and tablets lb. 6,905-9 at Rupees 12-7-8-7	86,195	9 11		
„ purchases—					Cinchona febrifuge, 17,388 lb. at Rs. 2	34,776	0 0		
Bark from public	1,40,153	0 0			Cinchona febrifuge tablets, 54 lb. at Rs. 3	108	0 0		
Bark from plantations	87,850	11 10			„ Bark consignment to Penitentiary	87	8 0		
Chemicals	42,125	0 9			„ value of bark destroyed by fire	299	8 7		
Tools and stores	174	5 9			„ work-in-progress—				
			2,70,308	9 4	Quinine sulphate, 360 lb. as per chemist's valuation	5,805	0 0		
„ expenses—					Cinchona febrifuge, 2,000 lb. at Rs. 12 as per chemist's valuation	1,760	0 0		
„ Fuel estimated value of wood 1,116½—lots at Rs. 8 from plantations	3,349	0 0			„ stock on 31st March 1924—				
Wages for cutting	1,486	8 0			Bark	2,48,877	7 7		
			4,835	8 0	Chemicals	31,373	15 8		
Feed and upkeep of bulls .. .. .	.....		7,809	7 4	Tools and stores	6,039	1 3		
Wages—Artificers	7,012	14 2						2,80,789	8 1
Coolies and airdars	2,296	8 9							
			9,309	1 11					
Salaries—Superintendent	9,240	5 0							
Office	1,643	1 0							
			10,883	6 0					
Travelling allowance .. .. .	.....		96	12 0					
Contingencies—									
Repairs to buildings	755	6 10							
Repairs to machinery	10,132	10 5							
Factory petty expenses	332	6 9							
Petty office expenses	18	10 0							
Laboratory charges	471	5 8							
			11,710	7 8					
„ depreciation—									
On buildings	2,400	0 0							
On machinery	7,280	0 0							
On office furniture, etc.	398	10 10							
			10,078	10 10					
Total ..			7,10,924	7 2	Total ..			7,10,924	7 2

No. 366, DEVELOPMENT, 10TH MARCH 1925

CINCHONA DEPARTMENT, OOTACAMUND.
Trading Account for the year ending 31st March 1924.

	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.
To stock on 1st April 1923—					
Quinine sulphate	8,56,585	8 0			
Quinine hydrochloride	48,807	5 0			
Quinine bi-hydrochloride	1,862	3 0			
Quinine tablets	3,786	3 0			
Cinchona febrifuge	10,414	8 0			
Packing materials	1,785	8 6			
Transmission charges	291	10 2			
			4,23,582	8 8	
Cost as per Production Account—					
Quinine sulphate	2,98,350	11 5			
Quinine hydrochloride	8,906	15 9			
Quinine bi-hydrochloride	4,406	9 5			
Quinine bi-sulphate and tablets	86,195	9 11			
Cinchona febrifuge	34,776	0 0			
Cinchona febrifuge tablets	108	0 0			
			4,22,742	14 6	
Packing materials purchased			5,587	5 8	
Distribution charges by Penitentiary			4,325	0 0	
Carriage outwards			234	7 0	
Gross profit transferred to Profit and Loss Account			2,95,280	11 7	
Total ..			11,51,702	15 5	
By sales—					
Quinine sulphate	4,18,911	4 0			
Quinine hydrochloride	9,039	8 0			
Quinine bi-hydrochloride	8,248	4 0			
Quinine sulphate tablets	4,907	8 6			
Cinchona febrifuge	1,01,698	8 0			
			5,87,114	11 6	
Sundry sales			296	9 0	
Stock as at 31st March 1924—					
At the Factory—					
Quinine hydrochloride, 220 lb. at Rs. 17-12-1-7				3,906	15 9
In transit—					
Quinine sulphate, 2,100 lb. at Rs. 13-0-7-7			27,384	8 6	
Quinine sulphate tablets, 80 lb. at Rs. 13-0-7-7			1,043	3 4	
			28,427	6 10	
At Deputy Director's office—					
Quinine sulphate, lb. 27,908- $\frac{1}{2}$ at Rs. 13-0-7-7			3,68,928	8 0	
Quinine hydrochloride, lb. 2,172-9 at Rs. 17-12-5			38,755	5 0	
Quinine bi-sulphate and tablets, lb. 5,905-9 at Rs. 12-7-8-7			86,195	9 11	
Quinine sulphate tablets, lb 34-12 $\frac{1}{2}$ at Rs. 13-0-7-7			458	8 9	
Cinchona febrifuge, lb 7,187-15 at Rs. 2			14,875	14 0	
Cinchona febrifuge tablets, 54 lb at Rs. 2			108	0 0	
			5,03,816	18 8	
At the Penitentiary —					
Quinine sulphate, 4,086 lb. at Rs. 13-0-7-7			53,281	12 10	
Quinine hydrochloride, 310 lb. at Rs. 17-12-5			5,529	15 9	
Quinine bi-hydrochloride, 126 lb. at Rs. 18-4-9-5			2,305	11 9	
Quinine sulphate tablets, 4 oz at Rs. 13-0-7-7			3	4 2	
Cinchona febrifuge, lb. 7,911-8 at Rs. 2			15,823	0 0	
Cinchona red bark			4	8 0	
			76,948	4 11	
Packing materials			1,192	1 9	
Total ..			11,51,702	15 5	

CINCHONA DEPARTMENT, OOTACAMUND.

Profit and Loss Account for the year ending 31st March 1924.

	RS.	A.	P.		RS.	A.	P.		RS.	A.	P.
To Direction Expenses—											
Deputy Director's salary	14,459	11	0								
Office establishment	4,778	14	0								
Travelling allowance	2,276	8	0	21,515	1	0					
Rent and taxes	1,778	12	9								
Postages and telegrams	430	6	6								
Office expenses	309	2	8	2,518	5	11					
Interest on Fixed Assets—											
Dodabetta Plantation	3,132	7	0								
Naduvattam Plantation	14,663	15	0								
Factory	9,442	8	0								
Direction	354	8	0	27,598	1	0					
Audit fee reserve for 1923-24				2,500	0	0					
Depreciation—											
On buildings at 8 per cent on Rs. 10,000	300	0	0								
On furniture at 7 per cent on Rs. 624	44	15	9	844	15	9					
Net profit transferred, to Balance Sheet				2,52,519	4	4					
				Total ..	3,06,990	12	0				
								Total ..	3,06,990	12	0

CINCHONA DEPARTMENT, OOTACAMUND.

Plantation account, Dodabetta and Kukul, for the year ending 31st March 1924.

	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.
To Value of plantations as on 1st April 1923—	....	....	75,276 0 2	By Sale of bark to factory—	....	....	15,421 15 8
Forest land, 146.45 acres .. ..	....	....		89,468 lb. = 147,583 units, cost per unit, say, Re. 0-1-8.06.	....	....	48 14 0
Acquired land, 100.30 acres .. ..	....	....		.. Value of fuel supplied .. ..	....	....
.. Expenses—				.. Value of plantations as on 31st March 1924—			
Wages—				Value at the beginning .. ..	....	75,276 0 2	
Blocks in development .. ..	....	2,769 9 6		Add—Total expenditure as per contra.	....	14,809 5 8	
Blocks developed .. ..	....	2,351 13 0	5,121 6 6				
.. Salaries—				Less—Maintenance wages	2,351 13 0		90,085 5 5
Superintendent	1,948 4 0			Harvesting wages	949 3 0		
Office	1,961 0 0			Proportionate overhead charges.	4,898 11 6		8,194 11 6
.. General wages	1,000 14 6						81,890 9 11
.. Travelling allowance	227 4 0			Less—Value of acreage harvested—			
.. Feed and upkeep of bulls	2,128 4 6			Dodabetta, 39,268 lb./3,000 = 13.08 acres at Rs. 470-12-2.	6,119 14 3		
.. House coolies	707 12 0			Kukul, 200 lb./3,000 = 1/3 acre at Rs. 470-12-2.	31 6 2		75,789 5 3
.. Repairs to buildings	637 3 9						
.. Sundry expenses	180 1 0			.. Value of plantation on bark basis as on 31st March 1924—			
Total Overhead charges .. ..	....	8,738 11 9		Bark on trees 301,525 lb. at 3 1/2 per cent = 1,055,287 units at Re. 0-1-6 per unit.	....	98,942 8 0	
Divided as between blocks developed and in development in the proportion of acreage as 14 : 11.							
.. Blocks in development .. ..	....	3,845 0 3	8,738 11 9				
.. Blocks developed .. ..	....	4,893 11 6	949 3 0				
.. Harvesting wages .. ..	....	....	532 5 10				
.. Depreciation on buildings, etc. .. ..	....	....	292 8 0				
.. Rent of land .. ..	....	....			
			<u>91,310 3 3</u>				<u>91,210 8 8</u>

CINCHONA DEPARTMENT, OOTACAMUND.

Plantation Account, Naduvattam and Hooker for the year ending 31st March 1924.

	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.
To Value of plantations as on 1st April 1923, 1,818 acres.			404,184 9 6	By Sale of bark to factory—			
„ Expenses—				Naduvattam, 87,578 lb. = 173,135 units.			
Wages—				Hooker, 150,661 lb. = 301,322 units.			
Block in development		25,596 1 6		218,239 lb. = 436,457 units.			
Blocks developed		7,027 7 11	32,623 9 5	Cost per unit, say, Re. 0-1-6-8.			70,790 0 2
Salaries—				„ Shortage of bark in block 1,898 treated as deferred revenue loss.			12,763 8 11
Superintendent	3,805 0 0			„ Lopping yield in development blocks			1,638 12 0
Office	3,678 6 0			„ Value of fuel supplied to factory			3,349 0 0
General wages	3,789 3 2			„ Value of plantations as on 31st March 1924.—			
Travelling allowance	453 3 0			Value at the beginning		4,04,184 9 6	
Feed and upkeep of bulls	1,560 11 1			Add—Total expenditure as per contra.		53,092 11 7	
House coolies	1,878 0 11					4,57,277 5 1	
Repairs to building	931 11 8			Less—Maintenance wages	7,027 7 11		
Sundry expenses	72 0 3			Harvesting charges	4,241 10 9		
Cartage	63 14 4			Proportionate overhead charges.	7,489 9 7		
Total Overhead charges		16,227 7 5			18,758 12 3		
Divided as between blocks developed and in development in the proportion of acreage as 6 : 7.					4,88,518 8 10		
Blocks in development		8,737 13 10		Less—Value of acreage harvested—			
Blocks developed		7,489 9 7		Naduvattam, 87,578 lb./3,000 = 22.5 acres at Rs. 464-9-2.3 per acre.	10,452 14 9		
„ Harvesting wages			16,227 7 5	Hooker, 1,50,661 lb./3,000 = 50.2 acres at Rs. 794-1-5.5 per acre.	39,863 7 6		
„ Depreciation on buildings, etc.			4,241 10 9	Lopping yield in develop- ment blocks.	1,638 12 0	51,955 2 3	
„ Rent of land			2,427 13 8			3,86,563 6 7	
			2,636 0 0	Less—Shortage in the yield of bark from block 1898 harvested during the year.		12,763 8 11	3,73,799 13 6
			4,62,841 2 9	„ Value of plantation on bark basis as on 31st March 1924—			
				Naduvattam 548,236 lb. at 3½ per cent = 1,918,826 units at Re. 0-1-6 per unit.		1,79,639 15 0	
				Hooker, 1,072,000 lb. at 3½ per cent = 3,752,000 units at Re. 0-1-6 per unit.		3,51,760 0 0	
				Total ..		5,81,589 15 0	4,62,841 2 9

No. 366, DEVELOPMENT, 10TH MARCH 1925

CINCHONA DEPARTMENT, OOTACAMUND.

BARK PRODUCTION ACCOUNTS.

Dodabetta and Kukul plantations for the year ending 31st March 1924.

	RS.	A.	P.	RS.	A.	P.
To value of acreage harvested—						
Dodabetta—						
39,268 lb./3,000 = 13.08 acres at Rs. 470-12-2 per acre				6,119	14	
Kukul—						
200 lb./3,000 = 1/15 acre at Rs. 470-12-2 per acre				31	6	
To Maintenance charges—						
Dodabetta	2,254	1	0			
Kukul	97	12	0			
				2,351	18	0
To Harvesting wages					949	8
„ Proportionate overhead charges					4,893	11
„ Charges other than those capitalized—						
Depreciation on buildings, etc.	832	5	10			
Rent of land	292	8	0			
				1,124	13	10
				15,470	18	8
By value of bark taken—						
Dodabetta .. 39,268 lb. = 146,609 units.						
Kukul .. 200 lb. = 924 „						
				39,468	147,533	
at Rs. 0-1-8 per unit					15,421	15
By value of fuel supplied					48	14
				15,470	13	8

Naduvattam, Hooker, Moyar and Wood Estates plantations for the year ending 31st March 1924.

	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
To value of acreage harvested—									
Naduvattam—									
67,578 lb./3,000 = 22.5 acres at Rs. 464-9-2.3 per acre				10,452	14	9			
Hooker—									
150,661 lb./3,000 = 50.2 acres at Rs. 794-1-5.5 per acre				39,863	7	6			
To Maintenance charges—									
Naduvattam	5,026	8	9						
Hooker	2,000	15	2						
				7,027	7	11			
To Harvesting wages					4,241	10	9		
„ Proportionate overhead charges					7,489	9	7		
„ Charges other than those capitalized—									
Depreciation on buildings, etc.	2,427	13	8						
Rent of land	2,636	0	0						
				5,063	13	8			
				74,139	0	2			
By value of bark taken—									
Naduvattam. 67,578 lb. = 173,135 units.									
Hooker .. 150,661 lb. = 549,602 „									
				218,239	722,737				
at Rs. 0-1-6.8 per unit					70,790	0	2		
By value of fuel supplied					3,349	0	0		
				74,139	0	2	74,139	0	2

CINCHONA DEPARTMENT, OOTACAMUND.

Cost Account.

Quinine produced in 1923-24.

	RS.	A.	P.	RS.	A.	P.
Quinine sulphate—						
Total charges as per production account				4,30,134	15	1
Less—Recoveries—						
Cinchona febrifuge, manufactured, 17,442 lb. at Rs. 2	34,884	0	0			
Work in progress—cinchona febrifuge, 2,000 lb., estimated value, at as. 14 per lb.	1,750	0	0			
Work in progress—quinine sulphate, 360 lb., estimated value	5,305	0	0			
Cost of chemicals, etc., used for the manufacture of 220 lb. quinine hydrochloride at Rs. 3 per lb.	660	0	0			
Cost of chemicals used for the manufacture of 240½ lb quinine bihydrochloride at Rs. 4 per lb.	963	0	0			
Estimated value of chemicals, etc., used for the manufacture of quinine bisulphate, lb. 6,905-9, at Rs. 2 per lb.	13,810	0	0			
Sale of bark	37	8	0			
Bark destroyed by fire	299	8	7			
				<u>57,709</u>	<u>0</u>	<u>7</u>
Net charges				<u>3,72,425</u>	<u>14</u>	<u>6</u>
 Manufactured 28,560 lb. quinine sulphate, cost per lb., say, Rs. 13-0-7.7.						
Quinine hydrochloride—						
Cost of 249 lb. quinine sulphate used at Rs. 13-0-7.7	3,246	15	9			
Add—Value of chemicals used	660	0	0			
Total cost of 220 lb. quinine hydrochloride, cost per lb., say, Rs. 17-12-1.7				<u>3,906</u>	<u>15</u>	<u>9</u>
 Quinine bihydrochloride—						
Cost of 254 lb. quinine sulphate used at Rs. 13-0-7.7.	3,442	9	5			
Add—Value of chemicals used	963	0	0			
Total cost of 240½ lb. quinine bihydrochloride, cost per lb., say, Rs. 18-4-9.5				<u>4,405</u>	<u>9</u>	<u>5</u>
 Quinine bisulphate and tablets—						
Cost of 5,551 lb. quinine sulphate used at Rs. 13-0-7.7	72,385	9	11			
Add—Chemicals, etc., estimated at Rs. 2 per lb. of manufacture	13,810	0	0			
Total cost of lb. 3,905-9 of quinine bisulphate and bisulphate tablets, cost per lb., say, Rs. 12-7-8.7.				<u>86,195</u>	<u>9</u>	<u>11</u>

CINCHONA DEPARTMENT, OOTACAMUND.

SCHEDULE A.

	RS.	A.	P.	RS.
<i>Buildings—</i>				
<i>Dodabetta—</i>				
As per balance sheet as at 31st March 1923	17,000	0	0	
Less—Depreciation to date	1,449	0	0	
	<hr/>			15,551 00
<i>Naduvattam—</i>				
As per balance sheet as at 31st March 1923	28,500	0	0	
Less—Depreciation to date	2,423	0	0	
	<hr/>			26,077 00
<i>Factory—</i>				
As per balance sheet as at 31st March 1923	80,000	0	0	
Less—Estimated value of structure destroyed by fire	500	0	0	
	<hr/>			
	79,500	0	0	
Less—Depreciation to date	6,798	0	0	
	<hr/>			72,702 00
<i>Direction office—</i>				
As per balance sheet as at 31st March 1923	10,000	0	0	
Less—Depreciation to date	850	0	0	
	<hr/>			9,150 00
	<hr/>			1,23,480 00

SCHEDULE B.

<i>Plant and machinery—</i>				
<i>Factory—</i>				
As per balance sheet as at 31st March 1923	1,04,000	0	0	
Less—Depreciated value of machinery destroyed by fire	1,806	0	0	
	<hr/>			
	1,02,194	0	0	
Less—Depreciation to date	19,763	0	0	
	<hr/>			82,431 00
	<hr/>			82,431 00

SCHEDULE C.

<i>Office furniture—</i>				
<i>Dodabetta—</i>				
As per balance sheet as at 31st March 1923	156	0	0	
Add—Additions during the year	14	8	0	
	<hr/>			
	170	8	0	
Less—Depreciation to date	23	8	0	
	<hr/>			147 00
<i>Naduvattam—</i>				
As per balance sheet as at 31st March 1923	129	0	0	
Add—Additions during the year	66	8	0	
	<hr/>			
	195	8	0	
Less—Depreciation to date	22	0	6	
	<hr/>			173 7 6

	RS.	A.	P.	RS.	A.	P.
Factory—						
As per balance sheet as at 31st March 1923	677	12	0			
Add—Additions during the year	238	2	0			
	<hr/>					
	915	14	0			
Less—Depreciation to date	89	5	0			
	<hr/>			826	9	0
Direction office—						
As per balance sheet as at 31st March 1923	624	2	0			
Less—Depreciation to date	87	2	0			
	<hr/>			537	0	0
	<hr/>			1,684	0	6

SCHEDULE D.

Capital—Madras Government—						
As per balance sheet as at 31st March 1923				11,57,540	10	0
Add—Profits, 1922-23				3,55,486	3	2
	<hr/>			15,13,026	13	2
Less—Value of buildings, machinery, etc., destroyed by fire				2,605	8	7
	<hr/>			15,10,421	4	7
Add—Withdrawals, etc.				3,03,000	14	2
Value of Europe stores				4,233	4	0
	<hr/>			18,17,655	6	9
Less—Remittances, etc.				6,83,586	5	5
	<hr/>			12,34,069	1	4

Order—No. 366, Development, dated 10th March 1925.

Recorded.

2. The progressive diminution of the supply of bark from private plantations has created a situation which necessitates the increase of the area under Government plantation in order to obviate the danger of undue dependence on imported bark, the price of which may, in the absence of an adequate home-grown reserve, be raised to a prohibitive level. The Government have therefore decided to proceed with a scheme which has been long under consideration for the opening of a new cinchona plantation in a tract of land in the Anamalais which, the Government are advised, is in every respect suitable. The area available comprises some 20,000 acres, of which it is proposed to bring under cultivation 2,300 acres within a period of ten years. Arrangements have been made for the preliminary clearance of jungle to be taken in hand at once and it is hoped to begin plantation during the course of the current year.

3. The noteworthy points of the year under review were the new departure in the manufacture of quinine bisulphate on a large scale and the success of the cinchona febrifuge, now named 'Malarene,' which has been proved to be efficacious for certain forms of malaria and which is obtainable from a bark now easily grown than other species.

4. On the financial side, the profits of the year were Rs. 2,52,519 against Rs. 3,55,486 in 1922-23. This decrease is due partly to a curtailment of sales but mainly to a reduction in the price of quinine, a cheap supply of which is of more importance than any other consideration. The production and manufacturing side of the department will shortly be placed on a commercial basis. Proposals are under the consideration of the Government for a reorganization of the present system of sale.

(By order of the Governor in Council)

G. T. H. EMMACKEN,
Secretary to Government.

To the Deputy Director of Agriculture (Cinchona).
 „ Board of Revenue (all departments).
 „ Law (General) and Law (Education) Departments.
 „ Finance Department.
 „ Local Self-Government Department.
 „ Surgeon-General.
 „ Inspector-General of Prisons.
 „ Accountant-General.
 „ Postmaster-General, Madras.
 „ Agent to the Governor-General, Madras States.
 „ Assistant Quartermaster-General, 9th (Secunderabad) Division (with C.L.).
 Copy to the Honorary Secretary, Agri-Horticultural Society.
 „ Chamber of Commerce, Madras.
 „ Director, Botanical Survey, Calcutta.

Editors' Table.