

S. 1906.

C O N T E N T S

Pr qgs. of the Agricultural Conference held in the Revenue and  
Agricultural Department at

1. Agricultural Conference:  
Simla, 6th to 13th October, 1890. Jp2, M90 C1 1-63 pp.
2. Agricultural Conference:  
Simla, 2nd to 7th October, 1893. Jp2, M93 C9 64-100 pp.
3. Board of Agriculture:  
Cawnpore, 18th February, 1907. J2, dN:1 D7 101-223 pp.
4. Board of Agriculture:  
Fusa, 17th February, 1908. J2, dN:1 D8 224-265 pp.

AcN. ११११ १६१०६

SERVANTS OF INDIA SOCIETY'S LIBRARY  
PUNE 411 004

FOR INTERNAL CIRCULATION

To be returned on or before the last date stamped below.

~~6 JAN 1983~~

27 Aug 83

27 OCT 1983

PROCEEDINGS  
OF THE  
AGRICULTURAL CONFERENCE

HELD IN THE  
REVENUE AND AGRICULTURAL DEPARTMENT

SIMLA

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

WITH APPENDICES.



SIMLA :  
PRINTED AT THE GOVERNMENT CENTRAL PRINTING OFFICE.

1891.

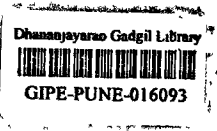
Jp2, M90

C1  
16106

MA

PRINTED AT THE GOVERNMENT CENTRAL PRINTING OFFICE.

1891.



**INDEX.**

---

	Page,
PROCEEDINGS OF THE FIRST MEETING—THE PRESIDENT'S OPENING ADDRESS} ...	1
PROCEEDINGS OF THE SECOND MEETING—SCIENTIFIC INVESTIGATION ...	7
PROCEEDINGS OF THE THIRD MEETING—INVESTIGATION BY MEANS OF EXPERIMENTAL STATIONS OR OTHER SIMILAR AGENCY ...	17
PROCEEDINGS OF THE FOURTH MEETING—AGRICULTURAL EDUCATION ...	31
PROCEEDINGS OF THE FIFTH MEETING—AGRICULTURAL EDUCATION ...	53
PROCEEDINGS OF THE SIXTH MEETING—AGRICULTURAL EDUCATION ...	67
PROCEEDINGS OF THE SEVENTH MEETING—AGRICULTURAL ENQUIRY ...	73

Jp2, M90  
C1

## APPENDIX I.

Statement showing the normal rainfall of the different districts of Bengal.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	2	3	4	5	6	7	8	9	10	11	12	13
Burdwan . . . . .	0.41	0.90	1.08	1.98	5.04	10.15	13.25	11.76	8.40	5.25	0.88	0.10
HirDhan . . . . .	0.45	0.78	0.07	1.15	4.07	10.80	13.40	10.93	10.39	5.23	0.41	0.07
Bankura . . . . .	0.80	0.65	1.00	1.88	4.38	10.88	13.28	11.88	8.70	3.18	0.64	0.11
Midnapore . . . . .	0.84	0.88	1.18	1.84	5.88	10.28	13.48	13.88	9.61	4.41	0.64	0.13
Hoogly . . . . .	0.88	1.15	1.28	3.07	5.50	10.28	13.08	13.83	8.88	3.28	0.89	0.15
Howrah . . . . .	0.19	0.90	1.02	1.91	5.27	10.28	11.83	11.40	9.48	3.79	0.81	0.13
24-Parganas . . . . .	0.89	1.16	1.20	1.73	5.49	10.89	13.96	13.29	10.04	5.21	0.68	0.17
Calcutta . . . . .	0.29	1.02	1.14	1.84	5.60	11.04	13.31	13.90	10.40	5.97	0.68	0.21
Nadia . . . . .	0.40	1.09	1.49	2.82	6.73	10.00	10.28	10.96	8.48	4.01	0.74	0.11
Murshidabad . . . . .	0.46	0.78	0.80	1.65	5.13	10.14	10.90	10.48	9.35	3.75	0.49	0.08
Jessore . . . . .	0.48	1.15	1.41	3.20	7.13	11.60	10.64	10.67	8.45	4.44	0.88	0.14
Khulna . . . . .	0.34	1.07	1.49	3.01	6.48	12.77	13.10	13.28	9.35	3.81	0.78	0.16
Patna . . . . .	0.77	0.68	0.86	0.28	1.75	7.71	13.40	11.21	7.20	3.08	0.19	0.10
Gaya . . . . .	0.70	0.61	0.48	0.17	1.14	6.23	12.40	11.73	8.55	3.27	0.20	0.23
Shahabad . . . . .	0.78	0.73	0.26	0.17	0.77	6.44	13.60	11.66	6.26	3.61	0.25	0.24
Baran . . . . .	0.73	0.44	0.16	0.20	1.55	7.25	11.77	11.00	8.20	3.27	0.18	0.10
Champan . . . . .	0.73	0.48	0.44	0.60	2.61	9.24	13.73	13.81	9.89	3.28	0.11	0.15
Mozaffarpur . . . . .	0.77	0.47	0.38	0.55	2.20	7.41	12.08	11.00	8.17	3.61	0.11	0.08
Darbhanga . . . . .	0.74	0.43	0.39	0.68	1.86	7.47	13.89	13.49	10.08	3.16	0.11	0.07
Monghyr . . . . .	0.77	0.65	0.35	0.53	2.16	7.68	13.28	11.41	9.67	3.49	0.09	0.07
Bhagalpur . . . . .	0.68	0.51	0.44	0.90	3.15	6.34	13.73	11.68	10.19	3.28	0.07	0.07
Darjeeling . . . . .	0.23	0.69	1.76	4.24	9.29	23.26	23.08	24.96	16.23	4.23	0.21	0.23
Furnee . . . . .	0.46	0.41	0.49	1.57	5.41	13.61	23.16	14.93	15.44	3.86	0.07	0.06
Southal Parganas . . . . .	0.68	0.60	0.48	0.81	3.76	9.79	13.68	11.26	11.10	8.15	0.23	0.08
Sambalpur . . . . .	0.43	0.46	0.93	0.48	1.23	10.40	13.97	16.16	9.81	1.98	0.48	0.25
Angul . . . . .	0.23	0.53	0.96	1.36	3.43	9.76	11.17	10.68	9.67	4.68	1.09	0.20
Cuttack . . . . .	0.30	0.74	1.17	1.37	4.23	9.71	11.89	13.77	10.19	6.19	1.07	0.29
Balasore . . . . .	0.35	1.04	1.49	1.79	4.06	9.10	13.08	11.26	11.18	6.64	1.21	0.19
Puri . . . . .	0.28	0.75	0.90	0.88	3.13	8.17	10.28	13.06	9.28	7.13	2.20	0.24
Hazaribagh . . . . .	0.71	0.23	0.70	0.20	1.29	6.48	14.23	13.60	8.27	3.13	0.21	0.23
Ranchi . . . . .	0.46	0.23	0.66	1.07	1.99	9.64	14.20	13.21	9.20	3.68	0.23	0.20
Palaman . . . . .	0.28	0.23	0.61	0.23	0.94	6.80	13.28	13.43	7.66	3.09	0.29	0.25
Manbhum . . . . .	0.47	0.74	0.28	1.02	3.21	9.28	13.60	13.73	8.23	3.70	0.21	0.13
Singbhum . . . . .	0.24	0.77	0.76	1.46	3.23	10.27	13.07	14.54	8.19	3.20	0.48	0.13

## APPENDIX II.

Normal mean temperature of Districts in Bengal.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.		
1	2	3	4	5	6	7	8	9	10	11	12	13		
Burdwan . . . . .	66.9	71.2	81.1	88.2	88.2	86.5	84.8	84.2	84.3	81.7	79.7	67.1		
Baniganj . . . . .	66.2	69.3	80.8	88.8	89.1	87.4	84.2	83.4	83.3	80.8	78.8	66.1		
Bankura . . . . .	66.8	70.1	78.6	86.9	89.0	87.2	83.9	83.2	80.1	80.8	78.0	66.2		
Midnapore . . . . .	66.2	72.1	82.2	89.2	88.5	87.0	84.0	83.2	83.2	80.8	78.1	67.2		
24 Parganas . . . . .	67.9	73.4	81.2	88.4	88.4	86.1	84.2	83.5	83.9	81.9	74.4	67.7		
Calcutta . . . . .	66.2	71.2	80.2	86.7	89.0	88.8	85.9	82.7	82.2	80.5	78.0	66.3		
Nadia . . . . .	64.8	67.8	78.8	86.5	86.5	85.8	83.9	83.5	83.1	80.7	72.8	66.4		
Murshidabad . . . . .	65.2	69.8	79.2	87.4	86.5	86.4	84.1	83.6	83.7	80.9	78.0	65.9		
Jessore . . . . .	65.5	70.8	80.4	86.2	85.8	85.2	84.2	83.7	84.0	82.6	78.8	66.3		
Patna . . . . .	61.5	65.9	70.5	87.1	89.0	88.2	85.0	84.3	84.6	80.4	71.1	63.0		
Gaya . . . . .	63.8	68.8	79.8	86.2	82.2	80.9	85.1	84.2	84.4	80.3	71.5	63.9		
Shahabad	Dehri . . . . .	64.0	68.1	77.8	89.2	82.1	80.9	84.4	83.2	83.1	80.9	71.5	64.5	
		Buxar . . . . .	63.0	63.2	77.8	86.9	89.9	88.7	84.1	83.5	83.2	79.6	70.6	62.8
			Arrah . . . . .	61.5	64.5	77.1	86.9	86.5	83.7	84.8	84.2	83.0	79.5	70.4
Saran . . . . .	61.9	64.7	78.1	85.9	88.6	87.7	85.0	84.0	83.9	79.6	70.4	63.0		
Champaran . . . . .	69.8	63.2	73.4	82.6	85.3	85.3	84.2	83.7	83.1	78.2	69.8	61.2		
Muzaffarpur . . . . .	Normal not yet worked out.													
Darbhanga . . . . .	63.5	65.7	75.4	84.0	86.6	85.8	84.7	84.0	83.6	79.9	71.7	64.2		
Bhagalpur . . . . .	63.2	66.4	77.0	84.9	88.1	88.5	84.2	83.6	83.1	78.4	70.8	62.9		
Darjeeling . . . . .	40.8	41.8	48.5	58.6	63.2	60.7	61.8	61.4	59.9	55.2	48.3	43.6		
Purnea . . . . .	61.6	65.2	76.2	83.5	84.6	84.7	84.4	83.8	83.4	78.3	70.5	63.5		
Sonthal Parganas . . . . .	68.6	67.0	78.6	87.8	87.9	86.4	83.1	83.4	83.2	79.0	70.4	63.5		
Bambalpur . . . . .	...	...	...	...	...	...	...	...	...	...	73.1	66.0		
Cutlack	Cutlack . . . . .	72.2	77.9	84.7	90.1	90.9	87.9	84.2	83.7	84.2	82.2	75.6	70.4	
		False Point . . . . .	68.7	73.8	79.8	85.8	85.4	85.2	83.2	82.6	82.0	80.8	74.0	67.7
			Balasore . . . . .	68.8	73.7	81.2	86.7	88.2	86.5	83.5	82.9	83.1	80.4	73.2
Puri . . . . .	Normal not yet worked out.													
Hasaribagh . . . . .	63.9	66.8	78.8	85.4	87.4	84.2	79.2	78.6	78.4	75.1	67.6	61.4		
Banohi . . . . .	62.7	66.6	78.5	84.6	87.8	83.0	78.5	78.0	78.1	74.2	67.7	62.2		
Palamau . . . . .	Normal not yet worked out.													
Manbhum . . . . .	Normal not yet worked out.													
Singbhum . . . . .	67.6	71.8	80.9	89.8	88.6	87.5	83.7	82.8	83.1	78.5	71.9	66.1		



## APPENDIX III.

Statement showing the composition and ordinary prices of oil-cakes used as manure for sugarcane.

(1) Castor-cake, price R2 per maund—		
Moisture	. . . . .	11.01
* Organic matter	. . . . .	75.49
† Soluble mineral matter	. . . . .	8.27
Sand	. . . . .	5.23
		<hr/>
		100.00
* Nitrogen	. . . . .	6.48
† Phosphoric acid	. . . . .	3.05
Potash	. . . . .	1.48
(2) Rape-cake, price R2 per maund—		
Moisture	. . . . .	12.58
* Organic matter	. . . . .	70.86
† Soluble mineral matter	. . . . .	9.01
Sand	. . . . .	7.57
		<hr/>
		100.00
* Nitrogen	. . . . .	6.14
† Phosphoric acid	. . . . .	3.00
Potash	. . . . .	1.45
(3) Safflower-cake, price R2 per maund—		
Moisture	. . . . .	8.36
* Organic matter	. . . . .	83.74
† Soluble mineral matter	. . . . .	6.21
Sodium Chloride	. . . . .	1.89
		<hr/>
		100.00
* Nitrogen	. . . . .	7.61
† Phosphoric acid	. . . . .	3.54
Potash	. . . . .	1.40
(4) Neem-cake, price R2-4 per maund—		
Moisture	. . . . .	5.68
* Organic matter	. . . . .	84.56
† Potassium nitrate	. . . . .	7.55
Potassium chloride	. . . . .	2.23
		<hr/>
		100.00
* Nitrogen	. . . . .	6.61
† Phosphoric acid	. . . . .	1.90
Potash	. . . . .	2.89
		<hr/>
		Price per maund
		R s.
(5) Linseed-cake	. . . . .	2 8
(6) Poppy-cake	. . . . .	3 0
(7) Sesamum-cake	. . . . .	3 0
(8) Mahua-cake	. . . . .	2 8

## APPENDIX IV.

Statement showing the course of the trade in Sugar in Bengal during the five years 1901-02 to 1905-06.

	1901-02.	1902-03.	1903-04	1904-05	1905-06.	REMARKS.
<b>Imports.</b>						
<b>Refined sugar—</b>						
From Foreign countries by sea* and land.	1,515,927	1,516,119	1,276,955	2,107,463	2,211,346	*Imports into Bengal by sea up to September 1905 included a certain amount of low-grade sugar as refined, which has been classed as unrefined from October 1906.
“ Indian ports and provinces . . .	434,112	383,603	308,404	614,438	251,849	
<b>Total refined sugar . . .</b>	<b>1,950,039</b>	<b>1,879,722</b>	<b>1,585,359</b>	<b>2,721,901</b>	<b>2,463,195</b>	
<b>Unrefined sugar and molasses—</b>						
<b>Unrefined sugar—</b>						
From Foreign countries by sea and land.	“	“	“	“	229,483	†Molasses—raw, gw, jaggery, shiro and treacle Molasses is not distinguished from other kinds of unrefined sugar when imported coastwise or from foreign countries by land. But the quantity in these cases is trifling.
“ Indian ports and provinces . . .	74,907	43,340	58,465	48,041	61,517	
<b>Molasses†—</b>						
From Foreign countries . . . . .	415,918	447,296	257,677	333,851	533,071	
“ Indian provinces . . . . .	590,356	554,252	504,265	577,024	533,058	
<b>Total unrefined sugar and molasses . . .</b>	<b>1,006,274</b>	<b>1,024,898</b>	<b>761,942</b>	<b>910,875</b>	<b>1,077,029</b>	
<b>Total imports from foreign countries . . .</b>	<b>1,931,875</b>	<b>1,963,415</b>	<b>1,544,002</b>	<b>2,441,314</b>	<b>2,973,877</b>	
“ “ Indian provinces . . . . .	1,105,023	940,408	806,671	1,040,028	598,460	
<b>GRAND TOTAL IMPORTS OF SUGAR . . .</b>	<b>3,036,928</b>	<b>2,908,528</b>	<b>2,100,833</b>	<b>3,461,107</b>	<b>3,540,227</b>	
<b>Exports.</b>						
<b>Refined sugar—</b>						
To Foreign countries by sea and land . . .	19,591	14,375	15,513	20,137	37,983	
“ Indian ports and provinces . . . . .	154,319	154,021	275,245	439,438	437,491	
<b>Total refined sugar . . . . .</b>	<b>167,480</b>	<b>168,006</b>	<b>290,758</b>	<b>459,575</b>	<b>475,474</b>	
<b>Unrefined sugar and molasses—</b>						
<b>Unrefined sugar—</b>						
To Foreign countries by sea and land . . .	81,116	49,181	43,575	43,347	83,948	
“ Indian ports and provinces . . . . .	475,733	391,360	392,841	390,500	448,723	
<b>Molasses—</b>						
To Indian provinces (by rail and river only)	690,646	723,811	618,367	663,586	631,636	
<b>Total unrefined sugar and molasses . . .</b>	<b>1,171,495</b>	<b>1,164,352</b>	<b>1,064,783</b>	<b>1,097,433</b>	<b>1,164,307</b>	
<b>Total exports to Foreign countries . . .</b>	<b>63,707</b>	<b>63,556</b>	<b>58,888</b>	<b>63,484</b>	<b>71,931</b>	
<b>Total exports to Indian ports and provinces . . .</b>	<b>16,226,208</b>	<b>1,179,203</b>	<b>1,825,633</b>	<b>1,485,024</b>	<b>1,497,629</b>	
<b>GRAND TOTAL EXPORTS OF SUGAR . . .</b>	<b>1,385,915</b>	<b>1,282,759</b>	<b>1,384,521</b>	<b>1,548,508</b>	<b>1,569,800</b>	
<b>Net imports of sugar . . . . .</b>	<b>1,651,013</b>	<b>1,625,769</b>	<b>1,715,782</b>	<b>1,912,899</b>	<b>1,970,427</b>	
<b>Production of sugar . . . . .</b>	<b>13,628,200</b>	<b>13,631,500</b>	<b>13,078,900</b>	<b>13,69,000</b>	<b>13,300,000</b>	
<b>Presumptive consumption . . . . .</b>	<b>15,179,213</b>	<b>15,302,995</b>	<b>14,769,723</b>	<b>14,626,959</b>	<b>14,600,867</b>	

## APPENDIX V.

Dated Ottur, the 23th December 1906.

From—H. M. CARRY, Esq., Manager, Ottur Sugar Works, Silout Tirhut State Ry.,

To—The Director of Agriculture, Bengal.

I regret not having found time before to reply to your letter of the 5th ultimo No. 4623.

Prices ruling at present in Bihar for cane are Re. 0-4-6 and Re. 0-5 0 per maund which should always be a safe price for the manufacturer and gives the grower a good return. Seeing the great fluctuations in the price of sugar, these are high prices for a minimum rate, but when sugar exceeds a certain price, the grower should be allowed to participate in the high prices.

The *raiyat* has no statistics to know what pays him best, but I am sure, he would find the above rates for his cane would pay much better than making jaggery in the primitive and wasteful manner prevailing. It is a surprising fact, but the price of *gur* in this country seems to be in no way ruled by the world's price of sugar, but with the latter at its lowest and *gur* at its highest, I still think it would pay the *raiyat* to sell his canes.

Round these parts, eight small central factories have been erected in the last few years. Of these three are new and commence work this season; one is closed down as sufficient supplies of cane in the neighbourhood are unprocurable. With one exception, the others have all suffered up to date on the same account. Two small factories were erected for making jaggery of sorts, but were promptly closed as wasteful and unsatisfactory. A third since erected on the same lines seems to have done poorly so far. It is not likely in these parts, where so much tobacco is grown, it will ever be necessary or pay to make spirits. There is a good demand for molasses at prices that pay better than spirit-making would.

The size of the factory and the capital necessary entirely depends on the available cane lands within a practical distance. It appears to me, that in Bihar small central factories are most suitable as the cane plots are generally so scattered and small in size that light railways would hardly serve and with bullock cart transport only a factory to deal with 300 tons of cane a day would probably be quite large enough as, with 100 days' working, the total of 20,000 tons of cane required would represent the most that would be grown year in and year out within an area that could be suitably served by bullock carts. If 10,000 tons is more likely to be the figure, then let a factory for 100 tons per *diem* be selected.

Roughly speaking, a sum of ₹1,50,000 should cover the total cost of erection of a complete factory of the last-mentioned class, but I have not the time and sufficient data at my disposal to give a "carefully compiled statement."

Double crushing with or without shredding rolls preceding each mill of 3 rolls is the general type of crushing plant used in the factories here. Heaters, clarifiers, subsiding tanks, filters, and filter presses, are also general in varying forms. Triple effect evaporation, vacuum pan, centrifugals, dryers, and crushers, with large tank room for low grades and molasses roughly complete the outfit of the various factories here.

The capacity of the mills varies from 100-400 tons cane per *diem* and should work 3 to 4 months at least for a full crop, but so far few have had a sufficiently liberal supply of cane. All the above-mentioned factories deal with cane, some continuing work after the cane season refining native sugars. I have heard of no one so far importing foreign sugars for refining purposes. One factory alone not included in the above-mentioned deals with jaggery only for its raw material.

The general machinery in use is not suited to any other industrial purposes than sugar refining.

Small factories had much better make a raw refining sugar to feed a big refinery. The cost of manufacture is much reduced and expensive, skilled supervision almost dispensed with, the latter being concentrated in the refinery though advising and checking results of the small raw sugar factories. One sales department and a limited number and regular grades of sugar also tends to economy. Small factories making only raw sugar could be run entirely by natives, visited by experts from time to time to check waste.

#### MADRAS.

*Proceedings of the Board of Revenue (Revenue Settlement, Survey, Land Records and Agriculture), dated the 21st January 1907. 372-Misc.*

The Hon'ble Mr. A. E. CASTLESTUART STUART, I.C.S., Commissioner of Revenue Settlement, Survey, Land Records and Agriculture.

Read the following letter from the Director of Agriculture, No. 39--Dis., dated the 16th January 1907.

With reference to paragraph 3 of B. P. No. \* 236-Misc., of the 11th instant, calling on the Government Botanist to submit the result of the enquiry into the sugarcane industry in this Presidency, I have the honour to inform you that the Government Botanist, who is just proceeding on leave on medical certificate, informs me that he has not prepared any report. The Agricultural Inspector deputed by the Government Botanist to make enquiries on the subject in various districts has not yet completed them. It will not therefore be practicable to send in any report on sugarcane-growing in this Presidency in time for the next meeting at Cawnpore.

#### RESOLUTION.

Communicated to the Inspector-General of Agriculture, in continuation of the correspondence ending with B. P. No. † 324-Misc., dated the 18th January 1907.

(True extract.)

L. W. SWAMIKANNU,

Secretary.

## PUNJAB.

## 1. Owing to the very limited acquaintance of the writer with the cultivation

Introductory.

of sugarcane and manufacture of its products, this note does not aim at any exhaustive treatment of the subject, but is intended merely to give a general idea of the status of the sugarcane industry in the Province. Some day, and it is to be hoped at no distant date, the subject will be fully dealt with. The note follows Mr. Barber's suggested form of inquiry and forms indeed as far as possible replies to his queries, and it is hoped may be of some use to him. It is to be regretted that little has been done in the way of experimental work with regard to the crop, the only Experimental Station in the Province being at present situated at some distance from the cane-growing tracts. This, however, will be soon rectified by the establishment of a second station at Jullunder in the heart of the cane-growing districts.

The writer has omitted any attempt to describe or classify the varieties of sugarcanes and to make any definite suggestions as to lines on which improvements may be made. His acquaintance with the crop has been too limited for that.

It is, however, an undisputed fact that the valuable crops, such as sugarcane, form the backbone of the agriculture of the country. The growing of such crops can only be accomplished by much labour and good husbandry. The former factor admits of the land supporting a greater number of people; the latter tends to the upholding of the fertility of the soil.

An extension of the area under the crop means an extension of the land under good cultivation. But it also means more; for the subject includes both the cultivation of the crop and the industry of the manufacture of its products.

## 2. Table I gives the average rainfall and its distribution throughout the year for the Punjab. The figures for the

Climate.

hill stations, which can easily be recognised, are retained.

A glance at the table at once shows the scant rainfall during the winter and spring months and the late arrival of the monsoon, also the small annual rainfall in the western, southern and south-western parts of the Province. The principal falls occur on the submontane tracts which will be found further on to correspond to the chief sugarcane districts. The climate of the Province may be briefly described as hot and very dry—intensely hot by day and night from May to August in the tracts which receive more or less of the monsoon, the heat continuing up to the end of September where the annual rainfall is low. The daily maximum temperatures generally run from 105° to 110° and above in all the stations in the plains before the rains. The winter months are cool with low temperatures at night and occasional frost. From the agricultural point of view the climate is a severe one and tests the hardihood and vitality of plants to the uttermost.

The eastern part of the Province has a more moderate climate than the western, having a shorter hot weather and a milder cold weather.

## 3. As far as I am able to say, there are no historical references of any antiquity on the subject in this Province.

History of the crops in the Punjab.

The crop seems to have been in cultivation in the time of Alexander the Great. There is a legend that it was brought into the Punjab by "a great King who brought three things from the sea which required too much water—rice, sugarcane and the buffalo."

There seems to be some evidence that sugarcane cultivation spread originally from the United Provinces to the Punjab. It is quite certain that many of the Punjab varieties have been brought from Meerut and Rohilkhand. The *paunda* varieties are supposed to have come originally from Saharanpur, where they came to from Ceylon. It is believed by some cultivators that the *chan* variety has descended from the wild grass cane (*kahi*) which is occasionally to be met with in the jungle. Whether indigenous or exotic, there exists no information to indicate even roughly at what period cultivation of the plant arose.

The new canal colonies present a field for the study of the crop under new conditions, and a comparison of the figures from 1896 to 1904 gives some indica-

tion of the gradual increase of area during colonization where the colonists brought their own seed and methods of cultivation. A special study of the behaviour of the various varieties under the new conditions of soil and climate, which differ considerably from those of the eastern part of the Province, has not been made, but would be no doubt useful. Special modifications of the cultivation and treatment of the crop will in time probably arise, and its whole history will be interesting to follow.

4. Table II gives the acreage under sugarcane in each district of the Province from 1896 to 1905 inclusive, the figures for 1906 not being at present available.

Extent of the cultivation of sugarcane in the Punjab.

The most striking feature is the great decrease in area for the year 1905. This was probably entirely due to the fact that most of the canes set aside for seed were destroyed by frost. The average area for the five years 1896 to 1900 was roughly 346,900 and for the four years 1901 to 1904 (leaving out 1905 as abnormal) 334,900, which shows a decrease of  $3\frac{1}{2}$  per cent in spite of an increase of nearly 20,000 acres in Lyallpur District. The percentage of decrease is perhaps too small to admit of any definite explanation. There are, however, influences which doubtless have some effect on the crop area. Perhaps the chief are the increasing popularity of wheat and cotton in the Province.

A counteracting tendency may be found in the high prices of *gur* and *shakar*. Perhaps a fair estimate of the figures in Table I would be that there is a slight tendency to decrease of area in the older districts and a possibility of expansion in the colonies.

5. Broadly speaking, although sugarcane is cultivated in every district, it does not assume any relative importance except in those districts which have a fairly plentiful and secure supply of water in some form or other. The reason of course is obvious: the crop requires a great deal of water for its successful growth and this supply must be fairly secure as the capital outlay is great and failure cannot be lightly risked.

The character of the cultivation of the Province.

The chief cane-growing districts are, as we might expect,—

- (1) Those which have a plentiful supply of irrigation water from canal or wells.
- (2) Those having a moderate supply but a relatively higher rainfall.
- (3) Those which have a sufficient rainfall for the full growth of the crop. This class of cultivation is in the Punjab confined to those lands which lie close to the hills.

Relatively speaking, the first-mentioned class of land is the most important for sugarcane, security in this case being much greater. Representative tracts are the northern part of Jullunder Division and part of Lahore Division.

The second class of land is represented mainly by the Delhi Division in its southern districts. The third class or *barani* cultivation is mainly carried on and successfully too in the Gurdaspur and Hoshiarpur Districts. Table III has been compiled to shew the relative importance of the crop in each district which is indicated by the percentage of sugarcane to the total area cropped.

The figures used are the total average cultivated areas for the last five years and the average sugarcane area for 1901 to 1904, the year 1905, as before being eliminated.

The more important sugarcane districts may be broadly stated to be those lying in the submontane tract between the Chenab and Jumna rivers. Generally speaking, the crop forms part of the regular rotation. In those parts where it does not assume any relative importance it is to be found in isolated patches round about wells on land which is intensively cultivated.

There are of course other factors which influence the extent and character of the cultivation. Labour must be plentiful and cheap, the land must be of good quality, and manure must be available. The quality of land is perhaps not so much a determining factor as it might appear, as good land is to be found all over the Province. The scarcity of labour and supply of manure is no doubt one of the reasons why the sugarcane crop is relatively not of so much importance in the canal colonies where land is good and irrigation water cheap.

6. It is impossible for the writer to attempt any classification of the Punjab varieties at present until he has a collection of fully developed specimens beside him. For the same reason nothing but a very general description can be given. As far as possible, a complete collection of the varieties will be submitted at the next meeting of the Board of Agriculture at Cawnpore.

The following is as complete a list as can be given at present. Some of the varieties mentioned are rare and found only as admixtures amongst others. Many of the varieties mentioned appear to be exactly similar and will probably turn out to be the same variety under a different name.

#### A.—Chewing canes—

These are generally known under the name of "*paunda*" and are thick and succulent.

1. *Paunda*.—Greenish, soft, hard and juicy; the thickest of all varieties.
2. *Pauni* or *Poni*.—Soft skin—thinner than *paunda*—lighter green colour—corresponds with "*mairti*" of Saharanpur (?)
3. *Kinara*.—White, soft, juicy. This cane is also used for *gur*-making but is not at all common.
4. *Saharni*.—A *paunda* variety which has been imported from Saharanpur.

#### B.—Gur-making canes—

5. *Chan*.—The most important and most extensively cultivated in the Province, red in colour, thin to medium thickness, skin softish to hard, largish joints, yields small quantity of juice but good percentage of sugar.
6. *Dhau* or *Dholu*.—This is a good variety—whitish resembling *pauni*—smooth soft skin—thicker than *chan* but thinner than *pauni*.
7. *Ekar*.—Resembles *dhau*, somewhat thicker when ripe, said to have black lines.
8. Hissar reports give the name *Ganna* to some variety. This however is a general name for medium varieties.
9. *Dohb*.—{ *Ikh*, also reported from Hissar. *Ikh* seems to be a
10. *Lat*. — { general name for thin varieties.
11. *Tereru*.—Resembles *dhau*, but has a hard, coarse rind.
12. *Kahu*.—A thickish greenish white variety with a soft skin—is said to be a good ratooner.
13. *Kahta*.—A very thin reddish variety—very narrow leaves, hard rind—juice of good quality.
14. *Mendhin*.—Said to be American and found at Sialkot.
15. *Desi of Shahpur*.—Probably *chan*.
16. *Desi of Rohtak*.—Also probably *chan*.
17. *Sortha*.—A soft rinded variety whitish in colour.
18. *Lalri of Karnal*.—Description like *chan*, probably the same variety.
19. *Chinki*.—A poor thin fodder cane (found at Gujrat).
20. *Ghorru*.—A poor, dry, hard cane, found in Ludhiana District; when growing looks well but a poor yielder, tall, suitable for dry sandy tracts.

7. Generally speaking, the soils of the Province are alluvial in origin and a section reveals successive layers of sand, clay and loam. As a rule the land is

Sugarcane soils.  
fertile where the clay or loam outcrops, or where, when the surface is sandy, the clay or loam is not too far down to prevent the roots of plants from reaching it. A seemingly sandy soil may be seen producing excellent crops, but the reason is that the clay is near the surface. In sandy soils where the clay is too far removed from the surface the land is either barren or inferior. The clay is, as a rule, fairly pervious to water and drains readily.

In general character the typical sugarcane soil may be said to be an alluvial loam, naturally deficient in organic matter but fairly well supplied with mineral substances.

A shallow layer of sand overlying a stratum of clay is advantageous, the land being easily worked, any caking after irrigation being easily broken up and the moisture conserved.

8. As stated above, it is almost certain that most, if not all, of the Punjab varieties of sugarcane are exotic. Definite and recorded introductions of new varieties, however, are difficult to trace.

Recorded introduction of new varieties.

The *paunda* variety is said to have come from Shaharanpur and at the time of its introduction was said to have been "as tall as a bamboo and as thick as a man's thigh. At that time it was said to have been very hard." It certainly must have degenerated sadly since those days. Whether any further decline is going on at present, it would be difficult to say.

The only recorded introductions of exotics as an experiment were at the Agri-Horticultural Gardens at Lahore and the Lyallpur Agricultural Station. At the former place a number of new varieties were planted, but the result was a failure, while at the Lyallpur station two Poona varieties, *Bansl* and *Sanabali*, were grown but produced only 1,944 lbs. of *gur* each per acre against 5,008 lbs. per acre of the local *katha* variety. Neither of the two experiments were persisted in.

There is little doubt but that exotics from more humid climates undergo deterioration in the Punjab. The plant which seems to thrive best in this Province is a thin hardy variety which requires less water and manure than the more succulent varieties, and under present conditions it is questionable if any other type of cane would be popular with the cultivator, who complains that even his own species of cane requires too much water and manure.

9. The appearance of any new variety by sports or otherwise is unknown to the cultivators. Whether such have arisen it is impossible at present to state as there is no record of any scientific observation on the point.

Sports and seedlings.

No cases of any canes having been raised from seed are on record although unsuccessful attempts have been made by local officers to do so. The cultivator on the other hand is always on his guard against his canes producing seed.

10. As far as I am aware, sugar and spirit are produced only from sugarcane in the Province. The following experiment with the object of obtaining *gur* from *juar* was conducted at the Lyallpur Agricultural Station in the years 1901-02 and 1902-03 :—

Other sources of sugar.

Variety.	Years.	OUTPUT PER ACRE.					PERCENTAGES OF		
		Green tops and leaves.	Stalks.	Juice	<i>Gur</i> .	Grain.	Juice to stalks.	<i>Gur</i> to Juice.	<i>Gur</i> to stalks.
Sweet . . .	1901-02	5,024	18,969	6,816	816	...	48.79	11.97	5.84
Local . . .	1902-03	7,896	6,072	8,572	584	644	58.82	15.76	9.28
Sweet . . .	1902-03	4,164	4,140	1,836	276	592	44.84	15.03	6.66
Quatha . . .	...	..	...	...	...	...	.	...	...

The Annual Report says :— "This year the *gur* was made when the crop was fully matured and this accounts for the higher percentage of *gur* to juice and stalk and of juice to stalk. The *gur* made was of very bad quality like a thick mass of black syrup. The *gur* made last year presented the same characteristics. This syrup sometimes turns into a black hard brittle and solid mass, but it produces no crystals. There appears to be an unduly large proportion of glucose. The results are not encouraging and the experiment will be discontinued.

11. The time of planting and reaping vary very little throughout the Province. Sowing is usually done from the 25th of February to the end of March,

Planting and reaping seasons.

The first cuttings as a rule being about nine months after sowing time (that is from the end of November to the end of December). It is recognised by cultivators that the best time for cutting is about the new year, but the work has to be begun earlier in order to get the whole area cut in time before the planting of the next crop. Cutting goes on into February, occupying usually about two months.

12. Probably in no other respect do the practices of the province vary more than in rotations. It is quite

Rotations

universally understood that sugarcane must not follow sugarcane in the rotation, and hence the practice is rarely met with except on those lands which are renovated annually by silt deposits.

The chief crops in the alternative are wheat, cotton and maize. As a rule sugarcane is preceded by a *rabi* crop, but it is not uncommon to find it grown after a *kharif* crop. Where this practice prevails the usual crop is cotton followed by a catch crop of *sengi*, which is immediately grazed off and the land ploughed up.

Where the preceding crop is a *rabi* crop, it is usually wheat, but as a rule cotton forms part of the rotation at some time or other.

After sugarcane it is usual to follow on with a *kharif* crop, which may be maize, cotton, etc.

There seems to be no hard and fast rule in any district with regard to rotations, but the above principles are generally adhered to.

The ploughing in of *san* (hemp) and grazing of *sengi* are really manurial practices and will be further noted under that heading, but it may be here mentioned that such practices are chiefly confined to the Jullundur District, where the manurial value of leguminous crops is well understood and the knowledge acted upon.

Catch crops with cane seem to be rarely attempted, but melons are sometimes grown along with the *paunder* varieties.

13. The usual protective crop for sugarcane where such are grown is *san* hemp. This practice is also most common in the Jullundur District.

Protective crops.

14. Ratooning is not at all common, and, as a rule, finds little favour amongst cultivators. It is carried on mostly in the Gurdaspur and Hoshiarpur

Ratooning.

Districts, on the land which receives an annual deposit of silt. The usual practice is to plough the land a few times to loosen the earth about the roots. Little or no manure is supplied for the ratoon crop. The after cultivation is the same as for ordinary set planted cane.

Sometimes it may be necessary to have recourse to ratooning owing to scarcity of seed, but generally speaking, ratooning is not common.

The *kahu* cane of Gurdaspur is said to be specially suitable for ratooning.

Cultivation.

15. Cultivation may be broadly classified into three types:—

- (1) Where the sugarcane crop follows a *rabi* crop allowing a year's fallow.
- (2) Where it follows a *kharif* crop (e. g., maize).
- (3) Where it immediately follows a *rabi* catch crop.

The procedure in (1) is described below; in (2) it is identical except that there are fewer ploughings. (3) This is usually brought about by *sengi* being sown amongst the cotton crop. When the latter is cut down the *sengi* is grazed off by cattle and the land ploughed in February. In this case (usually in Jullundur District) little or no manure is given.

16. Where the crop is preceded by a *rabi* crop ploughing begins as a rule after the wheat harvest, i. e., in June and goes on up to sowing time. As many

Preparatory Tillage.

ploughings as possible are given. In some districts it is said that the land is ploughed about 40, 60 or even 100 times. The general rule seems to be to plough as often as possible and probably the average will be about 15. The fallow then is complete in one sense, that the land is frequently stirred. It is questionable, however, if the ploughings are deep enough, and whether it would not be better economy to give one or two very deep ploughings, reducing the



number. The usual depth of ploughing is not above from 6 to 7 inches and it would be well worth experimenting with deeper stirrings of the soil. Weeding and hoeing are, as a rule, carefully carried out and persisted in until the crop has fairly prevented further operations. The usual amount considered quite necessary is 4 times, but it is done as often as possible. The only implements necessary for the preparation of the soil are the plough and the *sohaga* or leveller.

17. There is practically only one method of planting, *viz.*, behind the plough. The procedure is as follows.

Planting.

The ploughman proceeds in the usual way and the planters, 6 or 7 for each plough, follow up and lay the cut sets in the furrow pressing them down with their feet as they proceed. The plough comes round again at a distance of about 8 inches making a new furrow and covering the sets in the preceding one. The sets are usually covered with about 3—4 inches of earth. The field is then levelled with the *sohaga* which finishes the operation.

18. As a rule the cultivator in the Punjab does not bring his sets from a distance, although in some parts of the Delhi Division it is recognised as good

Change of seed.

practice to bring seed from Meerut. There is no dependable information with regard to the effect of this practice on the growth of the plant and the richness of the juice.

The usual practice is for each cultivator to grow and select his own sets and where these may prove insufficient to purchase new sets locally.

Generally speaking, with the exception of the case mentioned above, the cultivator is averse to using seed brought from a distance, his usual answer being that the outturn is less and the juice poorer, but it is possible that this belief is due to prejudice.

19. The seed canes, except in the case of the *paunda* and soft skinned varieties, are often allowed to stand over till the last, and cut just before sowing. This practice, however, proved disastrous in the winter of 1904 when the standing canes were destroyed by frost, and is likely to go out of fashion.

20. The whole cane as a rule is used for cutting into sets except the "tops" and rooting joints. The Punjab canes, especially the *dholu* and *chan* varieties, which form the bulk of the crop, appear to be quite suitable for this practice. The sets get no special treatment in the way of pickling, etc.

The thick or hard-rinded varieties are usually buried for some time before planting, if they have not been stored in pits, to hasten germination. Care is taken to shelter the sets from the sun before planting by covering them up.

The number of joints in a set, varies from two to four. Two, I think, is the more common number.

21. The number of sets per acre is not usually calculated. An acre of cane is supposed to require from 5,000 to 6,000 whole canes and as from 5 to 6 sets

Number of sets per acre.

per cane are the usual numbers, 25,000 to 36,000 may be said to be the usual number per acre, although I believe the latter figure is often exceeded. The mode of planting has been mentioned above.

22. The sets are usually planted from 8—12 inches apart in the furrows which are about 8 inches distant from each other. Owing to irregularity of ploughing

Distance between sets

the sets are not all planted at an equal depth, but after levelling the usual amount of covering they have is from 3—4 inches.

23. It is not the custom in the Punjab to fill up blanks in the crop, and on the whole considering the large amount of sets planted it is seldom necessary to do so.

Vacancies

24. Transplanting from seed beds seems also to be unknown, but might be very useful as the cane often suffers in its early stages from drought and the ravages of white-ants.

Transplanting

25. Stool planting is of very rare occurrence in the Province, but was attempted in some places last year along with ratooning owing to the scarcity of

Stool planting.

sets. The effect is reported to have been similar to ratooning, and cultivator say they would not attempt it except under similar circumstances.

26. The two main sources of irrigation water are by wells and canals.

*Irrigation.*

Tank irrigation is of limited extent and unimportant in the Province. The canals give on the whole a good and regular supply of water. Well irrigation is effected by means of the Persian wheel and bucket systems. From the point of view of sugarcane cultivation, well water is most scarce during the early days of the crop, but as most of the *kharij* crops require little water before the rains, the sugarcane crop gets the greater bulk of the water and on the whole this is sufficient. After the rains break the critical time is past and water is more abundant in the wells. No doubt a more plentiful and cheaper supply of irrigation water in the cane districts would lead to an increase of area under the crop. Everywhere one is met by the cry that "sugarcane requires too much water." In some tracts unfortunately the water level is sinking and this is bound to affect, if it is not now already affecting, the area under sugarcane. The crop is bound to be the first to be affected through diminution of the water supply. The supplanting of the sugarcane crop by others in some districts has probably as its ultimate cause the increasing scarcity of water. The use of oil engine pumps might possibly lead to an increase of area under the crop, but until definite experiments have been carried out to determine their economic value in the Province as compared with present methods of water-lifting, no opinion can be expressed. It will be interesting to observe the results of the canal irrigation extension schemes at present being carried out on the sugarcane area in the Province. "Cheap water and plenty of it" is the main stay of the crop.

27. Drainage, as mentioned before, is, generally speaking, good throughout the Province, and as it is the custom to plough up all fallow land after the rains conservation of moisture is fairly well secured.

*Drainage.*

28. Although it is recognised that the sugarcane crop requires a special manuring of its own, the whole question is so involved with that of the general

*Manuring.*

fertility of the soil that it is impossible to compare the various practices of cultivators without reference to the treatment of the land throughout the rotation. Where sugarcane forms part of the usual crop rotation, as it does in all the important cane districts, the practice is to consider it the most important crop of the series and to give it the first consideration with regard to manure, the other crops being considered subsidiary in their manurial requirements. We thus find that in the majority of places most of the available manure goes to the sugarcane crop. Further, the crop as a rule is given the benefit of a fallow of not less than ten months.

29. Where the cane crop follows a *kharij* crop, it is the practice in some places as mentioned above to grow a catch crop of *sengi*, which is subsequently

*Sengi as a fertiliser.*

grazed off for manurial purposes. It is important to observe that in this case cultivators hold that no other manure is required. This practice would seem to indicate a great power of expansion of the manurial supply of the Province if necessary. At the same time it must be noticed that such land probably gets some manure at some stage of the rotation or other. But the point is well worthy of consideration, as in the cane-growing districts the area under the crop is probably mainly influenced by the supply of manure and water. This practice also admits of the abolition of the long fallow and the possibility of cane following cotton (a *kharij* crop), which would doubtless add to the economic value of the crop in the rotation.

The chief source of manure is of course farm-yard manure. Cakes as far as I know are not used, but occasionally crude saltpetre and nitrous earth, where available, are applied.

30. The amount of manure supplied varies considerably and depends on local circumstances. Close to the hills some land receives an annual supply of

*Quantity of manure.*

river silt and requires no manure. But these cases are exceptional and the crop in general receives from 150—300 maunds (82lbs.) per acre of farm-yard

manure. Some cultivators hold that an excess of manure spoils the quality of the juice. This may be probably explained by the tendency of an overdose of manure to retard the ripening of the crop.

31. Manure is generally applied when the final preparation of the land before planting is begun, say a month before. It is customary in some cases,

Time of application.

where the supply at that time is deficient, to apply a second dose after the cane has appeared above the ground. The manure is generally in this case worked into the soil in the process of weeding. As a general rule, however, all the manure is applied before sowing.

32. In discussing the quantity and quality of the available manure in the Province it is worth while considering the influence of climate. It is quite probable

Available manure in the Province

that owing to the colder winter climate and the short duration of the monsoon both the quantity and quality will compare unfavourably with other Provinces. It is probable that more cattle-dung is used during the cold weather in this Province than in others. The rains prevent the use of cattle-dung as fuel to a large extent during their duration and the comparative dryness of the Province must act adversely to the accumulation of manure.

The trash and leaves of the cane are all lost to the manure heaps as it is required for *gur*-making. The stools, too, are often burnt and this residue is thus lost to the soil.

33. The practice of ploughing leguminous crops into the land under fallow in the hot weather, although not necessarily before sugarcane, comes under the

Residue of leguminous crops.

heading of manuring. This practice is met with mainly, I think, in Jullundur where the cultivation is, generally speaking, excellent. The usual crop used for this purpose is *san* hemp. The great drawback the cultivators experience is the difficulty of ploughing in such crop properly with their *desi* ploughs. A shallow draught furrow-turning plough would be very useful for this purpose.

It must also be taken into consideration that in the sugarcane-growing tracts the leguminous crops—*san*, *mash* and *mung*—are widely grown and the value of their manurial residue must be considerable.

34. Regarding the supply of oil-cakes for manure in the Province I have not been able up to the time of writing, to

Oil-cakes.

obtain any figures dealing with the total amounts. The oil seed crops form an important item in the *rabi* crop of the Province. *Sarson* (rape) and *toria* (mustard) are the two chief varieties grown, others being rockel (*taramira*), sesamum (*til*) and castor. An analysis of the cakes from these crops is given in Table IX.

35. Unfortunately no manurial experiment dealing with sugarcane of any value has hitherto been carried out in the

Manurial experiments.

Punjab. In 1904 the Lyallpur Station took up one experiment, but its value was lost owing to the attack of borers. The result is given in the Station Report for that year, but must be largely discounted.

36. It may be said that the Province in one way and another has considerable manurial resources capable of expansion. The most valuable and probably

Expansion of manure supply.

the cheapest sources lie in the possibility of growing leguminous catch crops, the development of which has not been attempted.

37. Any attempt to increase the area under sugarcane by manurial expansion ought to take into consideration the possibility of working out a scientific

Value of suitable rotations.

rotation of crops culminating in sugarcane. Such a series ought to include if possible at least one other paying crop such as cotton, at least one leguminous crop, and finish up with a catch crop of, say, *sengi*, before sugarcane. This is practically the practice of many of the best Jullundur cultivators, but whether it would prove suitable for other districts remains to be seen. It is just possible that the land of other districts, where the *kharij* fallow system is carried out, may not be able to do without the fallow, but where possible it certainly *prima facie* looks like good economy.

38. After cultivation consists mainly of weeding and hoeing and it is generally recognised that the more often this can be done the better for the crop.

After cultivation.

Four hoeings and weedings are considered quite necessary and as many more as possible. In good cultivation an average will possibly be six weedings and two hoeings.

*Weedings* for the purpose of cleaning and loosening the soil are performed by means of the trowel-like hand implement called the "baguri" or "kharpa." Hoeings for the purpose of breaking up the hard surface are done with the *kahi* which consists of a broadish iron blade fastened at an angle of about 60° to a wooden handle.

Improved cultivators are unknown.

The land is seldom protected from the rays of the sun during the early days of the life of the crop, but this is sometimes done, especially at Hoshiarpur, by laying down the leaves of the *Chhachra* (*Butea frondosa*). After the canes attain a height of a few feet it is impossible to penetrate into the plots and all cultivation ceases.

39. The only treatment during the growth of the crop is tying which although more commonly done in the Delhi Division is known all over the Province.

After treatment.

As far as I know bamboos are seldom used for this purpose, although it is usually done for the sake of supporting the crop. The common practice is to tie two or three canes together by their leaves. Nothing is done in the way of treating the canes to keep off jackals, etc., watching and making noise by night being the only attempts to guard against their attacks.

40. It is the usual custom to irrigate up to the time of cutting. This practice is believed by cultivators to increase the amount of juice and to be a protection against frost.

41. Very little is known in this Province about the sugarcane diseases.

Diseases and insect attacks.

What is known is merely the knowledge of the cultivators themselves. The chief

insect pests are the moth-borer and white-ants, more especially the latter, which are responsible for a good deal of the damage done to the crop.

Cultivators say that *tela* (*aphis*) does some damage, but I find that the term *tela* is very often used to denote any form of disease. *Red smut* is known, but I doubt if the damage done by this disease is fully appreciated.

*Black smut* occurs occasionally but is rare.

*Arrested growth* is said to occur sometimes, but I have not seen it. It is said to be due to drought which is doubtful as it is confined to a few plants in a whole field.

As a rule fungoid diseases are, I think, comparatively rare, soil and weather conditions being unfavourable for their development. The climate is generally speaking dry and the drainage good.

Animal attacks are general all over, jackals and rats being perhaps the most serious, others being monkeys and wild boars.

42. The fact that deterioration rapidly sets in after cutting is thoroughly well understood and the custom is to take the canes direct to the mill. In fact the

Deterioration of the juice after cutting.

cutting forms part of the *gur*-making operations and goes on at the same time.

43. Canes are usually cut at the ground as low as possible, and this is always done at one operation, the tops being removed after reaping: There is

Cutting.

practically only one type of cane grown in the Province, and I know of no local variations of these rules.

44. The yield per acre in canes is not usually calculated by the cultivator, but the Lyallpur Station experimental weightings give some idea of the yield per

Yield per acre in canes.

acre in canes and also of the percentage of *gur* to cane.

45. The cultivator invariably manufactures or partly manufactures his own produce. Canes, except the *paunda* varieties, are never sold as such.

Manufacture.

The two chief products are *gur* and *mal rab*, the latter being generally sold to the sugar manufacturers. The process in the manufacture of *gur* and *mal rab* being practically the same, a description of *gur*-making will be sufficient to indicate the character of the manufacture of both products in the Province.

46. It may be said at the outset that the *gur*-making methods vary very little throughout the Province, any difference being generally due to the skill and industry of the individual *gur*-maker.

47. The two kinds of cane-pressing mills in use are the *belna* and iron roller mill. Both are too well known to need any description. The iron roller mill has come largely into use and is generally recognised by the cultivator to be quite a success. Some districts still hang on to the *belna* mill. These tracts are mostly in the districts irrigated by Persian wheels where the cultivator has been in the habit of using the trash of the cane for rope making. It is acknowledged by the users of the iron mill that it expresses 10 per cent. more juice and costs about one-half the labour of the *belna*. In the face of this it is difficult to see how the argument for the "*belna*" can be maintained, but it is probably only a matter of time until the use of the iron roller mills becomes universal. The mills as a rule either belong jointly to several cultivators or are hired by them for the season.

48. The canes are cut and stripped by men who receive as payment for their labour the tops and a few whole canes.

The expressed juice flows into either a large jar or is collected by several small jars. These jars are made of earthenware, but I have heard of cases where old *kerosine-oil tins* have been used.

49. When sufficient juice has been expressed it is poured into the boiling-pan, being strained either over the fire or before it is put on the fire.

The most common practice is to have only one boiling pan, but in some places batteries of two are used, one, the cooler one, being raised a little higher than the other.

While the juice is being boiled the scum is removed by ladles and either thrown away, given to sweepers or fed to bullocks. Where *mal rab* is the product aimed at, the juice is generally cleared by using a preparation of the bark of the *suklai* tree. Sometimes also the root of the *bhindi* plant is used for this purpose and in rare cases liming is carried out. Milk also is sometimes added after about two hours' boiling. When crystals appear, if *rab* is wanted, the boiling mass is emptied into clear earthen vessels called *matlis*, while if *gur* is desired boiling is continued until all the water has disappeared and the mass is of a thick curdlike consistency.

50. The proper moment for ceasing boiling in both cases is merely judged by the *gur*-maker himself: no tests are employed except to see roughly the state of the mass by taking out a small quantity with the fingers. The boiling *gur* is emptied into a shallow circular earthen pan called *gand*. The mass is stirred for a few minutes by a *khurpa* and then allowed to cool.

51. After cooling, the *gur* is collected into the centre of the *gand*, beaten between the hands, and made into round balls, in which shape it is sold in the market.

The jaggery as a rule has to be sold at once, but the purchaser is usually on the spot.

52. The whole process goes on simultaneously through day and night. As one boiling is finished, a new lot of juice is ready. The juice thus stands no longer than the time of boiling (2—2½ hours). Collecting pans where used are not heated.

53. As a rule the leaves and trash are sufficient for fuel, but occasionally where the *belna* mill is used and some of the trash is used for rope-making, extra

fuel in the shape of wood, cowdung, or cotton stalks has to be used. It may be said in any case that no residue gets back to the field for manure.

54. Liming is comparatively rare. I am not in a position to say whether it is done completely or not.

Liming.

I am not aware of any process used for preserving jaggery.

55. Table IV gives the average monthly retail prices of *gur* in the Punjab for the years 1901—1905. The average price of *gur* in local markets works out at about R4-8-0 per maund of 82 lbs. The cheapest time is of course during and after the *gur*-making season. The price usually is at its maximum in September and October just before cutting time.

56. The cultivator as a rule sells his *gur* when it is ready for the market and so does not benefit by the rise in price which takes place later on. As a rule he considers R3-8-0 to R4 a good price for good *gur* at marketing time.

57. In the principal cane tracts the supply of *gur* is greater than the demand and the surplus *gur* goes to those parts where cane-growing is less important. In the Punjab a ready market is always obtainable within the Province.

58. *Profit and Loss Account of Sugarcane cultivation in the Province.*— I have the greatest suspicion of such calculations which are after all only estimates. It is no doubt quite possible to give a statement of the cost of cultivation in particular instances and even to give an average cost of production in different localities. But the cost of production, calculated on the basis of hired labour, may easily vary to the extent of R10 per acre which in many cases is equal to the net profit.

A record of the actual nett revenue from the crop of one piece of land for a number of years would really be of use, but unfortunately we have no such record.

I append the actual cost of production at the Lyallpur Agricultural Station with the ordinary *desi* cultivation calculated on a hired labour basis—

I. Cultivation—	R a. p.	R a. p.
Ploughings . . . . .	8 0 0	
24 carts manure (300 maunds) . . . . .	12 0 0	
Seed (bought) . . . . .	12 0 0	
Sowing . . . . .	2 0 0	
Weeding with <i>khurpa</i> . . . . .	6 0 0	
Hoing with <i>hahi</i> . . . . .	2 0 0	
Irrigation expenses . . . . .	2 0 0	
Water rate, etc. . . . .	10 0 0	
	54 0 0	54 0 0
II. Manufacture of <i>gur</i> —		
*Trashing . . . . .	30 0 0	
Pressing . . . . .	25 0 0	
<i>Gur</i> -making . . . . .	7 8 0	
	62 8 0	62 8 0
		116 8 0
		per acre.

*Revenue.*

30 maunds <i>gur</i> at R3-8-0 per maund . . . . .	105
*Value of tops, etc (given to trashers) . . . . .	30

135

leaving a profit of R18-8-0 per acre.

\*This is the usual practice.

The price of seed given above is, I think, excessive. The writer has a number of such calculations made at Jullundur, Phillour, Hoshiarpur, Karnal and Rohtak, but considers that they are not reliable enough to publish. The cost of *gur*-making, however, in each case is about the same, *viz.*, R1 per maund of *gur*.

Probably the Lyallpur figures represent about a fair average throughout the Province.

Other saccharine product.

59. The other saccharine products from sugarcane are—

- (1) *Shakar*, which is simply *gur* finely ground.
- (2) *Khand*, the drained raw sugar obtained from *mal rab*. The process is as follows. The *rab* is emptied into large *kachha* vats lined with matting holding from 100 to 400 maunds. At the bottom of the vat is placed a mat constructed of reeds resting on bricks 8 or 9 inches high or on wooden supports. Over the reed matting a piece of coarse cloth (*pal*) is spread. The bottom of the vat is drained into reservoirs to hold the molasses. The molasses called *Shira* are frequently collected in earthen jars. The *rab* having been poured into the vat or *khanchi* is left for 3 weeks or a month. After the molasses have drained away the mass which remains is covered with a water weed called "*jala*" to the depth of a few inches. This is changed every day for about a fortnight. The mass gradually becomes clear and takes on a lightish colour at the top. This is removed and the remainder covered up again. The stuff removed is put in the sun and worked with the feet. It is now *khand*.
- (3) *Misri* is prepared from *khand* by boiling it with water and a little milk. The scum is removed and the liquid poured into earthen or metal vessels where the *misri* crystallizes. The quantity of water added seems to vary considerably from one-fourth to an equal quantity of the *khand*.
- (4) *Bura*, a superior form of *misri*, is obtained from *khand* by boiling it as for *misri*. The syrup is removed from the fire and stirred with two wooden instruments called *mosads*. The substance is sifted and powdered.
- (5) *Taviki misri* is the usual *misri* obtained by pouring the purified *khand* into an iron tray.
- (6) *Kusa misri* is obtained by pouring the purified *khand* into small earthen bowls where it is permitted to stay for a week. Some *shira* is extracted and the mass is now *kusa misri*.

60. Little has been hitherto done in the way of introducing improved machinery for sugar-making into the Province. At present only one factory

exists. It is situated in the Gurdaspur District. After a chequered career, during which it was found to be impossible to make the concern pay as a sugar factory pure and simple, it has combined the business of a soda-water factory and has been lately paying 10 per cent. on capital. The factory deals with *rab* which is obtained from the cultivator.

61. *Introduction of new varieties.*—This has been attempted but in a spasmodic fashion owing to the want of an organised Agricultural Department. This difficulty, however, will soon be overcome especially as the new agricultural station at Jullunder is in the heart of the cane-growing districts.

62. This point can only be settled by actual trials on experimental stations. It is too early to say whether improved cultivation may be an economic success or not.

63. The canal irrigation system of the Punjab has been and is still being enormously developed. The question of increased well-irrigation by oil-engines and other motor powers is under consideration by the Agricultural Department. A very large increased area of land will thus have a regular water-supply and it is possible that a considerable proportion may eventually become cane-yielding.

64. Probably we may look for more improvement in the manufacture of *gur* and *rab* than in any other direction. The existing methods are crude and very

Improved methods in manufacture.

probably wasteful. It is possible that instructions in better methods might be of great assistance to cultivators. This might possibly be undertaken at the new Jullundur station.

65. With regard to the introduction of small plants for sugar-making the writer has really too little acquaintance with the customs and practices of the country to express a definite opinion. There is little doubt, however, but that small concerns would have a better chance than large ones. Possibly there might be a chance through village co-operation in the matter. The small native sugar refineries are in the hands of the *banias* at present, who doubtless make a handsome profit. It has been stated that the decline of "rab-making" in some districts is due to that fact.

66. It is difficult to say whether it would be better for one factory to produce the sugar from the raw material or to buy the product of the cultivator for that purpose.

67. The fact that the *rab*-making process is profitable and leaves the cultivator a good price for his labour would seem to be averse to the former proposal. The question of transport would also be unfavourable.

68. The question of Government aid cannot at present be discussed. The whole question requires first of all to be gone thoroughly into, and that has not been done. Experimental work will be undertaken at the Jullundur station when it is established, but until then little work of any value can be accomplished.

S. MILLIGAN,

Deputy Director of Agriculture, Punjab.

TABLE I.

Average monthly rainfall at Head-quarters of each District in the Punjab.

District.	Number.	District.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total average rainfall in a year.
DELHI.	1	Hissar . . .	0.66	0.42	0.50	0.22	0.66	1.87	4.63	4.25	2.08	0.27	2.07	0.43	13.01
	2	Rohtak . . .	0.82	0.56	0.54	0.24	0.73	2.68	5.91	5.66	3.21	0.34	0.03	0.51	21.22
	3	Gurgaon . . .	0.88	0.41	0.49	0.16	0.68	2.75	8.39	7.10	4.32	0.34	0.04	0.34	25.92
	4	Delhi . . .	1.02	0.61	0.87	0.35	0.71	3.18	8.38	7.44	4.42	0.39	0.10	0.43	27.70
	5	Karnal . . .	1.23	1.16	0.73	0.41	0.97	4.11	9.40	6.90	4.80	0.37	0.12	0.50	30.55
	6	Ambala . . .	1.53	1.58	0.86	0.55	0.86	4.09	11.01	8.74	4.50	0.44	0.24	0.67	35.07
	7	Simla . . .	3.21	3.07	2.48	2.32	3.71	7.84	13.42	17.87	6.17	1.19	0.41	1.35	67.97
JULLUNDUR.	8	Kangra (Dharmata) . . .	4.89	4.88	3.87	1.95	2.58	11.04	40.81	39.19	12.44	1.32	0.25	0.57	125.69
	9	Hoshiarpur . . .	2.42	1.83	0.92	0.47	0.74	3.91	9.94	9.55	4.79	0.29	0.10	1.24	36.00
	10	Jalandur . . .	1.52	1.25	1.03	0.59	0.73	2.81	7.75	7.20	3.44	0.38	0.09	0.71	27.64
	11	Ludhiana . . .	1.44	1.11	1.14	0.65	0.85	2.66	8.81	6.59	3.70	0.81	0.08	0.73	28.25
	12	Ferozepore . . .	1.11	0.88	0.68	0.51	0.57	2.28	6.32	4.86	2.41	0.51	0.05	0.47	20.61
LAHORE.	13	Montgomery . . .	0.53	0.60	0.42	0.21	0.39	1.12	2.86	2.72	0.94	0.13	0.05	0.27	9.64
	14	Lahore . . .	0.87	1.13	0.82	0.51	0.60	1.86	6.65	4.88	2.10	5.43	0.11	0.47	20.70
	15	Amritsar . . .	1.76	1.14	0.86	0.41	0.63	2.57	7.03	7.33	1.69	0.26	0.05	0.50	24.29
	16	Gurdaspur . . .	2.18	1.87	1.41	0.57	0.97	4.16	9.90	8.71	3.63	0.49	0.14	1.09	34.94
	17	Sialkot . . .	1.94	1.85	1.53	1.27	1.05	2.38	10.30	9.74	2.99	0.49	0.26	0.77	35.22
18	Gujranwala . . .	1.44	1.41	1.17	0.70	0.77	1.86	7.35	6.11	2.14	0.41	0.20	0.62	24.18	
RAWALPINDI.	19	Gujrat . . .	1.90	1.52	1.76	1.02	0.74	2.38	7.86	6.94	2.41	0.42	0.05	0.27	27.84
	20	Shahpur . . .	0.82	0.95	0.95	0.63	0.63	1.13	3.76	3.07	1.50	0.15	0.22	0.33	14.28
	21	Jhelum . . .	1.96	1.38	1.56	1.00	0.87	2.00	7.59	6.39	2.34	0.45	0.24	0.50	26.38
	22	Rawalpindi . . .	2.50	2.10	2.09	2.05	1.42	1.79	8.24	7.71	3.18	0.53	0.04	1.11	33.86
	23	Attock . . .	2.17	1.95	1.67	1.11	0.63	0.62	3.57	3.36	2.02	0.16	0.36	0.53	18.69
MULTAN.	24	Mianwah . . .	0.77	0.73	0.79	0.77	0.62	0.81	2.95	2.62	0.91	0.05	0.28	0.20	11.55
	25	Lyalpur . . .	0.41	0.72	0.71	0.08	0.42	0.84	3.39	1.43	1.03	0.12	0.17	0.12	8.09
	26	Jhang . . .	0.61	0.45	0.71	0.36	0.43	1.03	3.32	2.18	0.84	0.14	0.06	0.34	10.33
	27	Multan . . .	0.39	0.66	0.42	0.37	0.59	0.43	2.19	1.66	1.00	0.07	0.06	0.27	7.11
	28	Muzaffargarh . . .	0.38	0.35	0.35	0.33	0.34	0.36	1.36	1.42	0.52	0.08	0.08	0.27	5.73
	29	Dera Ghazi Khan . . .	0.41	0.45	0.56	0.32	0.45	0.47	1.63	1.23	0.45	0.05	0.11	0.26	6.39



TABLE II.

Showing the area of the sugarcane crop of the Punjab for the last five years, i.e., from 1901—05.  
(HARVESTED AREA.)

Division.	Number.	District.	AREA UNDER SUGARCANE IN—					Average, * 1901—04.
			1901.	1902.	1903.	1904.	1905.	
DELHI.	1	Hissar	1,101	779	741	904	116	71
	2	Rohtak	21,739	18,117	19,994	24,434	5,408	21,171
	3	Gurgaon	9,477	5,497	7,880	7,557	485	7,548
	4	Delhi	17,271	17,512	16,350	17,575	7,959	16,927
	5	Karnal	19,541	20,766	19,323	19,553	11,843	19,795
	6	Ambala	8,828	10,377	12,350	15,870	10,001	11,855
	7	Simla	...	...	...	...	...	...
JULIAN- BUR.	8	Kangra	5,687	4,982	4,769	4,829	2,306	5,061
	9	Hoshiarpur	21,074	22,114	24,149	24,021	11,507	22,839
	10	Jullundur	30,040	31,682	31,181	27,797	10,440	30,169
	11	Ludhiana	12,498	11,896	11,465	9,692	6,391	11,139
	12	Ferozepore	2,966	2,109	2,109	1,507	1,039	2,671
	13	Montgomery	1,006	582	435	411	866	608
	14	Lahore	6,832	5,655	6,176	6,504	2,799	6,679
RAWAL- PINDI.	15	Amritsar	20,146	16,645	17,638	16,546	4,104	17,498
	16	Gurdaspur	49,917	48,231	52,612	51,590	28,260	50,587
	17	Sialkot	36,690	30,646	32,135	34,919	23,491	34,570
	18	Gujranwala	30,971	22,174	19,762	20,492	9,569	23,349
	19	Gujrat	7,833	7,461	6,406	6,694	5,501	6,998
	20	Shahpur	1,448	1,074	1,509	2,641	1,523	1,665
	21	Jhelum	304	312	265	238	236	281
MULTAN.	22	Rawalpindi	104	158	126	116	185	181
	23	Attock	7,624	1,792	1,650	1,557	1,763	1,680
	24	Mianwali	43	49	70	108	118	66
	25	Lyalpur	37,553	28,683	33,358	30,672	6,842	32,566
	26	Jhang	5,483	2,134	1,711	459	248	2,672
	27	Multan	1,079	1,370	1,015	1,141	832	1,157
	28	Muzaffargarh	4,663	6,560	5,732	5,392	4,575	5,594
	29	Dera Ghazi Khan	54	51	78	88	65	77
		TOTAL	356,947	320,268	330,787	333,231	155,405	335,301

\* The year 1906 being exceptional is omitted from averages.

TABLE III.  
Percentage of Sugarcane to cultivated area.

Name of District.	Percentage.	Remarks.
Hissar	00	District poor, rainfall 15 inches.
Rohtak	3 8	
Gurgaon	9 8	Insecure.
Delhi	3 5	
Ambala	2 5	
Kangra	7 3	Hill district.
Hoshiarpur	2 8	
Jullundur	3 9	
Ludhiana	1 5	
Ferozepore	0	Dry, rainfall 14 inches.
Montgomery	1 3	Very dry, rainfall 8 5 inches.
Lahore	6	
Amritsar	2 0	
Gurdaspur	5 6	
Sialkot	3 7	
Gujranwala	2 4	
Gujrat	9	
Shahpur	2	
Jhelum	90	Rawalpindi Division colder with shorter season
Rawalpindi	00	
Attock	2	
Mianwali	00	Poor district very dry
Lyalpur	2 6	Slight rainfall, irrigation good.
Jhang	2	
Multan	1 7	Dry.
Muzaffargarh	1 2	Do.
Dera Ghazi Khan	00	Do.
Average for the Province	1 7	

TABLE IV.

Showing the average monthly wholesale prices of sugar (raw) at Lahore for the years 1901-1905.

Months.	1901.	1902.	1903.	1904.	1905.
	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.
January . . . . .	4 9 2	4 1 8	4 1 8	3 15 4	4 9 2
February . . . . .	4 3 6	4 3 6	4 0 10	3 12 3	4 18 9
March . . . . .	4 3 6	4 4 4	3 13 8	3 12 3	5 0 8
April . . . . .	4 6 9	4 8 2	3 15 4	3 14 1	5 0 8
May . . . . .	4 11 5	4 9 2	4 0 8	4 1 8	5 5 4
June . . . . .	5 2 0	4 4 4	4 0 10	4 3 4	5 12 3
July . . . . .	5 2 7	4 4 4	3 9 4	4 6 9	5 11 5
August . . . . .	5 2 7	4 5 3	4 3 4	5 6 10	6 2 6
September . . . . .	5 5 5	4 4 4	4 5 2	5 6 10	6 8 6
October . . . . .	5 2 7	4 5 3	4 11 5	5 11 7	6 2 7
November . . . . .	5 6 11	4 3 4	4 8 3	5 2 11	6 7 1
December . . . . .	4 9 2	4 1 8	4 3 4	4 8 2	6 0 8]

TABLE V.

Export of gur from the Punjab from 1896-1906.

Year.	By rail.	By land.	Total.	Remarks.
	1,000 maunds.	1,000 maunds.	1,000 maunds	
	R	R	R	
1896-97 . . . . .	450	120	570	Expressed in thousands of maunds. 1 maund=82 lbs. nearly.
1897-98 . . . . .	810	90	900	
1898-99 . . . . .	570	120	690	
1899-1900 . . . . .	420	130	550	
1900-01 . . . . .	600	140	790	
1901-02 . . . . .	350	500	850	
1902-03 . . . . .	230	130	410	
1903-04 . . . . .	370	110	480	
1904-05 . . . . .	570	110	680	
1905-06 . . . . .	210	110	320	
Ten years' average . . . . .	463	156	619	

TABLE VI.

Imports of gur and sugars into the Punjab for 1896-1906.

Year.	Sugar refined.	Sugar unrefined.	Gur, etc.	Total.	Remarks.
	R	R	R	R	
1896-97 . . . . .	770	* 1,130	...	1,900	Expressed in thousands of maunds. 1 maund=82 lbs. nearly.
1897-98 . . . . .	960	* 1,360	...	2,320	
1898-99 . . . . .	800	* 1,590	...	2,390	
1899-1900 . . . . .	680	720	1,160	2,560	
1900-01 . . . . .	1,030	370	680	2,080	
1901-02 . . . . .	1,360	640	1,280	3,280	
1902-03 . . . . .	900	770	1,380	3,050	
1903-04 . . . . .	1,350	810	1,060	3,220	
1904-05 . . . . .	1,220	810	1,080	3,110	
1905-06 . . . . .	2,160	840	2,450	5,450	
Average for 10 years . . . . .	1,123	904	909	2,936	* No distinction made up to 1899-1900 between gur and unrefined sugar.

TABLE VII.

Estimated consumption of sugar products in the Punjab for the years 1896-1906.

	1896-97	1897-98	1898-99	1899-1900	1900-01	1901-02	1902-03	1903-04	1904-05	1905-06	Rev
Estimated home production.	8,890	7,860	8,910	8,290	7,610	8,590	7,460	7,720	7,770	8,140	
Imports . . . . .	1,900	2,820	2,890	2,560	2,090	3,280	3,050	3,220	3,110	5,450	
Total . . . . .	10,790	9,880	11,800	10,850	9,690	11,810	10,510	10,940	10,880	8,590	
Deduct—Exports . . . . .	570	900	690	550	740	850	410	480	680	320	
Total home consumption	10,220	8,980	10,610	10,300	8,950	10,960	10,100	10,460	10,200	8,270	
Deduct—Refined sugars	770	960	800	680	1,030	1,360	900	1,850	1,220	2,160	
Consumption of <i>G<sup>W</sup></i> and unrefined sugar.	9,450	8,020	9,810	9,620	7,920	9,600	9,200	8,110	8,980	6,110	

Each item in thousands of maunds

TABLE VIII.

Analysis of oil cakes—Punjab.

	H. O.	Ash	Sand.	Oil.	Woody Matter.	Albud N.	Non albud N.	Total N.	Phos. acid.
Rape (sarson) cake . . . . .	6.81	6.78	1.69	10.28	9.85	4.35	.81	4.66	2.68
Rockel (Tara Mira) cake . . . . .	5.84	7.17	1.14	9.35	7.84	5.00	.87	5.87	...
Sesamum (Til) cake . . . . .	6.95	14.19	2.80	8.08	3.67	5.97	.83	6.29	...
Torn cake . . . . .	7.40	8.64	2.20	11.34	8.32	4.46	.29	4.75	...
Castor cake . . . . .	...	...	...	...	...	...	...	3.93	1.33

TABLE IX.

(Extract from Lyallpur Farm Report 1903-04)—To show weight in lbs. of canes per acre and percentages

Area sown in acres.	Manure applied.	Method of cultivation.	Description of method.	CUTTINGS PER ACRE IN ROWS.			PERCENTAGES.			Green tops per acre.	Remarks.
				Canes.	Jules.	Gar.	Jules to Canes.	Gar to Jules.	Gar to Canes.		
1/4th	Farmyard manure 100 lbs. N. per acre before sowing + oil-cake 50 lbs. N. per acre as a top dressing.	Behar System	Trenches about 14" deep are made 2 1/2' apart. Cuttings are planted on both sides of the trench.	20,048	12,028	3,248	60.00	27.00	16.20	8,780	
1/4th		Mauritius System (modified).	Two cuttings are planted in each pit dug 3" deep and 2' apart between ridges made according to the Poona System.	35,052	19,280	3,400	55.00	17.80	9.70	15,724	
1/4th		Poona System	Ridges are made 2' apart in beds of 10' x 10', and cuttings are planted between the ridges.	33,736	16,296	2,800	49.30	17.32	8.80	14,520	
1/4th		Ditto		22,540	13,372	2,412	59.32	18.00	10.70	8,652	The or were true in the field weeks be the harve
1/4th		Country system	The cuttings are placed in the furrow behind the native plough, and the field is levelled.	39,776	23,520	5,008	59.3	21.3	12.6	18,040	

Note.—Ploughing .. 2 Waterings .. 20  
Weeding .. 5 Waterings (in the variety experiment) .. 19

TABLE IX—(Contd.)

Extract from Lyallpur Farm Report 1904-05—To show weights in lbs. of canes per acre and percentages.

Area sown.	Name of Variety.	Manure applied	OUTPUT PER ACRE IN LBS.			PERCENTAGE OF.			Green tops per acre.	Dry leaves per acre.	REMARKS.
			Canes.	Juice.	Ger.	Juice to canes.	Ger to juice.	Ger to canes			
1½ acre each.	Katha Variety.	Castor cake 150 lbs. N per acre before sowing.	14,500	7,372	1,840	5.084	9.24	18.17	9,538	...	
		Rape cake 150 lbs. N. per acre before sowing.	17,100	10,100	1,820	59.06	18.02	10.64	829	2,232	
		Farm yard manure 150 lbs. N. per acre before sowing.	4,772	3,890	604	77.11	16.41	12.65	2,354	792	
		Farm yard manure 100 lbs. N. per acre before sowing and nitre 50 lbs. N per acre as top dressing.	19,896	10,028	1,760	50.40	17.55	8.84	9,508	1,888	Ploughings 1
		Farm yard manure 100 lbs. N. per acre before sowing and rape cake 50 lbs N. per acre as top dressing.	5,548	3,892	660	70.15	16.96	11.89	1,648	908	Weedings 3
		Farm yard manure 100 lbs. N. per acre before sowing and castor cake 50 lbs. N. as top dressing.	11,900	5,484	964	46.09	17.58	8.10	4,784	1,740	Waterings 13
		Unmanured	6,452	3,516	524	54.49	14.90	8.13	2,556	1,173	

Results of the Experiment with methods of cultivating sugarcane.

Area sown.	Manure applied.	Method of cultivation.	Description of method.	Year.	OUTPUT PER ACRE.			PERCENTAGE.			Green tops per acre.
					Canes.	Juice.	Ger.	Juice to canes.	Ger to juice.	Ger to canes.	
1½ acre each.	Farm yard manure 100 lbs N. per acre before sowing + Oilcake 50 lbs. N. per acre as a top dressing.	Behar system	Trenches about 14 inches deep are made 2½ feet apart. Cuttings are planted on both sides of the trench.	1903-04	20,048	12,028	3,248	60.00	7.00	16.20	8,780
				1904-05	16,964	8,276	1,344	48.84	6.24	7.92	13,508
		Mauritius system (modified).	Two cuttings are planted in each pit dug 3 inches deep and 2 feet apart between ridges made according to the Poona system.	1903-04	25,052	12,280	3,400	55.00	17.80	9.70	15,724
				1904-05	7,820	3,480	576	47.54	16.55	7.27	6,196
		Poona system	Ridges are made 2 feet apart in beds of 10' x 10' and cuttings are planted between the ridges.	1903-04	26,736	16,296	2,800	48.30	17.38	8.30	14,520
				1904-05	12,460	7,024	1,164	56.37	16.67	9.84	1,964
		Ditto.	As above, but the canes are trashed 3 weeks before harvesting.	1903-04	22,540	13,272	2,412	59.99	18.00	10.70	8,858
				1904-05	8,640	4,268	636	49.36	16.12	7.96	4,436
		Country system	The cuttings are placed in the furrow behind the native plough and the field is levelled.	1903-04	29,776	23,520	5,008	59.30	21.30	12.30	8,040
				1904-05	11,900	5,484	964	46.09	17.58	8.10	4,784

Ploughings 9; Weedings 4; Waterings 20-31.

## BURMA.

This note follows, as far as possible, the lines indicated in Mr. Barber's "Scheme for Provincial enquiry into the Sugarcane Industry," and the sections follow the paragraph numbers of Mr. Barber's paper.

1. It may at the outset be said that if India has certain advantages over other sugar-producing countries, such as its cheap and abundant labour, *etc.*, the scarcity and consequent dearness of labour in Burma put it at a great disadvantage in sugarcane as in all other products in which it must compete with India, and for which it has not a specific market of its own. A low rate of cooly hire in Lower Burma is 8 annas a day or Rs15 per mensem, and subject to correction, I imagine that this is very much higher than the labour rate in other sugar-growing parts of India. The rates for labour to manufacture the sugar would be proportionately in excess, so that, as a commercial venture, sugar is not likely to take much hold in Burma.

2. *Climate.*—The principal sugarcane-growing districts of Burma are—

Amherst, Thaton and Toungoo in Lower Burma and Yamethin and Kyaukse (rather for quality than quantity) in Upper Burma.

The following statement shows the maximum and minimum thermometer readings at the recording stations in these districts for the year 1905 :—

*Statement showing the Minimum and Maximum Thermometer's readings at the recording stations of Amherst, Thaton, Toungoo and Yamethin by months for the year 1905.*

	January.	February	March.	April	May.	June.	July.	August	September	October	November.	December.
<b>AMHERST (MOULMEIN).</b>												
Dry minimum thermometer	64.42	63.1	73.6	76.7	76.9	74.64	74.20	74.07	74.20	75.30	70.10	62.60
Dry maximum do.	87.84	91.7	92.8	94.7	92.7	82.72	83.40	81.90	83.80	86.60	87.10	90.10
<b>THATON.</b>												
Dry minimum thermometer	54.23	61.21	68.32	69.27	72.81	73.53	72.55	73.18	73.57	74.16	70.67	67.90
Dry maximum do.	83.61	87.64	91.39	93.77	91.00	82.10	79.08	80.42	80.97	85.26	86.87	86.97
<b>TOUNGOO.</b>												
Dry minimum thermometer	55.97	59.61	69.96	73.73	77.43	76.46	75.34	74.87	75.80	76.50	69.53	60.35
Dry maximum do.	83.96	89.39	95.06	91.00	93.00	89.42	87.13	87.03	87.40	89.60	86.20	82.50
<b>YAMETHIN.</b>												
Dry minimum thermometer	55.06	59.07	72.09	74.04	76.93	75.86	75.00	74.23	74.43	74.37	67.71	59.01
Dry maximum do.	82.90	87.36	93.77	93.84	93.21	90.71	87.63	87.73	87.77	83.31	86.37	80.31

*Rainfall.*—The following statement shows the recorded rainfall by periods for each of the districts specified for the year 1905 :—

Districts.	From 1st January to 31st March	From 1st April to 30th June.	From 1st July to 30th September	From 1st October to 31st December.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.
Amherst (Moulmein)	0	62.39	104.49	11.31	178.19
Thaton	0	84.17	140.49	7.25	231.91
Toungoo	0.60	24.55	54.33	9.77	89.30
Yamethin	1.07	8.05	18.86	7.74	35.72
Kyaukse	2.53	4.93	13.60	7.56	28.62

3. *The age of sugarcane cultivation in Burma.*—It is difficult to trace the past history of sugarcane cultivation in Burma. The principal sugarcane tract of Burma has always been the Bilin township of the Thaton District, and writing of it in 1882 Mr. J. E. Bridges, I.C.S. (retired), says: "In Burmese times there were small patches of black cane grown round Bilin and sugar was manufactured in small quantities. Shortly after the English took the country the 'Madras cane' was introduced from Moulmein, and it is now the cane almost exclusively grown in this tract." This is the only reference of any value that I can trace.

4. *The extent and character of cultivation.*—The following statement shows by districts the total area under sugarcane in 1906:—

District.	Area.	District	Area.
	Acres.		Acres
Akyab . . . . .	261	Amherst . . . . .	688
Kyaukpyu . . . . .	608	Tavoy . . . . .	62
Sandoway . . . . .	705	Mergui . . . . .	81
Hanthawaddy . . . . .	181	Thayetmyo . . . . .	24
Pegu . . . . .	182	Pakokku . . . . .	30
Tharrawaddy . . . . .	557	Magwe . . . . .	1
Prome . . . . .	807	Mandalay . . . . .	2
Maubin . . . . .	127	Bhamo . . . . .	8
Pyapon . . . . .	104	Myitkyina . . . . .	10
Basson . . . . .	185	Katha . . . . .	2
Henzada . . . . .	157	Lower Chindwin . . . . .	2
Myaungmya . . . . .	447	Upper Chindwin . . . . .	5
Toungoo . . . . .	1,368	Kyaukse . . . . .	381
Salween . . . . .	149	Meiktila . . . . .	253
Thaton . . . . .	4,291	Yamethin . . . . .	1,587
		TOTAL . . . . .	12,710

The total Provincial area for the past five years has been—

Years.	Acres.
1901-02 . . . . .	15,285
1902-03 . . . . .	16,277
1903-04 . . . . .	18,108
1904-05 . . . . .	11,803
1905-06 . . . . .	12,710
TOTAL . . . . .	68,683

It will be noted from the above statements that the cultivation is scattered in small areas over many districts and that only in three is there an area of over 1,000 acres. The total, never great, shows evidence of shrinkage; but this is so small and the total area affected so insignificant that no particular reason can be assigned. It may be noted that Mr. Bridges found 3,753 acres under sugarcane in Thaton in 1882, so that there has been some increase there.

*General character of the cultivation.*—In newly cultivated tracts in Lower Burma it is a common practice to take a small crop of sugarcane off newly cleared land preparatory to laying out the land in continuous paddy. This is generally on a patch of about an acre or so near the river bank, and, in fact, in most districts of Lower Burma this is about the extent of the cultivation. In the Bilin township of Thaton District, however, Mr. Bridges found cane cultivation pretty constant on one piece of land with fallowing every second or third year; in some cases the fallow area being planted out in paddy with sufficient spaces between the paddy to allow of cane tops being laid down in September. In this same tract in 1897 it was found by the Settlement Officer that as a rule only half a holding is worked annually, the other half being fallowed for about ten months, i.e., between the cutting of the crop and the preparation of the land for the new one. In Yamethin, Upper Burma, sugarcane rotates with early sessamum every alternate year, the period of fallow being three to four months in the year, i.e., between the reaping and sowing of the respective crops.

In Toungoo sugarcane is either grown in the ordinary method of Lower Burma without irrigation or manuring or on high poor land of sandy loam which is well manured and irrigated from a surface tank or well. As a rule this land is deteriorated paddy land, but after a sugarcane crop has been taken off, the treatment which the land has received to produce this crop leaves sufficient fertilising material in the soil to give a good crop of paddy and it reverts to its original crop for two or three years.

In Kyaukse sugarcane, with the other crops of the district, receives the benefit of the elaborate system of irrigation which the district enjoys. Sugarcane generally follows Goa beans, is always irrigated, and is only planted over in three years on the same soil. In Moulmein and in a few other districts we find both methods—the casual shifting cultivation and the permanents.

Relatively the permanent method of cultivation found in Thaton is considered the most important. The small areas recorded against other districts are simply small patches on the borders of creeks planted with coarse sugarcane which is only used as a sweetmeat and not manufactured. The bulk of the sugarcane of Burma is so used.

*Origin of the soil.*—Mr. Bridges thus describes the soil in Bilin :—

"The soil of the valleys of the Bilin and Thebyu rivers is almost entirely deep grey loam, mixed here and there with light clay. The land is covered by the floods for a few days at intervals during the rains to a depth of two or three feet and a thick layer of alluvial soil deposited on it." The Settlement Officer in 1897 says that: A sandy silt is preferred for cane cultivation. Given this soil over a good clay, the outturns are as a rule good. The rivers overflow their banks two or three times every season, thus giving the necessary amount of water to the plants and at the same time making fresh deposits. Cane is also grown on higher land when they depend on rain. In Toungoo sandy loam is the favourite soil. In general the favourite soil is either deltaic or alluvial formation revived from time to time by silt deposits. I am sorry that the short time at my disposal has prevented me from making the collection of soils suggested.

5. *Varieties of cane grown.*—I note on this with diffidence as I have no botanical adviser. Mr. Bridges noted the following :—

(1) Black cane (in Burmese times).

(2) Madras cane introduced shortly after we took the country, of yellowish colour and so flexible that it does not require any supports. It grows to a height of 10 to 12 feet. Percentage of sugar in juice by saccharometer ranges from 20 to 27·14. Percentage of coarse sugar in juice ranges from 12·52 to 17 per cent.

(3) The "*Kaing Kyan*," so called from its resemblance to *Kaing* or elephant grass. Whitish in colour, and grows to same height as Madras cane, but is much thinner. Also flexible and does not require supports. Juice contained 21·43 per cent of sugar by saccharometer and 13·42 per cent of coarse brown sugar according to actual experiment.

(4) The "*Anyagyan*" or Upper Burma cane, reddish in colour with short thick joints: 20 per cent. of sugar by saccharometer: 12·52 per cent. of coarse brown sugar.

(5) The "*Kyaukgoung-gyam*"—Large cane of greenish colour with short thick joints: 14·28 per cent. of sugar by saccharometer: 8·94 per cent. of coarse brown sugar. It grows best in alluvial clay when it gave 22·85 of sugar by the saccharometer and 14·31 of coarse brown sugar.

Both these canes are very brittle and require supports. They are eaten as a sweetmeat and cannot be utilized for making sugar as they break at the joints while passing through the mill. These are probably the most popular canes and the most largely cultivated in Burma.

(6) The "*Kyannet*" or black cane is a thin cane of a dark purple colour. It has green leaves and yields but little juice: 24·25 per cent. of sugar by saccharometer; 15·19 per cent. of coarse brown sugar.

There is another variety of black cane with purple leaves which is used by the Burmans as a cure for insanity.

Mr. Bridges' enquiry is probably the most exhaustive that has been made into the varieties of canes.

The "Madras cane," introduced about 1860, is the most general in places where systematic cultivation is gone in for; otherwise Nos. 4 and 5 above.

6. *Recorded introduction of new varieties.*—There are no recorded experiments with exotic canes in Burma. As noted above, the "Madras" cane is generally distributed over the country. It is reported, however, that "Mauritius" cane grows luxuriantly and abundantly in Mr. Milne's grant at Zeyawadi, Toungoo. An experiment with Chinese cane in Kyaukse failed.

7. *"Sports" and seedling canes.*—No new canes are known to have been so produced in Burma.

8. *Other sources of sugar and spirits.*—No sugar is manufactured in Burma on any scale from any other source. The juice of the toddy palm is the favourite liquor of the drinking section of the community.

## PART II.

### \* CULTIVATION.

9. *Planting and reaping seasons.*—*In Lower Burma.*—Plant in September; also when 'ratooning' is in vogue from November to the beginning of January. Reap about November.

*In Upper Burma.*—Sown broadcast or planted in December and January and reaped in November to January.

10. *Rotations and mixed cropping.*—In Lower Burma the cultivation in the main sugarcane-growing tracts is generally permanent. Occasionally peas or other vegetables are taken as a catch crop in the cold weather. Generally only half a plantation is worked each year and a crop of paddy is frequently taken off the part not devoted to sugarcane.

Paddy and sugarcane thus practically rotate. In Upper Burma sugarcane rotates with early *sessamum* every alternate year, the period of fallow being three to four months in the year, *i.e.*, between the reaping and sowing of the respective crops.

11. *Ratoons.*—Mr. Bridges notes that when ratoons are sufficiently thick no new plants are put down after the cane has been cut, but as a rule cane tops are planted in the intervals between the ratoons.

Fifteen years later the Settlement Officer saw only few instances of ratooning in the same tract and was told that the owner was letting his plants ratoon either because he was unable to procure more cane to plant or in order to obtain seed to plant the following year. The Settlement Officer notes that in Amherst they ratoon on an average for three years, occasionally for five years. Ratooning seems to be rare in Upper Burma.

12. *Preparation of the land for planting.*—The land is first cleared of all weeds and then ploughed up. The plough used is an iron one, and to make the furrows a wooden piece, in shape something like a bat, is fastened on to the blade. About a month or so after the cane is planted the ground is carefully weeded and the soil loosened. This may be done only once or it may be done three times during the year. It depends on the quality of the soil, the amount of weeds which spring up and the interest of the cultivator. Usually the weeds are removed and the ground loosened twice. In Upper Burma, for this crop, as for all other crops, the methods of cultivation are somewhat more thorough. The land is well ploughed and harrowed, trenches 6 feet apart and 1½ feet wide are then made by means of a plough and in the trenches holes, 12 inches deep, are dug with spaces of 6 inches between them. After the showers of April and May when the plants are about 4 feet high the trenches are filled up and three weeks after the ground between the rows is well hoed and loosened. In July and August small drains are made from end to end of the field to prevent flooding, and the earth thus obtained is used for banking and supporting the plants. Until the end of the rains weeding and repairing the banks are carried on. Only farmyard manure, and that sparingly, is used.

13. *Planting.*—After the land is furrowed the cane is cut into pieces about 1½ feet long, each piece having three or four eyes and is laid along the furrows with about 12 inches interval between each piece. This is done in September or October, sometimes a little later. A little earth is spread over



each piece. If cane tops are used instead of cane pieces, after weeding, holes are dug, each about 1 foot in depth and 1 foot across. Cane tops soaked in water to induce germination are then planted, generally three in a hole. The holes are then filled up, water poured on and the soil well pressed down.

14. *The source from which the seed is obtained.*—The Burman evinces a preference for cane pieces as against cane tops, his theory being that the out-turn of jaggery from a field planted with pieces is much larger than from one planted with tops. In flooded land when planting is late, tops are used for filling up intervals.

15. *The part of the cane used for planting.*—The general practice in Burma seems to be to cut up the whole cane into sets and plant them, only the lower rooting joints being rejected.

16. *The actual preparation of the sets for planting.*—There are generally three joints to each piece of cane used for planting. Canes which have flowered are never used for seed as they are considered worthless for planting purposes. Occasionally cane tops are soaked a few days in water to induce germination, after which they are planted out. Nothing is done to resist fungoid attacks.

17. *The number of sets per acre.*—In Yamethin, where very careful enquiries were made by the Settlement Officer, the number of sets per acre is given at 11,150. The average for Lower Burma would seem to be just about 12,500 in the best land and 9,500 in second class land. There seems to be generally a certain amount of method in the planting.

18. *The mode of planting.*—The cane is ordinarily planted in trenches with intervals of a foot to a foot and a half between each cane and the cane is subsequently banked up. There is an interval of about 6 feet between trenches. These trenches are gradually banked up till they become ridges.

19. *Supplying vacancies.*—The Burman does not worry himself about failures and seldom, if ever, fills up vacancies. I am not in a position to make any remarks on the keeping of canes.

20. *Seed beds and nurseries.*—I have not come across these in Burma.

21. *Stool-planting.*—No instances of this have come under my notice.

22. *Irrigation and drainage.*—In Lower Burma irregular irrigation from wells or streams is sometimes resorted to. In Kyaukse the land chosen is first well irrigated before planting. It is again irrigated 2½ months after planting if the land is at all dry; and again a month and three months later. If the field is at all water-logged a drain, 4 feet deep, is dug round it.

23. *Cultivation.*—Before planting the land is cleared of grass and weeds. About 10 days after the cane has been planted the earth is loosened in the intervals between the holes and the cane pieces further covered up with mould. In the beginning of January the earth is again loosened and the plants further covered up. About the month of May the land is again cleared of weeds and grass and the plants are then left until the month of August or September, when they are stripped of the leaves that have become old and withered. Clearing of weeds is done once or three times a year with the "Mamooty" or Burmese *dah*.

24. *Manuring.*—Is little used in Burma; the only manure available is badly treated farmyard manure which is occasionally used for sugarcane before planting. The trash is sometimes burned, but not universally. It is more generally used for fuel for the mills.

25. *Treatment of the canes during growth.*—This is described in paragraph 23.

26. *Treatment of the fields preparatory to reaping the canes.*—In Burma the fields receive no special treatment.

27 to 32. *Disease Phenomena.*—The disease which is most commonly known is red smut, while white-ants and the moth-borer are very common. In the total absence of scientific advice I am not in a position to note on the specific diseases referred to in these paragraphs.

33. *Reaping.*—The canes bloom about the month of November: they are then severed with a *dah* from the stool close to the ground. The tops and branches are cut off, the former being used for seed and the latter for cattle-food: the cane is then cut in two pieces of about 4 feet each and carried in bundles to the mill.

34. *Deterioration after cutting.*—The mill and furnace are always erected in the holding and close to the cultivators' hut: only sufficient cane to feed the mill for one day is cut: there is therefore no time for deterioration after cutting.

35. *Mode of cutting the canes.*—As close to the ground as possible; the tops extending to where the hard cane is met.

36. *Yield per acre in canes.*—Average number of canes in Mr. Bridges' enquiries 10,809—average weight 37,378 lbs. In Yamethin the average number of canes was 18,492; but the weight was not taken. In the area operated on by Mr. Bridges, the Settlement Officer in 1897 got the following results:—

Average number of canes per acre:—

Class I land	.	.	.	.	.	12,577
„ II land	.	.	.	.	.	9,503

Average weight of canes per acre (after tops cut off):—

Class I land	.	.	.	.	.	30,704 lbs.
„ II land	.	.	.	.	.	18,314 „

In Toungoo in Class I land the average number of canes was found to be 12,800 per acre and the weight 59,108 lbs.

### PART III.

#### MANUFACTURE.

37. *Manufacture of jaggery or gur.*—The old form of mill described as follows by Mr. Bridges is still in very general use. “The mill consists of two heavy upright cylinders, about 1 foot in length and 2 feet in diameter. The cogs are circular and are cut in two rollers superposed to the crushing cylinders. A shaft about 12 feet long is fixed to one of the upper cylinders and is turned by a buffalo yoked to it. A few improved machines are now used: they consist of three upright pyngado cylinders and the middle cylinder to which the shaft is attached turns the other two by means of short straight wooden cogs.”

Generally the older pattern mills still find favour; but in places they have been ousted by the newer pattern. Mills with only two cylinders but with the short straight cogs are also now in use. As all canes are pressed twice and sometimes thrice there is some saving of labour in having a three-cylinder machine, for as the cane is passed through from one side it is passed back again from the other. With only two cylinders one man has to be constantly gathering up the partly crushed cane and carrying it round again to the other side.

As the juice is expressed it flows into a bamboo frame beneath the mill and from thence through bamboo piping into an iron pan in the furnace room.

“The juice is carried in chatties from the receiving pan to the iron boiling pans which are placed there in a row over a furnace dug in the ground. The fire is kindled at one end of the furnace and boils all the pans in succession on its way to the chimney. The liquor is at first placed in the pan furthest from the fire, and as it evaporates it is passed on by means of ladles to the next pan, and from this to the pan immediately over the fire. It gets thicker as it passes along, and the impurities are removed by means of a wooden skimmer. In each pan is placed a bamboo frame-work to prevent the boiling juice from escaping over the sides of the pan. After the juice in the third pan has become sufficiently thick it is taken off the fire and passed into an iron pan, where it is allowed to cool for a few minutes. It is poured on a bamboo mat spread evenly with a piece of bone and then divided with a piece of pointed bamboo into small squares. After it has become hard it is broken into cakes and packed away into bamboo baskets covered with leaves. Each basket contains about 175 lbs. of jaggery.”

Mr. Bridges introduced Thomson and Mylne's mills into Bilin. They were considered a great improvement on the wooden ones, but the cultivators objected to the small size of the cylinders: they would have hollow cylinders with a diameter of 1½ feet and a length of one foot, thus increasing the speed of the mill without any additional strain on the cattle. They would also have the shaft 10 instead of 7 or 8 feet long. As compared with the Burmese machine

in general use the Thomson and Myles mill was 12 per cent. slower, but yielded 20·28 per cent. more juice and jaggery: as compared with the improved Burmese it was 25 per cent. slower, but yielded 7·40 per cent. more juice and jaggery.

*Fuel.*—The cultivators and their hired labourers bring in enough fuel from the jungle. The cane trash, after being dried for a day or two, is also used as fuel, not by itself but with wood.

*Sugar-refining.*—Several attempts have been made at sugar-refining, but the net profit on the work was so small that these attempts were not repeated.

*Prices.*—The prices fluctuate so much that it is hard to say what an average local price for jaggery is. In Bilin the average opening price is nearly always R35 per 100 viss, but it goes down very quickly, as low perhaps as R16. A good deal of course depends upon the quality of the jaggery. The hard yellow cakes will keep longer and are worth about 10 per cent. more than the darker and softer cakes. The wholesale price in Rangoon is R35 per 100 viss in September and R30 in March, but the prices often fall much lower. The demand does not seem to be great, and is certainly not continuous, and a considerable amount of the jaggery, it is understood, comes from Madras.

38. *Profit and loss on sugarcane cultivation.*—The area under sugarcane cultivation in Burma is so small and scattered that it has in most cases not received special attention from Settlement Officers, but has been included amongst minor miscellaneous cultivation. Enquiries into profit and loss have however been made in Bilin, Amherst and Yamethin with the following results. Cultivators in Bilin always calculate by the *ta*—theoretically '29 of an acre, but owing to local variations taken by the Settlement Officer at '35 of an acre. The following is the cost of cultivation per *ta* :—

Clearing, ploughing, cutting up cane and planting . . . . .	R	2	0
First loosening and weeding . . . . .		1	8
Second loosening and weeding . . . . .		1	4
Seed cane . . . . .		6	0
Tools (annual cost) . . . . .		1	4
		<hr/>	
Total . . . . .		12	0

This equals R34 per acre. Deducting half the cost of loosening and three-fourths the cost of clearing and ploughing for home work we get R26 per acre as the cost of cultivation.

An average outturn of jaggery may be taken at 700 viss per acre. The monthly wages for cost of manufacture (one boiling gives 6·5 viss of jaggery or about 1,370 viss per month) are—

Two cutters at R11 . . . . .	R	22	
Two buffaloes at R4 . . . . .		8	
One herdsman . . . . .		7	
One cook . . . . .		20	
		<hr/>	
Total . . . . .		57	

Rupees 29 per acre, the average outturn being only 700 viss per acre.

*Implements.*—(Annual) :—

One mill costs R40, lasts 5 years . . . . .	R	8	
Four cauldrons cost R5 each, last 4 years . . . . .		5	
Baskets, oil, etc. . . . .		9	
Plough and furrows repairs . . . . .		10	
		<hr/>	
Total . . . . .		32	

The average holding is 4·52 acres: cost of implements per acre R14. Cost of living is R75 per acre. The average price to meet the numerous fluctuations is taken at R22 per 100 viss. Leaving the cost of living out of the amount we get 7 (00) × 22—(R26 + 29 + 14, = R154—R69 = 85 per acre, or deducting cost of living R75 per acre = Rs. 10 profit per acre.

In Amherst with a price of R30 per 100 viss, and excluding cost of living, the Settlement Officer got a net profit of R6 6.51 per acre. As the ordinary sugarcane cultivator has usually other land, it is difficult to equate the proportion of his cost of living which should be put down to sugarcane separately. With a proportionate reduction the profit would probably be about the same as in Bilin—R10 per acre, clear, after deducting cost of living.

In the Yamethin report the cost of cultivation varies from R75 to R97 per acre. On a valuation of canes at R1-8-0 per 100 with an average yield per acre of 10,000 we get R150—R75=Rs. 75 or R150—R97=R53 as profit per acre (without cost of living).

39. *Character and richness of the juice.*—In the absence of the chemical analysis (and I understand none has ever been made of Burma cane) I can only write in an amateurish manner on this paragraph.

The Settlement Officer in Bilin found the percentage of juice in the cane to be on an average 57.79 in first class land and 55.61 in second class, and the percentage of jaggery in the juice to be 16.81 and 16.18, respectively. These are the only statistics on the subject I can trace except the early investigation of Mr. Bridges. He found from 24.25 to 24.71 per cent of sugar to juice and from 14.45 to 15.76 per cent. of jaggery in the juice.

40. *Sugar-making.*—So far as I know this is not attempted in Burma; and the present small acreage under this crop hardly suggests that the Burma production will ever affect the commerce of the world. I hope to be able to bring samples from the Rangoon bazaar as suggested at the end of this paragraph.

The Chief Collector of Customs reports that the imports and exports of sugar are as follows for 1905:—

*Statement showing the imports of sugar, refined, into the Province of Burma during the Calendar year 1905.*

Country of shipment.	Country of origin.	Quantity.	Value	REMARKS.
		Cwts.	R	
<b>FOREIGN TRADE.</b>				
<i>Sugar, refined.</i>				
United Kingdom	Austria, Belgium, France, Germany, Holland, Peru, Java, Straits, Réunion, Demerara, Trinidad, Guatemala, British Guiana, and West Indies.	7,819	88,716	
Austria-Hungary	Austria	5,957	59,836	
Belgium	Belgium	597	7,512	
Germany	Germany	20,277	219,914	
Holland	Holland	492	4,432	
Egypt	West Indies	2	25	
Aden	Germany	5	31	
Ceylon	Germany	4	45	
Hongkong	Java and China	58,222	6,73,502	
Java	Java	204,328	2,118,466	
Siam	Straits	...	7	
Straits Settlements	Straits, Java and China	27,243	304,426	
Total		3,25,456	3,471,912	
<i>Sugar, unrefined (excluding molasses).</i>				
Java	Java	1,970	18,715	Raw sugar. Brown and unrefined sugar.
Straits Settlements	Straits	358	3,221	
Total		2,328	21,936	

Statement showing the exports of sugar, refined and unrefined, into the Province of Burma during the Calendar year 1905.

Country of shipment.	Country of origin	Quantity.	Value.	REMARKS.
<b>COASTING TRADE.</b>				
<i>Sugar, refined.</i>				
		Cwts.	Rs	
Bengal . . . . .	{ Indian . . . . .	11,470	1,80,235	
	{ Foreign . . . . .	985	14,606	
Bombay . . . . .	Indian . . . . .	40	795	
Madras . . . . .	Indian . . . . .	28,073	3,19,591	
Total . . . . .		38,548	5,15,277	
<i>Sugar, unrefined (including molasses)</i>				
Bengal . . . . .	{ Indian . . . . .	11,809	68,136	
	{ Foreign . . . . .	1,567	8,386	
Bombay . . . . .	Indian . . . . .	75	1,322	
Madras . . . . .	Indian . . . . .	3,882	37,771	
Total . . . . .		17,333	1,10,615	
Grand Total		3,88,665	4,119,740	

Statement showing the exports of sugar, refined and unrefined, from the Province of Burma during the Calendar year 1905.

Country of destination.	Country of origin.	Quantity.	Value.	REMARKS.
<b>FOREIGN TRADE.</b>				
<i>Sugar, refined.</i>				
Straits Settlements . . . . .	Foreign . . . . .	Cwts. . . . .	Rs 5	Re-export.
<i>Sugar, unrefined (including molasses).</i>				
Siam . . . . .	Indian . . . . .	457	1,820	Jaggery 455 cwts. Rs1,796.
Hongkong . . . . .	Indian . . . . .	1	10	
Madagascar . . . . .	Indian . . . . .	40	200	
Total . . . . .		498	2,030	
<b>COASTING TRADE</b>				
<i>Sugar, refined.</i>				
Bengal . . . . .	{ Indian . . . . .	9	85	
	{ Foreign . . . . .	562	6,886	
Bombay . . . . .	Foreign . . . . .	632	8,854	
Madras . . . . .	{ Indian . . . . .	1	15	
	{ Foreign . . . . .	9	90	
Total . . . . .		1,213	15,930	
<i>Sugar, unrefined (including molasses.)</i>				
Bengal . . . . .	Indian . . . . .	308	2,604	
Madras . . . . .	Indian . . . . .	30	232	Jaggery 19 cwts. Rs165.
Total . . . . .		338	2,836	
Grand Total		2,049	20,801	

PART IV.

IMPLEMENTS.

41. The cultivation of sugarcane is on such a small, and apparently, a declining scale that the Department of Agriculture would hardly be justified in devoting much attention to it till some of the more popular and extensive crops have been exploited. The crop will however find a place on both the experimental farms; the indigenous variety will be carefully studied and exotics tried. We shall be glad to assist other provinces by trying under the peculiar conditions of Burma any experiments they may want attempted, *e.g.*, acclimatization experiments and the effect on Indian canes of transporting them to Burma.

MAYMYO:  
The 8th December 1906.

J. MACKENNA,  
Director of Agriculture, Burma.

CENTRAL PROVINCES.

The chief districts in which sugarcane is grown in the Central Provinces can be divided into three classes according to the method of irrigation which is practised. In the districts of Betul and Chhindwara water is entirely supplied by wells. Further south in Chanda and Bhandara tank irrigation is the general practice, while in Balaghat and Bilaspur water is raised from low-lying *nalas* and tanks supplemented if necessary by wells. With this exception the methods of cultivation are fairly general all over the provinces. The cane-growing districts of Betul and Chhindwara lie on the Satpura plateau at an elevation of about 2,000 feet. Here in comparison with other parts of the provinces the climate is fairly cool and during the cold season the thermometer sometimes fall below freezing point, doing damage to sugarcane and other crops. The majority of the gardens in Balaghat have an elevation of about 1,000 feet and the climate is similar to that of Nagpur, but damper in the monsoon. Bhandara District is slightly cooler than Nagpur, the maximum temperature not usually rising above 112° while Chanda has recorded 119°, the highest shade temperature in the Central Provinces:—

Month.	NAGPUR, ELEVATION 1025 FEET.		RAIPUR, ELEVATION 170 FEET.		CHANDA, ELEVATION 684 FEET.	
	Mean maximum	Mean minimum	Mean maximum	Mean minimum	Mean maximum	Mean minimum
January	83.5	54.9	78.5	54.4	87.1	53.7
February	84.2	54.8	79.1	54.0	86.1	52.9
March	95.5	66.4	91.9	67.1	87.1	60.5
April	101.0	71.1	97.2	71.9	100.6	72.4
May	110.8	82.3	106.5	81.9	109.4	83.2
June	106.5	81.9	105.2	83.5	106.4	82.4
July	86.6	75.3	86.3	73.8	90.9	76.6
August	88.0	75.3	88.0	75.8	89.1	76.2
September	86.8	73.1	86.7	74.6	87.1	73.6
October	81.5	66.4	89.1	69.3	70.5	66.0
November	87.8	60.0	85.3	60.6	87.1	67.7
December	82.8	62.4	79.5	53.3	82.6	49.3

Average rainfall during the last 38 years

Month.	Nagpur	Betul.	Chhindwara.	Balaghat.	Bilaspur	Raipur	Bhandara.	Chanda.
January	40	54	76	81	45	43	55	27
February	40	51	42	52	52	42	44	35
March	83	52	40	45	65	61	61	68
April	88	19	36	34	65	51	75	53
May	49	0	51	61	115	433	55	62
June	899	780	860	1144	853	1027	947	783
July	1311	1346	1090	1828	1416	1407	1536	1623
August	1004	1175	759	1592	1199	1329	1415	1205
September	845	724	905	989	111	691	951	998
October	206	213	181	173	193	194	140	184
November	45	49	52	43	52	32	52	43
December	31	43	38	20	24	18	28	25
	4541	4515	4180	6076	4909	5378	5399	5230

*Area under cultivation.*—Taken as a whole the area under sugarcane in the Central Provinces is decreasing. This decrease is most apparent in what were formerly the chief cane districts—Bhandara, Betul and Chhindwara. Its causes will be discussed later.

Table showing the decrease in area under sugarcane in the Central Provinces.

	Betul.	Chhindwara.	Balaghat.	Bilaspur.	Raipur.	Bhandara.	Chanda.	PROVINCIAL AREA.		
								Irrigated.	Non-irrigated.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
At 80 years' Settlement—										
1884 to 1899	7,000	6,175	4,078	5,144	2,415	10,959	4,074			95,698
1894-95	6,712	5,548	1,788	4,327	1,255	4,882	3,483	18,049	15,086	89,115
1899-1900	4,655	2,936	1,120	2,851	825	3,329	2,319	28,448	1,757	26,205
1904-05	2,789	1,529	1,548	2,799	795	2,158	1,028	19,601	1,789	21,389
1905-06	2,315	1,554	1,687	3,380	1,584	2,264	1,068	15,809	2,481	17,740

*Character of the cultivation.*—In the sugarcane districts almost every village has a few gardens which are generally small in area, about two acres being the average size. The position of the garden is changed from year to year, cane being grown once in the course of a three or four years' rotation. It thus most frequently happens that a new garden lies alongside the old one and is sown very conveniently as the crop on the preceding garden is harvested. The other crops in the rotation vary with the nature of the soil and water supply. On the lighter lands, such as the *sehar* of Balaghat, the rotation consists of rice, mung (*Phaseolus mungo*) or urad (*Phaseolus radiatus*) and sugarcane. On the black soil of Chhindwara and Betul the rotation is with wheat, gram, linseed, peas or mixtures of these crops. Gram has generally the reputation of being the best preparation for sugar. Various other rotations are occasionally practised. In Bilaspur sugar and urad are grown alternately; in parts of Chanda the land is left fallow for three or four years between the crops while in Chhindwara some ryots take sugarcane after cotton. This latter practice, however, is not at all a common one. Ground-nut (*Arachis hypogaea*), and sann hemp (*Crotalaria juncea*) are also sometimes grown as the preceding crop while upon the unirrigated areas of Bilaspur the rotation follows rice upon black cotton soils and til (*Sesamum Indicum*), urad, cotton or one of the smaller millets upon inferior land.

*Soils.*—Where the water-supply is good, much sugar is grown upon fairly sandy soils such as the *sehar* of Balaghat or *wards* of Chanda. Of the black soils, *kali-morand* and *muttabarra* are all used, the majority of gardens being situated upon *morand*. *Kali* appears to be the least expensive land for sugarcane cultivation, the natural water-supply being good and less manure is required. Where, however, conditions are favourable *sehar* land produces good quality gur. The value of any land for sugarcane depends mainly upon its water-holding capacity.

*Varieties of cane grown.*—The varieties of sugarcane grown in these Provinces are few in number. The most important is *pachranga*, a purple and yellow striped cane found in practically every district. It produces a fair quantity of juice and a good, although dark-coloured, gur. It is also fairly hard and so less liable to attack from jackals. This cane frequently gives a white sport known as *gadhara*, but the latter from the observation of the cultivators never throws back to *pachranga*. The origin of *pachranga* is quite unknown. It is frequently mixed in the gardens with a few stools of *kala*, a dark red cane having no particular value in the northern parts of the Provinces. To the south it is grown to a larger extent. A variety of importance in the north of the Provinces is a thick yellow cane known as *engrezi*, *poundhi* (Betul) or *bhounthi* (Balaghat). It appears to have been an *otahete* cane introduced about fifty years ago by Colonel Sleeman, then Commissioner of the Division. It is a cane yielding a large quantity of juice and a good quality, yellow gur. Its one disadvantage is that having such a soft rind it is much attacked by jackals and its introduction into some districts seems impossible unless all the cultivators adopt it simultaneously. Otherwise the jackals would select out the

*poundhi* gardens and destroy them completely. An attempt was made in 1904 to introduce this cane from Betul into Balaghat. It was only partially successful as owing to the time taken in transit many canes perished on the way. There is a fourth variety which is only grown in the Bilaspur and Balaghat Districts and which has proved upon analysis to be one of the richest canes in India. It is a greenish white cane smaller than *poundhi* and known as *malyagar*. There appears to be no record of this cane having been introduced into other districts, but as it grows only in the best parts of Bilaspur and Balaghat it is quite possible that it is less hardy than other varieties.

In addition there are a few varieties of hard canes which are frequently grown around the outsides of the gardens in order to protect the better varieties from jackals. Their juice is mostly used for drinking purposes, while the canes are given by the cultivator to his labourers and others.

Sugar is not prepared in these Provinces from any plant but the sugarcane. An attempt was made at the Nagpur Farm by Mr. (now Sir Bampfylde) Fuller to prepare it from *Sorghum*, but the product was unsatisfactory. The whole of the native spirit consumed in the Provinces is prepared from Mahua (*Bassia latifolia*).

*General cultivation.*—Throughout the greater part of the Provinces the cane is sown at the end of December or January and reaped at any time from the end of December to the beginning of March. It thus occupies the ground for at least 12 months, while in the Betul District the period extends to as much as 14 or 15 months. In some parts of the Balaghat District where an inferior variety of hard cane is largely grown, the crop is planted in March or April and reaped in November. In addition to the time the crop is actually on the ground another period of from two to seven months must be added during which the land is undergoing preliminary cultivation. When the poorer classes of cane are grown the rotation is frequently with one of the smaller millets or early paddy; a mixture of kodon (*Paspalum scrobiculatum*) and kutki (*Panicum polypodium*) is sometimes used for this purpose.

Mixed cropping is but little practised, chillies (*Capsicum frutescens*) and castor (*Eicemus communis*) with occasionally a little ambari (*Hibiscus cannabinus*) being the only crops grown with the cane. It is, however, a frequent practice to grow castor, tur (*Cajanus indicus*) or bhendi (*Hibiscus esculentus*) around the boundaries of the garden.

*Ratoons.*—The practice of ratooning is quite unknown in many Districts nor has it even been heard of. It is sometimes carried out for one year in the Bilaspur District on land where hard canes are grown without irrigation. In parts of Balaghat there is a superstition that if a cultivator continues to grow his crop from ratoons it will result in the gradual extermination of his family. At Dongaria, in the east of the Chhindwara District, *mung* or *sarari*, a thin hard variety, is sometimes grown from the stools of the previous crop after burning off the old leaves and watering, but the return is generally below that obtained from fresh seed. In the Betul District both the *poundhi* and *pachranga* varieties have been tried from ratoons, but without success, the former in particular giving an unsatisfactory crop. This was, however, most probably due to the fact that no manuring was given the second year, but simply the usual amount of watering and interculture.

*Preparation of the land.*—This is commenced as soon as the previous crop has been removed, which gives, with a rabi crop occupying this position in the rotation, a period of seven or eight months before sowing. Following paddy the time for preparation of the land is much curtailed, but this is counteracted to some extent by the fact that such rotation is only practised on the lighter soils. Ploughing is done with a wooden country plough which consists of steeply inclined narrow share with an iron point but no mould-board. This is worked by two bullocks in two directions across the field and the soil broken into blocks without being inverted. About 10 to 12 ploughings are usually given or even more, with the result that a tilth to the depth of from 9 to 12 inches is obtained. If time permits one or two *bukharings* are also given and occasionally the land levelled by means of a heavy log of wood. The lumps of soil are then broken down by hand and except in paddy fields, water is given previous to planting.



In some districts a portion of the manure is usually applied at this time consisting generally of well decayed cattle manure. Village refuse is also given if available. The practice of folding sheep or goats is unknown in the north of the Provinces, but sheep are folded in the Chanda District.

*Source of seed.*—All seed used is obtained locally, frequently from the adjoining garden or from a garden which has a local reputation for seed supply. The common practice is to uproot the whole cane, divide it into pieces containing three or four eyes each and use the latter as sets. Where *khari* land, i.e., land receiving the village drainage, is planted with sugarcane, the crop is invariably sold for seed purposes. The reason for this is that cane from *khari* land never produces good *gur* and the canes being well grown, the practice of using them for seed is undoubtedly a good one. In districts where the harvest is early, canes for seed are left standing for a few weeks until required, while in others the seed cane is cut and planted before the main bulk of the crop is reaped. Occasionally the canes are topped as they stand and the tops carted away for seed. The rest of the cane is pulled for *gur* making when required.

*Selection and preparation of seed.*—There seems to be no preference amongst the ryots for any special part of the cane as seed, the whole being cut up and used indiscriminately. No observation seems to have been made or opinion formed as to which part of the cane gives the best outturn.

As a rule three eyes are contained in each set, but when the sets are sold the length of each is of more importance than the actual number of joints. No preparation is given to the sets and, if necessary, they are left covered up with leaves for four or five days before planting. After that time they begin to lose vitality. In the few areas where inferior canes are grown without irrigation, the canes are soaked in water for eight or ten days before planting in order to hasten germination.

*Planting.*—This operation is always carried out in saturated soil except upon unirrigated land. In this case the canes are not cut but planted whole, an implement resembling a large country plough, called a *bawan*, being used. The *bawan* has a large hole passing downwards through the sole and through this the canes are passed and pressed into position as the implement is moved along. In general practice the land is divided by a plough with a double mould-board into furrows about two feet apart. At right angles to these furrows main water channels are formed, and as one coolie directs the water two or three others plant the sets. As each set is dropped into position it is pressed down by the foot to a depth of about five inches. As a rule the ends of the sets touch and even, in thick planting, overlap, the rate of planting being modified by the distance between the sets in the row rather than by the distance between the rows, which is fairly constant through all the cane-growing areas.

No other system of seeding is in vogue and should the germination be bad, nothing appears to be done to supply the vacancies.

*Irrigation.*—Within about a week of planting irrigation begins and continues regularly until the rains. Where the soil is light, water is applied as frequently as every fourth day. On black soils the period between waterings may be ten or even fifteen days, the time depending upon the depth and quality of the soil. Where water can be obtained from tanks the cost of irrigation is reasonable, but during recent years the expense of lifting it from wells has increased. This is alleged to be mainly due to the three following causes:—  
(i) Dearthness of bullocks since the famine years, (ii) scarcity of water owing to a succession of dry years, (iii) dearthness of leather *motes* due to the export of hides from the villages.

Should there be a *nala* near the garden a hole is dug in its bank and the water lifted by manual labour. The lift consists of a kerosine tin at one end of a pole and a lump of clay at the other, the pole being balanced at its centre. A man standing over the well pulls the empty tin down and when full the weight of the clay raises it again, the water being then discharged into a channel. In dry seasons the hole must be deepened, the rate of watering then becoming very slow. Where the source of supply is not more than four or five feet below the level of a garden an arrangement known as a swing bucket is used. With this two men sit over the water and by means of a shallow basket

held by ropes swing up small quantities into a distributing channel. From a depth of four feet about one-tenth of an acre can be irrigated in three days. After the rains have ceased, water is again applied at intervals of about three weeks, the applications becoming less frequent as the crop ripens.

*Surface cultivation.*—During the hot weather of April and May the land is worked with a *kudāl*, a tool resembling a shorthanded pick. This if carried on continuously is one of the most costly operations, so that although weeding receives attention from almost all cultivators, thorough surface cultivation is only practised by the more wealthy. Nothing is done to the gardens after the rains until harvest except such application of water as is necessary. Mulching in any form is unknown, grass being in most districts very scarce. On an average about four or five weedings and one picking are given.

*Manuring.*—Only one form of manuring is generally practised, the chief exceptions being where the land receives village drainage or is folded by sheep. The bulk of the manure consists of sweepings and rubbish, mixed with a small quantity of cattle-dung. There is no general rule as to the time of its application. If the cultivator has a fair amount of manure for disposal then part is applied in the preliminary cultivation of the land and part subsequently as a top dressing. If only one application can be made it is generally done after seeding, during the hot weather. The ryots prefer the manure as well rotted as possible, otherwise it harbours white-ants. Artificial manures are absolutely unknown and seem likely to remain so while communication with large towns is so difficult and the majority of the cultivators lacking in capital. The supply of oilcake, although sometimes used as manure, is too small to be of much importance, many of the oil seeds grown in the Provinces yielding edible cakes suitable for cattle food. Much of the cane residue, after drying in the sun, is burnt under the evaporating pans, but as the prevailing form of furnace gives poor combustion with this fuel, the residue is frequently returned to the land where in course of time it decomposes. Green manuring is practised in the Betul and Chhindwara Districts only and even there to no great extent. Sann, Jagni (*Guzotia obifera*) and occasionally urad are the crops used for this purpose, but the bulk of the cultivators have no knowledge of the practice at all. Ten to twenty-five cart-loads of manure are usually given per acre costing from Rs. 3 to Rs. 12. Where sheep are fed upon the land the cost may rise to Rs. 40 per acre for manuring.

*Treatment of canes during growth.*—It is the general practice in these Provinces to wrap the canes together in bundles of about six or seven and bind them with the lower leaves or with the leaves of inferior varieties growing on the outskirts of the garden. This operation is done twice during the months of July and August. Staking with bamboos is carried out in a few districts, but is not a general practice. The most important of these subsidiary operations is fencing as a protection against jackal and wild pig. This has become a great expense during recent years owing to increase in the price of wood. The fence generally consists of thickly matied thorny bushes sometimes supported between two rows of bamboos. It is frequently from four to five feet high and needs constant repair as the jackals force their way through wherever possible. Another plan in the Bilaspur District is to build a mud wall about five feet high around the garden, but this is quite a local practice. There is a great demand for gun licenses in many villages in order that a gun may be procured to scare away the animals at night when nearly all the damage is done. This, however, will not lessen their numbers appreciably and the continual firing can have only a temporary effect. A watchman is sometimes kept to guard the gardens, but the majority of the areas are too small to justify such an expenditure.

*Treatment before reaping the canes.*—In the best districts it is customary before harvesting the crop, and where a break in the irrigation has been made, to give two or three final waterings. Frequently, however, irrigation is continued regularly until harvest time and no reason seems to prevail for these practices.

*Diseases and pests.*—More canes are lost in the Central Provinces through wild animals, chiefly jackals, than through all other causes combined. Second to these pests is the troublesome parasitic weed *Agia (Striga lutea)*. This is

most virulent during the rains and in the cold season dies off. Upon the lighter soils it is less noxious than upon the stiffer black soils, the *sehar* land of Balaghat being practically free while much loss occurs upon the *kali* and *morand* soils of Betul. Where gardens are badly infested the cultivators frequently rest them from sugarcane for some years and use *urad* and *jagni* as a green manure. Change of crop is also given, but even after ten years it is said to be difficult to effect a complete eradication. It is more than probable that the cultivators do not collect the weed and burn it at the most effective times. Attempts are made to get rid of the weed during the growing season, but it appears that when once a firm hold has been obtained it is frequently left to come to maturity and the part of the garden affected, more or less abandoned. The only other pests doing damage to any extent are white-ants and the moth borer. The former are mostly prevalent on the lighter soils and do not seriously interfere with the crop on *kali* or *morand* land. Moth-borer is fairly general and does considerable damage during the hot weather. Various methods are resorted to by the cultivators for ridding their gardens of these pests. A mixture of camphor and asafetida tied in a bag is suspended in the water channel as a remedy for the borer. A piece of bear skin is used in the same way as a check against white ants. Incantations and offerings are made by the Gonds to disease-checking gods, this being also considered a remedy against damage by jackals. Salt dissolved in the irrigation water is used as a preventative for white-ants. Its utility, however, is questionable and it is perhaps worthy of notice that on *khari* land where the cane is supposed to be inferior through excess of salt in the soil, the damage caused by white-ants is not diminished. Apart from the cane actually devoured by jackals much loss is sustained by rot setting up where bruises have been caused by these animals.

Although as a rule the flowering of the cane causes no trouble to the cultivator, yet there are occasions when it is regarded as a grave misfortune. Such is the case in particular with the *Pachranga* variety which flowers only at very long intervals, but which phenomenon in some districts is regarded as a very ill-omen leading to the destruction of the cultivator's family. To prevent such a catastrophe the owner leaves his garden uncut when the crop becomes the public property of the village. Other minor forms of disease not widely prevalent in these Provinces are those which result in stunted growth. One of these called in the vernacular "*murri*" attacks the plant in March, causing the leaves to twist around the main shoot, while another form known as "*ohista*" acts in a similar way in July and covers the plant with a white netlike growth. Frost also does a certain amount of damage occasionally in the Betul and Ohhindwara Districts. Amongst the cultivators white-ants are known as "*dimah*" and the moth-borer as "*ronthi*" or "*murer*." Smut (Vern. *kanki*) is but seldom seen.

*Time and method of reaping.*—The harvest for *gur* making commences as a rule about the end of December and continues until March. Where the ryots require money urgently the canes are frequently cut for eating purposes as early as November. Cane harvest takes precedence before all other work on the land and when once it has started and the weather is favourable it is carried on without a break until all is completed.

Should cloudy weather, however slight, intervene, harvesting and *gur* making are immediately suspended. As the earliest *gur* fetches the best price, harvest frequently takes place before the canes are really ready, although the advantage thus gained is, in the opinion of some cultivators, counterbalanced by the lower yield of juice. Canes which ripen very quickly are looked upon with disfavour by the ryots who prefer to see the tops remaining green for a considerable period.

The milling and *gur* making plant is almost invariably situated quite close to the gardens so that no delay is caused in bringing canes to the mill. The gardens also being small, the cutting can easily be regulated to keep pace with the *gur* making, deterioration of the cut cane being thus prevented.

The canes are usually pulled up singly with a portion of the root attached and are then stripped and the root trimmed off by means of a small sickle, the work being generally done by women and children. The tops are also removed at the same time unless they have been taken previously for seed purposes.

*Yield of canes per acre.*—The following figures have been taken from a number of measurements made in various years and will give an idea as to the cropping power of an average sugarcane garden :—

Year.	Village.	District.	Soil.	Variety of cane.	Weight of cane per acre in lbs.	Weight of juice per acre in lbs.	Weight gur per acre in lbs.	Mill used.
1902-03	Koshi	Bhandara		Pachra n g a and Kala.	19,410	10,680	1,750	Poona.
	"	"	"	"	22,620	11,200	1,685	Local.
	Fatih	"	"	Dhaur (white).	42,170	24,700	5,080	Poona.
1904-05	Lanji	Balaghat	Sibar	Dhauri	19,850	10,400	2,840	Poona.
	"	"	"	"	19,100	9,200	2,040	Local.
	"	"	Mutburra	"	17,140	9,600	1,960	Poona.
	"	"	"	"	17,180	8,000	1,740	Local.
	Auria	Betul	Morund II.	Engrezi or Poundt.	15,450	8,000	1,550	Poona.
	"	"	"	"	26,350	14,000	2,150	Local.
	Jowalkhara	"	Morund I and II, Kachhar II.	Engrezi, Pachranga, Saradi.	30,800	16,000	3,150	Poona.
	"	"	"	"	38,000	18,000	3,400	Local.
	Nuka	Balaghat	Mutburra	Kath a 1 o r Mangi.	7,580	3,200	590	Poona.
	"	"	"	"	7,460	3,000	575	Local.
1905-06	Lanji	"	Sehar	Dhauri	29,200	17,300	3,300	Poona.
	"	"	"	"	24,100	11,980	2,620	Poona.
	Harda Tola.	"	Kachhar	"	33,940	21,070	3,380	Poona.

*Manufacture of gur.*—Only one method is in vogue throughout the provinces and this is of the simplest description. With the exception of the Betul District wooden mills are in most general use. They are made locally of babul (*acacia arabica*) and consist of two wooden rollers each with three skew teeth carved out upon the upper end. One roller is rotated by a bullock gear, the teeth conveying the motion to the other. Pressure is obtained by wedges which force the ends of the rollers inwards. A wooden mill can be driven by one pair of bullocks and will take from five to seven canes at once, but they need to be put through the mill three times before extraction is complete. Endeavours have been and are still being made to introduce iron mills into many districts, but these have not up to the present been adopted with much readiness. About twenty years ago the light iron Behar mill was demonstrated in the Betul District through the action of Mr. Macdougall, then Deputy Commissioner, and these met with so much favour that wooden mills in that district are unknown. It is only reasonable to suppose that had they been introduced into other districts at the same time their adoption would have been more general. At present the return from sugarcane cultivation is so uncertain that cultivators are unwilling to make a large outlay for a new implement although the cost of iron mills has greatly decreased. Twenty years ago the cost was Rs. 170; satisfactory mills can now be obtained for Rs. 40 to Rs. 80.

The mill is invariably sunk into the earth and the juice passes from it through a channel into a conical collecting jar sunk still deeper. To thoroughly cleanse the collecting jar is therefore a matter of some difficulty. The juice is strained as it leaves the mill through a piece of tin plate provided with holes, but this only removes the large pieces of foreign matter. When the evaporating pan is ready, the juice is baled into it, being strained as it passes through a wicker basket. This again is far from satisfactory and as the basket is well shaken when all the juice has been strained, very little real benefit results. The last of the juice passing through the basket is quite black in colour. The collecting pan is of such a size that it just holds enough for one evaporation. It is generally quite close to the furnace and only protected from impurities falling in by a bamboo mat. The pans, which are used singly, are about 7 feet in diameter and 12 inches deep. Formerly earthen pans were used and then iron ones, the ore being obtained from local mines such as those at Kinhi in Balaghat. At present the pans are either obtained ready made from Bombay or Calcutta or sheet iron is obtained and made up by the local smith. Occasionally such a man makes a reputation for his pans and then not only sells them over a large district, but may become an agent for iron mills as well. Efforts have been made to introduce the shallow form of pan from Poona, but without much success. One well-to-do cultivator, a malguzar, with a large area of cane, had been awarded one of these pans as a prize, but had not taken the trouble to fetch it quite a short distance by road.

The furnace is generally a hole in the earth bricked up to support the pan and with no other outlet, but the one where fuel is fed. A small outlet for the products of combustion is sometimes made at the back of the furnace, but no attempt is shown to prevent it becoming choked up. With such an arrangement combustion is very incomplete and the efficiency of the furnace very low. The fuel consists partially of leaves and residue of the canes, the latter having been previously dried in the sun. With the prevailing form of furnace the cane residue makes poor fuel and needs to be supplemented with wood. For this purpose the fencing of the gardens is used and larger material brought from the jungle. The provision of fuel, however, is one of the chief troubles of the cultivator.

As the scum rises to the surface it is strained off through wicker baskets the juice returning to the pan while the scum is not utilized any further. Neither liming nor any clearing process is practised although before the commencement of *gur* making the inside of the pan is rubbed with a mixture of butter, linseed and turmeric. The *gur* maker determines the point at which the evaporation is finished by the appearance of the bubbles of steam as they rise to the surface. The actual movement when the heating should cease is found by dipping the finger into water and then into the boiling syrup. If the latter congeals between the fingers and is of the desired consistency the pan is at once removed from the fire. After standing for about ten minutes it is poured into a flat rectangular box let into the earth to a depth of about 8 inches. When crystallised, the *gur* is scraped together into a cloth of drain; the resulting semi-spherical lump of dark yellow or brown material being known as a *bhela* and weighs about 140 lbs. Much of the *gur* made in the various districts is consumed locally and the remainder is exported chiefly to the Berars or the Hoshangabad valley. Here the superior quality of the Betul *gur* in particular still finds a market for it even against that produced at a cheaper rate in other Provinces. Locally the *gur* is sold retail at about 5 or 6 seers per rupee, the price being a little higher, 4 to 5 seers per rupee, for best quality *gur* from the *Poundi* cane. It is also sold wholesale to merchants coming from outside districts at from 45 to 60 rupees per *khandi* (280 seers).

It is a point well worthy of notice that at every fair sized village imported crystalline sugar of good quality can be obtained at about 4 seers per rupee, a price but little higher than the locally manufactured and often inferior *gur*. The latter retains its market owing to its greater sweetening power.

*Cost of the Cultivation.*—The cost of cultivation of one acre of cane over the whole of the Central Provinces is on the average about Rs. 150. It becomes less when the cane is grown on larger areas, but comparatively few gardens are more than 2 or 3 acres in extent. Given below are detailed costs of cultivation obtained from village *patwaris* and cultivators. In some years

the crop yields a profitable return, but much depends upon fluctuating influences over which the ryots have no control.

*The cost of cultivation of an acre of sugarcane in the Betul District (Jowalkhera village).*

	Pachranga.			Engreal.		
	Rs.	a.	p.	Rs.	a.	p.
Cost of 24,000 sets . . . . .	20	0	0	40	0	0
Charges for a mote and a nara for year . . . . .	5	0	0	5	0	0
Wages of 2 men for 5 and 6 months respectively . . . . .	40	0	0	50	0	0
Half cost of keeping a pair of bullocks . . . . .	20	0	0	20	0	0
Sowing charges . . . . .	2	0	0	2	0	0
Cost of 20 cart-loads of fencing materials . . . . .	7	0	0	7	0	0
Charges for weeding 3 times . . . . .	3	0	0	3	0	0
Charges for earthing once . . . . .	2	0	0	2	0	0
Tying of leaves 3 times . . . . .	6	0	0	6	0	0
Oil for mote and nara . . . . .	2	0	0	2	0	0
Wages of 15 (men and women) for 4 days at Rs. 2-5-0 a day . . . . .	9	4	0	9	4	0
Cost of fuel . . . . .	12	0	0	12	0	0
Hire for mill (Rs. 1-8-0) and pan (Rs. 0-8-0) for 4 days . . . . .	8	0	0	8	0	0
Rent on land . . . . .	1	8	0	1	8	0
Cost of manure (cattle-dung and rubbish) . . . . .	3	0	0	3	0	0
Hire for bullocks for juice expression for 4 days . . . . .	8	0	0	8	0	0
Additional cost of watching for 3 months . . . . .	...			6	0	0
<b>TOTAL</b> . . . . .	<b>148</b>	<b>12</b>	<b>0</b>	<b>184</b>	<b>12</b>	<b>0</b>

Outturn per acre in a normal year—

*Pachranga*—5 *khandis* (1,400 *seers*) *gur* at Rs. 40 per *khandi*=Rs. 200.

*Poundi* or *Engrezi*—6½ *khandis* (1,750 *seers*) at Rs. 45 per *khandi*=Rs. 281-4-0.

*Character of the juice.*—The following table shows the composition and variation in the analysis of the juice obtained from cane grown in different districts during successive years. As the composition of the cane depends largely upon the nature of growth and time of cutting, these figures can only be taken as giving a general idea as to the value of the juice produced in these Provinces.

*Composition of the juice and gur obtained from canes grown in the Central Provinces.*

[Analyses made under the direction of Dr. J. W. Leather.]

Season.	Village.	District.	Variety.	PER CENT BY WEIGHT.		PER CENT BY VOLUME.		Gur	
				Cane sugar.	Glucose.	Cane sugar.	Glucose.	Cane sugar.	Glucose.
1903-04	Guriya	Chhindwara.	Pachranga and Gadhar . . . . .	11.15	8.20	11.87	8.73		
	"	"	" . . . . .	12.80	9.67	13.51	10.4		
	Nagalwari	"	" . . . . .	8.18	1.62	8.87	1.72		
	Chiklee	Betul	Pachrang . . . . .	12.37	7.85	12.23	7.85		
	"	"	" . . . . .	18.73	8.51	14.77	9.18		
1904-05	Betul	"	" . . . . .	10.99	1.47	11.74	1.57		
	"	"	" . . . . .	12.84	9.71	13.71	10.4		
	Auna	"	Engrezi . . . . .	12.46	1.73	13.26	1.33	66.90	13.09
	"	"	" . . . . .	14.09	1.77	15.07	1.89	66.10	14.94
	Jawalkhera.	"	Pachranga . . . . .	18.26	1.15	14.11	1.22	73.97	9.68
	"	"	Engreal . . . . .	8.89	2.09	9.22	2.20	67.92	15.60
	Dunawa	"	Pachranga . . . . .	14.57	7.48	15.53	7.97	72.78	10.78
	"	"	" . . . . .	11.07	1.41	11.69	1.48	70.63	12.22
	Umri	Raichhat	Kathai . . . . .	16.08	8.53	16.19	9.16	69.72	11.47
	Sawngi	"	" . . . . .	14.71	9.46	15.25	10.2	63.25	13.66
1905-06	Pangson	"	" . . . . .	13.42	1.10	14.31	1.17	73.05	10.54
	Langi	"	Dhanrur Ma-lyagur . . . . .	20.62	1.80	22.40	1.87	73.42	8.65
	"	"	" . . . . .	17.53	2.77	18.69	2.99	81.34	6.76
"	"	" . . . . .	18.80	2.7	19.80	2.29			
"	"	" . . . . .	11.28	2.16	12.25	2.29			



Expenditure incurred in former years to grow 30,000 sets, i.e., 1½ acres.	Present expenditure incurred to grow 30,000 sets, i.e., 1½ acres.
₹ a. p.	₹ a. p.
	<i>Charges for forest</i>
	10 carts fencing at 4 annas per cart . . . . . 2 8 0
	30 carts fuel at 2 annas per cart . . . . . 3 12 0
Forest charges . . . . . 1 0 0	5 carts bamboos at 8 annas per cart of 100 . . . . . 2 8 0
	1 cart wood for plough . . . . . 1 0 0
TOTAL . . . . . 22 6 0	Total . . . . . 58 8 0

(2) In recent years rainfall has been rather uncertain, and with the water levels in the wells low, the cost of irrigation has increased.

(3) Scarcity of cattle has affected the cost of tillage and irrigation while the exportation of hides has increased the annual outlay upon well gear. The cattle used by the ordinary ryot are frequently also of a very inferior type.

(4) Labour has in many districts become very scarce and the rate of pay has risen. A male labourer now received 3 annas a day and a female 2 annas, against 1½ and 1 anna respectively in former years. Many coolies have also gone to work in mines, while others owing to the boom in cotton have taken up land for themselves and grow that crop.

(b) *Substitution of other crops.*—The two crops which to a large extent have replaced sugar are cotton and wheat, these being, in the opinion of the ryots, less expensive to cultivate, and yield a more certain return. It is not unusual to see in some districts disused wells adjoining cotton fields and showing where sugar was formerly the most important crop grown. Certain tracts of land in recent years have also risen in importance as centres of wheat export, only sufficient cane to supply *gur* for home consumption being now grown.

#### IMPROVEMENTS.

(1) *Water-supply.*—With the extension of irrigation works and the cheapening of water-supply an impetus should be given to the sugarcane industry in some parts of the Provinces, although in many others cultivators must still depend upon their wells. Demands for mechanical power to replace bullock gear are occasionally met with, but owing to difficulty of transit and distance from skilled labour in case of a break-down, such an installation as even a simple wind motor would involve great expense.

(2) *Introduction of new varieties.*—Owing to the liability of the best varieties to be attacked by wild animals, introduction of improved canes must be accompanied by better protection from damage. The cane to be valuable must be hard and yield a large amount of juice of good quality. The best canes grown at present, from the point of view of *gur* making, are too soft. Indiscriminate introduction of new varieties must be carefully guarded against.

(3) *Manuring and cultivation.*—In practically all the sugarcane districts of the Provinces the introduction of artificial manures to any extent is at present out of question. Something might be done to advance the proper use of cattle dung, although this is difficult where fuel is scarce. The greatest promise seems to lie in green manuring and the selection of suitable rotations. One of the greatest sources of expense to the ryot is in the renewal of the fence around his garden each year and much would be saved if the cane could be grown in successive crops on the same land. Selection of varieties suitable for ratooning would assist in this and also mixed cropping to a certain extent. Something also might be done in the way of surface cultivation to conserve the water-supply in the soil and thereby lessen the amount of irrigation required, while considering the high cost of sets in proportion to that of the whole season's cultivation, it is not unlikely that a lower seed rate would yield a more profitable return.



(4) *Gur-making*.—Improvements in furnace construction are very necessary, particularly in the form of a grate upon which to burn a thin layer of fuel, and also an outlet chimney to give more draught through the furnace. Minor improvements in straining and clarifying the juice might also receive attention. The Poona form of furnace has been demonstrated in many districts, but has only been adopted in a very few instances. With *gur* commanding so high a price it is not easy to foresee the monetary return likely to be obtained by the manufacture of refined sugar. The molasses would certainly form a valuable addition to the present available cattle foods. Owing to the wide distribution of the sugarcane areas and the scarcity of irrigation, even small factories would be unworkable under present conditions.

## APPENDIX.

*Description of the varieties of sug cane grown in the Central Provinces according to the method of Mr. J. W. Morrison and Dr. J. W. Leather—Agricultural Ledger No. 8 of 1898—*

Variety . . . . .	Pounda or Engrezi.
Where grown . . . . .	Betul, Chhindwara and Chanda.
General appearance . . . . .	Fairly thick, tall and soft, yellow or greenish yellow in colour. Frequently bent at top. Black smudges common. Does not ratoon well.
Type . . . . .	C.
Bloom . . . . .	At nodes only.
Nodes—	
Ring N <sub>1</sub> . . . . .	Dark yellow but not very distinct.
Band N <sub>2</sub> . . . . .	Yellow dots in a green ring, root dots slightly marked.
Band N <sub>3</sub> . . . . .	Grey coloured.
Height . . . . .	7 feet to 8 feet without tops
Girth . . . . .	4 inches to 5 inches. Diameter increases towards the centre of cane.
Internodes . . . . .	3½ inches to 5 inches.
Aerial roots . . . . .	On six or seven lower nodes only.
Buds . . . . .	Very small, flat, oval, pointed, grooved, colour varies.

---

Variety . . . . .	Pachranga.
Where grown . . . . .	Fairly general throughout the provinces.
General appearance . . . . .	A medium-sized fairly hard cane, irregularly streaked in purple, yellow and green. The cane is straight in growth and does not ratoon well.
Type . . . . .	B and E, slightly zigzag.
Bloom . . . . .	A little on the top internodes.
Nodes—	
Ring N <sub>1</sub> . . . . .	Indistinct, colour varies, generally light yellow. Extends around one half of the cane.
Band N <sub>2</sub> . . . . .	Root dots distinct.
Band N <sub>3</sub> . . . . .	Light grey in colour.
Height . . . . .	6 feet to 7 feet without tops.
Girth . . . . .	3 inches to 3½ inches. Diameter of centre part of cane slightly the greatest.
Internodes . . . . .	2½ inches to 5½ inches.
Aerial roots . . . . .	On four or five lower nodes.
Buds . . . . .	Khaki coloured, flat, oval, grooved, pointed.

---

Variety . . . . .	Kala satla.
Where grown . . . . .	In same districts as Pachranga and mixed with that variety.
General appearance . . . . .	A dark purple cane, fairly long and straight. The rind is marked longitudinally by thin white irregular lines.
Type . . . . .	B and E, slightly zigzag.
Bloom . . . . .	On top internodes only.
Nodes—	
Ring N <sub>1</sub> . . . . .	Very distinct, light yellow.
Band N <sub>2</sub> . . . . .	Root dots smooth but distinct, on yellow ground.
Band N <sub>3</sub> . . . . .	Blue-grey in colour.
Height . . . . .	7 feet without tops.
Girth . . . . .	3 inches. Fairly uniform throughout length of cane.
Internodes . . . . .	4½ inches to 5½ inches.
Buds . . . . .	Light brown in colour, oval, sharply pointed, grooved fairly prominent.
Aerial roots . . . . .	At bottom node only.

Variety . . . . .	Gadhara.
Where grown . . . . .	In same districts as Pachranga.
General appearance . . . . .	A medium sized cane, yellow or green in colour. The nodes at the top and bottom are set fairly close together.
Type . . . . .	B and E, slightly zigzag.
Bloom . . . . .	At nodes only.
Nodes—	
Ring N <sub>1</sub> . . . . .	Very distinct, dark orange in colour.
Band N <sub>2</sub> . . . . .	Greenish white with distinct root dots.
Band N <sub>3</sub> . . . . .	Grey ring, well defined.
Height . . . . .	6 feet to 7 feet without tops.
Girth . . . . .	3 inches to 3½ inches. Slightly thicker in middle part of cane.
Internodes . . . . .	2½ inches to 5 inches.
Aerial roots . . . . .	Up to the 10th node from the bottom.
Buds . . . . .	Small, oval, brown in colour and grooved.

---

Variety . . . . .	Bhondhya, Saradi, Katha.
Where grown . . . . .	Balaghat, Bilaspur and Chanda.
General appearance . . . . .	A dull brown coloured cane of nearly uniform thickness throughout its length. The rind is marked by longitudinal thin black lines. Inside surface of leaves frequently pink at the base. A very hard cane.
Type . . . . .	A generally, but occasionally B.
Bloom . . . . .	Covers most of the internode.
Nodes—	
Ring N <sub>1</sub> . . . . .	Wide and distinct, light yellow in colour.
Band N <sub>2</sub> . . . . .	Root dots on a white ground, not distinct.
Band N <sub>3</sub> . . . . .	Grey ring, not well defined.
Height . . . . .	7 feet to 8 feet without tops.
Girth . . . . .	2 inches to 2½ inches. Diameter fairly uniform.
Internodes . . . . .	5½ inches. Very regular in length.
Aerials roots . . . . .	On 3 or 4 lower nodes only.
Buds . . . . .	Fairly large, pointed, oval, prominent, yellow in colour and not grooved.

---

Variety . . . . .	Saradi.
Where grown . . . . .	Chindwara and Betul.
General appearance . . . . .	Dull purple, mixed with a little green in colour. A thin cane and very hard.
Type . . . . .	B.
Bloom . . . . .	Covers most of the internode.
Nodes—	
Ring N <sub>1</sub> . . . . .	A dark purple, swollen ring.
Band N <sub>2</sub> . . . . .	Irregular in shape with very prominent root dots on a pale yellow ring.
Band N <sub>3</sub> . . . . .	Light grey in colour, not well defined.
Height . . . . .	5½ feet to 6 feet without tops.
Girth . . . . .	1½ inches to 2½ inches. Diameter greatest at the bottom.
Internodes . . . . .	2½ inches to 4½ inches.
Aerial roots . . . . .	On lower 2 or 3 nodes only.
Buds . . . . .	Khaki-coloured scales with slight grooves, very small.

---

Variety . . . . .	Malyagar or Dhour.
Where grown . . . . .	Bilaspur and Balaghat.
General appearance . . . . .	A medium-sized greenish-yellow cane with characteristic black smudges which extend downwards from the nodes rather more than half the length of the joint, rind soft.
Type . . . . .	B.
Bloom . . . . .	General, at and below nodes.

Nodes—	
King N <sub>1</sub> . . . . .	Distinct, pale yellow in colour.
Band N <sub>2</sub> . . . . .	Fairly wide, light yellow in colour, root dots numerous and distinct.
Band N <sub>3</sub> . . . . .	Distinct grey band of bloom.
Height . . . . .	6 feet to 8 feet without tops.
Girth . . . . .	3 inches to 4 inches. Fairly uniform throughout length.
Internodes . . . . .	3 inches to 3½ inches.
Axial roots . . . . .	Very few and found on bottom nodes only.
Buds . . . . .	Very prominent, oval, pointed and brown in colour deep grooves.

#### EASTERN BENGAL AND ASSAM.

*Preliminary.*—The Agricultural Department was unable to spare an officer of its own for the enquiry into the sugarcane industry of the province. It had accordingly to be entrusted to District Officers, who collected information through the medium of their subordinate executive staff. The subject was an unfamiliar one to most of the investigating officers: much of the information received was therefore vague and unintelligible.

This Note has been prepared on the basis of the district reports, supplemented by such information as was available in the office of the Agricultural Department. The points raised in Mr. Barber's scheme of enquiry are dealt with *ad seriatim*.

#### PART I.

##### INTRODUCTION.

2. *Climate.*—The climate of Eastern Bengal and Assam is fully described in the subjoined note written by Mr. G. T. Walker, F.R.S., Meteorological Officer to the Government of India:—

*Temperature.*—The mean annual temperature of Eastern Bengal and Assam is appreciably lower than that of other parts of India in the same subtropical latitude. This is mainly due to the cooling influence of the exceptionally heavy rainfall of the province in April, May and the first half of June, during which period the weather over the larger part of the rest of northern India is dry, and warmer than at any other time of the year. The strong contrast of temperature between the east and the west of northern India usually lasts until August, by which time monsoon rainfall should have fallen freely in the north-west, and its moderating affect on temperature is no longer confined to north-east India.

Monsoon rainfall ceases in Eastern Bengal and Assam at about the end of September, and from November until February there ensues a general similarity between the temperature of the province and that of the belt of country lying to the west of it in the same latitude.

Over the greater part of India the upper and lower limits of temperature occur in May and January respectively, and it is in May that the strong cooling influence of spring rainfall is most apparent in this province. Not only, then, does the rainfall of those months reduce the mean annual temperature, but it does so most conspicuously at the time when the warmest weather of the year would otherwise occur, and it thus very greatly diminishes the annual range of temperature, while deferring the actual maximum until July everywhere except in the coast districts.

The yearly range varies from 17° or 18° in the districts below the northern tropic to 23° in the extreme north-east corner of Assam, and when this is compared with the range of 30°, which occurs in the east of the United Provinces and Rajputana, it will be seen that the climate is unusually equable in this respect.

In the coolest months of the year, January, weather is warmer on the coast than in the interior, temperature varying from 60° at Dibrugarh in Assam to 67° at Chittagong; in July a nearly uniform temperature, differing little from 82°, is recorded over the whole province.

The following table exhibits the monthly average of mean daily temperature at twelve selected stations in the province:—

Station.	Monthly average of mean daily temperature.												Year.
	January	February	March	April	May	June	July	August	September	October	November	December	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chittagong . . . . .	66.6	70.7	77.2	81.3	85.0	81.8	81.2	80.3	81.6	80.0	74.4	68.1	77.2
Shohar . . . . .	65.1	68.2	74.6	78.9	80.0	83.6	83.7	82.2	82.1	80.5	74.2	67.4	75.9
Barisal . . . . .	66.0	70.7	79.2	83.2	84.7	85.5	85.0	82.8	82.4	81.1	73.9	68.9	78.2
Narayanganj . . . . .	66.6	70.4	79.1	83.8	83.5	82.7	83.6	83.2	82.7	81.6	74.8	67.7	78.3
Mymensingh . . . . .	63.2	67.0	75.7	81.5	81.2	82.1	82.7	82.5	82.3	79.7	72.3	65.4	76.4
Bogra . . . . .	64.0	67.4	77.1	84.1	83.3	83.5	82.8	82.4	82.0	80.0	72.2	66.5	77.2
Sibsagar . . . . .	69.8	68.2	69.6	74.5	78.2	82.9	84.0	83.5	82.2	77.8	69.0	61.1	78.8
Dhubri . . . . .	68.6	67.0	75.0	79.7	79.3	81.1	82.1	82.2	81.1	78.7	71.7	64.7	73.6
Jalpaiguri . . . . .	61.4	64.7	72.2	78.9	80.2	81.0	82.5	82.4	81.8	77.8	71.0	64.1	74.9
Dinajpur . . . . .	62.8	68.3	75.2	82.7	82.0	82.5	84.0	82.7	82.8	79.7	71.7	64.2	76.6
Tespur . . . . .	61.5	64.4	71.5	74.6	79.2	82.5	82.6	82.7	82.2	78.1	70.2	62.9	74.5
Dibrugarh . . . . .	59.7	62.2	68.4	71.5	77.5	80.7	81.9	81.2	81.0	77.0	68.0	61.4	72.6

*Humidity.*—The high humidity of the whole province has become proverbial, and the results of observations bear out this popular belief, showing that, despite the great seasonal changes which occur elsewhere in this latitude as in other parts of India, the weather in the valley of Assam and delta of Bengal preserves its humid character with but small variation throughout the year. There are indeed few parts of the Indian area in which the air is so persistently damp as in Assam and the swampy regions of the Sunderbans at the mouths of the Ganges, without intermission from January to December; the upper half of the Brahmaputra Valley has a mean daily humidity exceeding 80 per cent., and over the remainder of the province humidity closely approaches that figure during the greater part of the year, while in February, March, April and November does it fall in mean value below 70 per cent.

The following table of mean relative humidity at 8 A.M., at twelve stations in the province for each month shows, how exceedingly damp the year is at all times of the year, and how near is the approach to saturation over the whole of the province:—

Station.	Average relative humidity at 8 A.M.												Year.
	January	February	March	April	May	June	July	August	September	October	November	December	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chittagong . . . . .	87.8	84.3	82.7	80.2	82.4	82.2	82.0	82.7	82.4	82.3	82.9	82.5	82.5
Shohar . . . . .	81.0	82.0	82.1	82.7	82.2	82.3	82.2	82.9	82.7	82.2	82.0	82.0	82.0
Barisal . . . . .	86.5	84.3	84.3	82.2	82.4	82.3	82.0	82.1	82.7	82.4	82.2	82.5	82
Narayanganj . . . . .	87.2	82.6	82.7	82.1	84.2	82.4	82.1	82.2	82.2	82.0	82.2	82.2	82.7
Mymensingh . . . . .	81.4	84.9	81.1	82.0	82.2	82.5	82.3	82.3	81.2	82.2	82.7	81.2	82.3
Bogra . . . . .	82.2	79.4	78.9	76.5	82.1	82.5	82.3	82.2	82.2	82.5	82.2	82.2	82.2
Sibsagar . . . . .	82.0	82.5	82.2	80.1	81.5	81.7	82.3	84.4	84.3	82.4	82.2	82.2	84.9
Dhubri . . . . .	81.1	82.7	74.5	78.3	82.3	82.5	82.3	82.3	81.8	82.5	82.2	82.2	82.1
Jalpaiguri . . . . .	80.9	82.5	75.0	75.3	82.5	82.2	81.2	81.7	82.7	82.1	84.2	82.5	82.2
Dinajpur . . . . .	82.9	79.3	82.2	71.7	80.1	82.2	82.0	82.1	82.7	82.2	82.2	82.2	82.1
Tespur . . . . .	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
Dibrugarh . . . . .	84.0	81.0	82.0	82.0	82.0	82.0	82.0	84.0	82.0	82.0	82.0	82.0	82.0

It cannot be said, however, that the absolute amount of water vapour present in the air is so marked a feature as is the humidity measured on the relative scale, that is, as a percentage of the possible or saturation amount. The quantity of vapour which the atmosphere is capable of containing depends solely on its temperature and increases rapidly with a rising thermometer; there are accordingly many parts of India and Burma where, in consequence of prevalent high temperature, absolute humidity is considerably above that of Assam, although the approach to saturation is not nearly so close. Such are the districts of Lower Burma and those lying along the Madras and Konkan coasts where, from November to April, high temperatures and proximity to the sea give an absolute humidity greater even than that in the valley of the Brahmaputra.

Absolute humidity is near its minimum in the early days of the year and is subject to but slow increase during February; for the next four months however it rises rapidly more especially in the interior districts of Eastern Bengal and up to the extreme north-east corner of Assam. From May to September humidity remains steady, and thereafter very rapidly declines to a minimum near the end of December.

*Cloud.*—Skies are seldom entirely clear over the province at any time of the year, and although during the cold weather months, when clear weather prevails over nearly the whole of northern India, the proportion of cloud-covered sky is at a minimum, it is still in excess of 10 per cent. on the coast and of 60 per cent. at Subsagar.

The cloudiest months are July and August when the proportion, which is fairly uniform over the whole province, lies between 72 per cent. and 93 per cent. The clearest months are November, December and January, but even then during the mornings thick fogs commonly cover the low grounds of Assam and the neighbouring tracts of Eastern Bengal, and remain undissipated till late in the day; these give place in the early spring, as the weather becomes warmer, to thick low-lying clouds, which gather daily over the valleys and afford the heavy rain which is a marked feature of the province at this time of the year.

*Rainfall.*—The rainfall of the province occurs in two periods of the year, the first extending from March to May and the second throughout the summer monsoon season.

The conditions which determine the earlier rainfall are largely those of geographical position and of the land surface, at any rate so far as concerns the two valleys of Assam, lying to the north and south of the uplands of the Garo and Khasi Hills. In the spring months there is no such continuity of steady rainfall as occurs during the monsoon, but the weather is characterised by storms which burst after the heat of the day, and generally come from a westerly or north-westerly direction.

The valley of the Brahmaputra is covered by swamp and forest land and largely protected by hills from the approach of drying winds; there is accordingly ample cause for its heavy spring rainfall in the excessive local evaporation. In the more open valley of the Surma and Barrak similar conditions also hold, with the added feature that the damp southerly winds from the head of the Bay of Bengal pass freely over its low-lying stretches and penetrate to the hills which form its northern boundary.

In Eastern Bengal the air during these months is on the whole less nearly saturated than in Assam, and rainfall, although it occurs there also, is less frequent and lighter than in the more easterly districts of the province.

Between these spring rain-storms and the succeeding rains of the monsoon season, a break of dry weather and westerly winds frequently intervenes.

During the months of the monsoon, rainfall is due as in other parts of north-east India, to the influx of southerly sea winds from the head of the Bay, and its distribution is necessarily much influenced by the contour of the country. The monsoon winds flow across the delta of Bengal in a direction nearly at right angles to the coast lines; where, their even flow being checked by the surface of the land, eddies and commotions result which induce heavy rainfall in the more immediate neighbourhood of the coast. These winds are hemmed in on the east by the Tippera hills and opposed on the north by the

Garó-Khasi range and the Himalayas. As a consequence they are deflected to the west and north-west, and while rising over the lower slopes of the hills undergo dynamic cooling which causes condensation of their water vapour and heavy rainfall.

For these two reasons the rainfall of the delta of Bengal decreases from the coast line on the south for some distance into the interior, and from the Valley of the Surma on the east to the broad plains of Bengal on the west. Thus the monsoon rainfall is found to decrease from 111·4" at Sylhet to 62·3" at Barisal, and to 50·3" at Calcutta; while from Barisal to Dacca the gradation is from 62·3" to 52·3". Still further to the north the influence of the hills begins to display itself in producing a rapid increase of precipitation, so that the decreasing rainfall from Barisal to Dacca is succeeded from Dacca to Mymensingh, 70 miles nearer to the Garó Hills, by an increase of 18". Rampur Boalia, which is at about the same distance as Dacca, but to the south-west of the Garó Hills, has a fall of 47·9" in the five months from June to October; while Bogra 60 miles nearer, has a fall of 57·9" and Rangpur, which is about the same distance as Bogra from the Garó Hills, but 70 miles nearer to the Himalayas, has as much as 68·0" in the same period. In all these cases the greatest differences are shown in the earlier months of the monsoon, and the effect disappears in October, when proximity to the coast becomes the most influential factor in determining the distribution of rainfall. The same characters are shown also in the case of the more eastern stations of Noakhali, Comilla, Sylhet and Cherrapoonjee, where rainfall decreases from 92·9" at the first station to 67·3" at the second, and thereafter increasing, on the further approach towards the hills, to 111·4" at Sylhet, culminates at Cherrapoonjee on the summit of the southern scarp of the Garó Range in the enormous fall of nearly 360".

The following table gives the rainfall data for the spring, monsoon and winter months:—

*Normal District rainfall.*

Division.	District.	Spring— March to May.	Monsoon— June to October.	Winter— November to February	Total of year.
		Inches.	Inches.	Inches.	Inches.
Rajshahi . . . . .	Jalpaiguri . . . . .	21 81	115 28	1 82	188 91
	Cooch Behar . . . . .	21 63	96 96	1 10	119 69
	Rangpur . . . . .	14 44	63 20	1 16	78 80
	Dinajpur . . . . .	8 97	59 86	1 13	69 96
	Malda . . . . .	6 23	49 02	1 63	56 88
	Rajshahi . . . . .	8 66	46 88	1 63	57 17
	Pubna . . . . .	12 12	47 26	2 08	61 46
	Bogra . . . . .	11 33	52 93	2 00	66 31
Dacca . . . . .	Mymensingh . . . . .	17 48	67 13	2 02	86 63
	Dacca . . . . .	16 81	51 49	2 33	71 13
	Faridpur . . . . .	14 52	48 31	2 75	65 53
Chittagong . . . . .	Bakerganj . . . . .	13 49	68 75	2 88	85 12
	Tippera . . . . .	18 09	55 00	2 50	75 59
	Noakhali . . . . .	17 78	91 82	3 39	112 99
	Chittagong . . . . .	17 43	91 47	2 91	111 81
Surma Valley and Hill Districts	Sylhet . . . . .	39 97	94 45	3 46	137 88
	Cachar . . . . .	38 42	86 64	4 54	129 60
	Goalpara . . . . .	27 06	86 93	1 62	115 61
	Kamrup . . . . .	21 68	63 39	1 86	76 93
	Darrang . . . . .	21 86	58 87	2 71	83 44
Assam Valley . . . . .	Nowgong . . . . .	16 32	52 33	2 13	70 78
	Sibsagar . . . . .	23 46	56 54	3 09	83 09
	Lakhimpur . . . . .	30 33	77 71	5 53	113 62
	Manipur* . . . . .	17 22	47 08	5 21	69 51

\* Rainfall for one station only.

It will be seen that in the Assam Valley the rainfall is greatest at the two extremities, and smallest in the middle region represented by Tezpur, Gauhati and Nowgong: this peculiarity is possibly due to the fact that to the south of this region lies the most lofty part of the Shillong plateau, on the southern

face of which the monsoon currents are largely drained of their abundant water vapour before passing on their course over the central tableland to the valley beyond. To the west of the central plateau the valley is open to the winds of the Bengal delta, while to the east the average height of the hill range falls greatly admitting the south-west monsoon by the gorge of the Jatinga Valley, over the low uplands of north Cachar and down the long valley of the Dhansiri, into the great plain of Sibsagar and Lakhimpur.

Notwithstanding the unusually heavy spring rainfall of the province of Eastern Bengal and Assam by far the greater part of the annual amount occurs between June and September, and has its maximum in June or July. Taking the period of the six months' heaviest rainfall, May to October, the rainfall of May at stations in Assam and the more north-eastern parts of Eastern Bengal varies from  $\frac{1}{3}$  to  $\frac{1}{10}$  of the total for the whole six months, and averages for all stations about  $\frac{1}{7}$ ; whereas in the Gangetic delta it averages  $\frac{1}{11}$ , and decreases westwards until at some of the more westerly stations of the delta the proportion is only about  $\frac{1}{15}$ .

*Storms.*—The storms of Eastern Bengal and Assam are of three types, differing in both character and place of origin:—

- (a) The cold weather storms which occur during the months of December, January, February and occasionally in March;
- (b) The cyclonic storms which pass from the Bay of Bengal during the south-west monsoon period and
- (c) The nor'westers and tornadoes, which are confined to the hot weather months.

The storms of the cold weather are similar in most respects to the depressions of Western Europe. They are caused by areas of low pressure moving from west to east, exhibit a slight circulation of wind, and give rise to unsettled weather, with more or less precipitation. Many of these storms can be traced from an origin as far west as Persia, across the Punjab and the United Provinces to their final stages in Assam, where their presence is indicated by only a slight lowering of the barometer, cloudy weather and some rain.

The cyclonic storms which form in the Bay of Bengal move along paths which vary in direction from month to month, and cross the Coast of India at different points. As a rule these storms pass from the sea to the land to the west of the mouth of the Ganges, but from September to the end of December an occasional storm may move into the south of Eastern Bengal: none, however, has been known to penetrate up the Assam Valley beyond the Garo Hills. The most severe storms of this type occur in October and November, and it is in the former of these months that the province is most frequently affected by them.

The hot weather storms are perhaps of the greatest interest, for, while they are of smaller extent, they occur frequently, attain great intensity and are often very destructive. They appear to owe their origin to the interaction between the damp sea winds and the dry winds from the interior supplemented by the action of the hills in giving rise to vigorous forced ascents of air. Their usual form is that of severe thunderstorms accompanied by hail; but sometimes they develop into tornadoes, the most intense form of small revolving whirls. These are rarely more than a few hundred yards in diameter and their paths of destructive violence are seldom longer than 10 miles; but along these paths they advance rapidly and with little warning overturn and destroy houses and trees, and cause general destruction of life and property. The rainfall associated with hot weather storms is of importance in north-east India, and more especially in Assam, where it is a valuable factor in the growth of tea.

The great humidity of the atmosphere, the absence of hot parching winds and the abundant showers which are received in the three months preceding the advent of the monsoon give Eastern Bengal and Assam a decided advantage over most other parts of India in regard to the cultivation of sugarcane and many other crops. The need of irrigation which adds greatly to the cost of cultivation in other parts of India is seldom felt in Eastern Bengal and Assam. Herein the climate of the province approaches that of the cane growing countries in the tropics more closely than any other Indian province. Owing to the great rainfall during the monsoon and the constant humidity of the air, the



soil remains moist long after the cessation of the monsoon, enabling the sugarcane crop to continue in active growth for a longer period than in the drier parts of Northern India.

3. *The age of sugarcane cultivation in India.*—The Hindu scriptures abound in allusions to sugarcane. Many of these are quoted or alluded to in Dr. Watt's Economic Dictionary. The oldest reference is *perpapa* in the *Ramayana*, in which Rama is said to have worshipped the goddess Durga with an offering of sugarcane juice. The Sanskrit Dictionaries give numerous synonyms for sugarcane which it is hardly necessary to quote here. The District Engineer of Rangpur quotes a passage from the *Statak Smriti* in which the sugar-mill (*ikshu jantra*) is mentioned. He also quotes a verse from *Rajanirghanta* (of which the age is uncertain) in which mention is made of four varieties of sugarcane—(1) *Paundraka*, (2) *Banshekahu*, (3) *Syamekshu* and (4) *Baktekshu* which literally mean: (1) the sugarcane of Paundra, which signified in ancient times the country watered by the Karatoa river in Northern Bengal, included in the present districts of Rangpur, Dinajpur and Bogra; (2) the bamboo cane which is perhaps the same as the tall, thin, hard *khari* or *khagri* cane of the present time; (3) the yellow cane; and (4) the red cane, the last two being obviously the prototypes of the yellow or white and the red or purple canes of our times. In fact, were we to classify the canes grown at present merely from their outward appearance, we should have to adopt a similar classification to that of *Rajanirghanta*. It is possible that the name *Paundaraka* has descended to us in the shape of such words as *Paunda*, *Pura*, *Puri*, etc., all of which appertain to the thicker and softer varieties of cane suitable for chewing.

*The extent and character of cultivation.*—Sugarcane is cultivated more or less in every plains district of the province. There is very little of this crop in any of the hill districts. The only hill districts where an appreciable quantity of sugarcane is grown are the Chittagong Hill Tracts, Manipur and the Khasi Hills, but the area occupied by it is so small as to be almost negligible. The following statement shows the acreage under sugarcane in the year 1905-1906 in the several districts of the province:—

Division.	District.	Acreage.	Total.
Rajshahi	Jalpaiguri	4,700	
	Dinajpur	25,000	
	Malda	2,800	
	Rajshahi	18,100	
	Rangpur	16,000	
	Bogra	20,000	
	Pabna	3,200	
	Total	89,800	89,800
Dacca	Dacca	19,700	
	Faridpur	25,000	
	Bakarganj	18,500	
	Mymensingh	7,000	
	Total	70,200	70,200
Chittagong	Chittagong	9,000	
	Tipperra	5,700	
	Nac'hali	600	
	Chittagong Hill Tracts	800	
	Total	15,600	15,600
Surma Valley	Sylhet	22,000	
	Cachar	5,900*	
	Total	27,900	27,900
Assam Valley	Goalpara	1,200	
	Kamrup	4,800*	
	Darrang	2,200*	
	Nowgong	22,000*	
	Sibsagar	6,000*	
	Lakhimpur	5,000*	
	Total	20,900	20,900
GRAND TOTAL FOR THE PROVINCE			224,400

The total area cropped with sugarcane in 1905-1906 thus appears to be about 2½ lakhs or little short of a quarter million of acres. Out of this area about 90,000 acres, or 40 per cent., was in the Rajshahi Division, 70,000 acres, or 30 per cent., in the Dacca Division, and the remaining 30 per cent. was shared by the remaining three divisions. It should be noted, however, that the acreages given above are, with the exception of those marked with asterisks, very rough estimates, which may be far from the truth. The acreages given against Cachar and the Assam Valley districts, with the exception of Goalpara, are based on survey and can be accepted as fully correct. Except for these few districts, it is not possible, from a consideration of the annual agricultural statistics, to say for certain what proportion of the total cultivated area is occupied by the sugarcane crop in each district, or whether the area has been increasing or decreasing in recent years. In the six districts for which accurate statistics based on a field-to-field survey are available, the actual areas under sugarcane in 1895-96 and 1905-1906 and the percentage which the area in the latter year bore on the total cultivated area are exhibited below:—

District.	Acreage, 1895-96.	Acreage, 1905-1906.	Increase+ or decrease— in 10 years per cent.	Percentage of area on total cultivated area.
Cachar . . .	1,071	5,878	+440.8	1.9
Kamrup . . .	3,810	4,315	+ 13.2	0.9
Darrang . . .	1,951	2,177	+ 11.5	0.8
Nowgong . . .	1,928	2,238	+ 16.0	1.1
Sibsagar . . .	6,879	5,974	— 13.1	1.2
Lakhimpur . . .	1,859	4,990	+168.4	1.9

The cultivation has rapidly increased in Cachar, where, as well as in the neighbouring district of Sylhet, time-expired tea-garden coolies have settled in large numbers and begun to cultivate sugarcane on hilly jungle-covered land which at one time was considered useless except for growing thatching grass. In the Lakhimpur district also, the area under sugarcane has undergone considerable expansion in recent years. The sugarcane industry in this district, as well as in the adjoining parts of Sibsaagar and Darrang, is now mainly in the hands of Nepalese immigrants. These people are nomadic in their habits and scarcely remain in a place for more than five or six years. Their custom is to settle down in the midst of a forest, usually on the banks of a river, make a clearing in the forest, grow sugarcane on it for as long as a single crop with its ratoons will last, and then shift to a new forest site. They are able to produce jaggery so cheap that the native Assamese cultivators are unable to compete with them; hence in those parts of Assam where the Nepalese have taken to growing sugarcane, the natives of the country have practically abandoned its cultivation. To this fact may be attributed the slight decrease of area under sugarcane in the Sibsaagar district, where of all districts in Assam the crop was at one time cultivated to the largest extent.

Though trustworthy statistics of area are not available for any of the Eastern Bengal districts or for Sylhet and Goalpara, it would appear from the district reports that in the open well-cultivated parts of the country, the cultivation of sugarcane is giving way to jute, which in recent years has assumed an unexpected importance owing to the extraordinarily high prices now being paid for the fibre and which is far easier to grow and gives a quicker return than sugarcane. On the other hand, the cultivation of sugarcane has been rapidly increasing in the more backward tracts where jute does not thrive well, e.g., the hilly tracts in the south of the Surma Valley bordering on the Tippera Hills, and at the foot of the Sitakund Range in Chittagong, and the high jungly tract of country in Rangpur known as the *khior* or the *barind*. There is no doubt that, barring jute in the more favoured parts of the country, there is no crop which pays the cultivator who can afford the labour to grow it so well as sugarcane, and the profitableness of the crop has rather increased than otherwise in consequence of the growing demand for jaggery, which has resulted from the opening up of communication in the interior of the country and the increasing prosperity of the rural population. The gradual introduction of iron-mills, which has enabled the cultivators to obtain larger yields of jaggery than was possible with the old fashioned wooden mills, is

another of those causes which have tended to make sugarcane cultivation more profitable than before.

Some of the district reports have assigned other more or less local causes for the increase or decrease of sugarcane cultivation. Thus, in Chittagong, it is said that the example of some planters, who have been growing sugarcane on hill slopes which were at one time considered worthless for any agricultural purpose, has led many people to do the same. In Goalpara, the subsidence of the ground level caused by the great earthquake of June 1897, is reported to have rendered the country excessively liable to flood and consequently less suitable for sugarcane thus causing a contraction of the area cultivated with that crop. A rise in the price of mustard cake, which is commonly used for manuring sugarcane in certain parts of Sylhet, is reported to have led to a curtailment of the sugarcane area in those localities. The inflow of saline water is, among other causes, held responsible for the comparative neglect in which sugarcane has fallen in the southern parts of the Backarganj district.

The cultivation of sugarcane is of comparatively recent introduction in the Chittagong Hill Tracts, and possibly also in the Manipur State. In the Chittagong Hill Tracts, it was introduced from the adjacent district of Chittagong some fifty years ago. The cultivation of sugarcane in Manipur on a systematic scale is said to date from the time of Raja Sir Chandra Kirti Sing (1850-86), though the plant was not wholly unknown in the State before his time. The cultivation of sugarcane for *jaggery* is an industry of recent growth in the Noakhali district. A large area of sugarcane is found in the south-eastern parts of the Faridpur district, where it was unknown till 30 or 40 years ago. The crop is grown there on river *chars* or *dearas* which are annually submerged.

The bulk of the sugarcane crop in the province is grown in small patches of one or two bighas (one bigha =  $\frac{1}{3}$  of an acre). The area of a sugarcane field is determined by the amount of labour at the command of the cultivator. There is a saying that a man who does not possess seven sons and twelve grandsons should not engage in sugarcane cultivation. Except in certain localities, it is rare for any one to grow sugarcane mainly or wholly with hired labour. The Nepalese sugarcane growers in Upper Assam, besides working with their own hands, employ a good deal of hired labour. A number of families squat down in one place, and, sugarcane being practically the only crop which they grow and the only source of their income, the area cultivated by each is comparatively large. No information is, however, available as to the average area of sugarcane cultivated by each family. Two European planters, Mr. Cattell and Mr. Brownlow, and a Bengali planter, named Babu Nabin Chandra Sikdar, have large sugarcane farms in Chittagong, and an Assamese gentleman, Srijut Debeswar Gossain, cultivates about one hundred acres of sugarcane on his farm at Barpathar, in the Sibsagar district. These farms are managed on commercial lines, and are believed to be profitable concerns. The land is cultivated wholly with the help of paid labour.

The principal kinds of soil on which sugarcane is grown in Eastern Bengal and Assam are either of deltaic or recent alluvial formation. The soil is either loam or clayey loam. Sugarcane is rarely grown on sandy soil.

Sugarcane is also grown to a considerable extent on a class of soil which passes under the name of old alluvium. It is believed to owe its origin to the disintegration of laterite rocks. It covers a large tract of country in the centre of the Rajshahi Division (known as the *Khar* or *Barind*) and also occurs in many parts of the Assam Valley, notably in the Golaghat subdivision, which is an important centre of sugarcane cultivation. The same soil occurs in the tract of country in the Dacca district known as the Madhupur jungle. The soil is usually a red or yellow clay, having evidently a great deal of iron in its composition. The old alluvium tracts occupy a comparatively elevated level and are immune from floods. The soil is more difficult to cultivate than new alluvium (*pai*), and does not retain moisture so well as the latter. In such soil the planting of sugarcane has to be deferred till April or May (and often till June), or if the crop be planted earlier, it has to be nursed by frequent waterings through the early stage of its growth.

The only examples of sedentary soil in Eastern Bengal and Assam on which sugarcane is grown are met with in the low hills or *teelas* in Sylhet

and Cachar and the sloping plains at the foot of the Sitakund Range in Chittagong. The soil is derived from sandstone rocks and is usually of a light open texture.

Very few analyses exist of the soils of Eastern Bengal and Assam. A number of tea soils has been analysed by Dr. H. Mann and others, but these scarcely throw any light on the character of the soils on which sugarcane is habitually grown.

Generally speaking, the bulk of the area in which sugarcane is grown consists of land on which the ordinary crops of the country are grown. Such land is too poor to bear a sugarcane crop without being manured. In the Dacca Division and the southern parts of the Rajshahi Division a great deal of sugarcane is grown on land which is annually submerged, and, being enriched with silt, stands in no need of manuring. So also in the case of land newly reclaimed from forest, the soil is naturally rich in vegetable mould and is capable of bearing sugarcane without the help of any manure.

From what has been stated above, the various descriptions of land in which sugarcane is cultivated in the province will appear to fall into the following classes, on each of which the character of the cultivation is of a distinctive type:—

I. *Alluvial land beyond the reach of floods.*—It is the most important class of land on which sugarcane is grown in the open thickly-populated parts of the province. The soil is usually of a loamy character, and being seldom allowed to remain fallow, it is too poor, as a rule, to bear sugarcane without manure. The crop is, therefore, invariably manured and cultivated with greater care and attention than elsewhere. The varieties of sugarcane usually cultivated in this class of land are the medium soft yellow or white cane preferred for the manufacture of jaggery and also used for chewing.

II. *Alluvial land which is annually submerged and enriched with silt.*—This class of land is mostly found in the deltaic districts of the Dacca and Rajshahi Divisions. The land is never manured. The only varieties of cane that can be grown on such land are the thin hardy kinds of cane which can bear submersion. The crop receives comparatively little attention, and such operations as trashing and wrapping are practically unknown. The jaggery made is of inferior quality and in many places where the inundation is heavy and lasts long, the crop droops prematurely as the result of prolonged water-logging and has to be harvested as early as October.

III. *Old alluvium (khar or barind) in the Rajshahi Division.*—The prevailing soil is a red or yellow clay which is more difficult to work than new alluvial soil and is liable to suffer from drought. Here, too, the thin hardy varieties of cane are grown by preference. They can stand drought better than the softer and more valuable canes, and receive less attention.

IV. *Land newly reclaimed from jungle.*—This class of land is found mostly in Upper Assam and in hilly tracts in the south of the Surma Valley and at the foot of the Sitakund Range in Chittagong. A nomadic system of cultivation is pursued. The land after being cropped with sugarcane is abandoned. The soil being rich in humus is never manured. In Upper Assam, the soil on such land is of alluvial origin and usually very rich. Successive crops of ratoon, often as many as five, are taken off the land before it is abandoned. The cultivation is of a primitive nature, though it is believed to be very profitable. The usual kind of cane grown on this class of land in Upper Assam is a thick soft white cane which elsewhere is grown only for chewing purposes. In the Surma Valley and Chittagong, the soil in newly reclaimed forest land is of sedentary origin, and is not, as a rule, rich enough to bear sugarcane longer than two or three years. The land lies high and dry, and the soil being of a light texture, the crop is liable to suffer from a prolonged absence of rain. There is, besides much risk of loss from wild pigs and jackals. For these reasons, the thin hardy varieties of cane, which are comparatively immune from drought and wild animals, are grown by preference in such land.

5. *Varieties of cane grown.*—It is not possible, from the meagre descriptions furnished in the district reports, to prepare anything better than a rough preliminary classification of the varieties of cane grown in the province. Appended to this note will be found a list of the varieties mentioned in the district reports with such description of each as has been furnished.

Roughly, the canes of Eastern Bengal and Assam may be divided (1) according to use, into (a) chewing, and (b) jaggery canes; (2) according to colour, into (a) white, grey, yellow or green canes and (b) black, purple or red canes; (3) according to character of rind, into (a) soft and (b) hard cane; and according to thickness of stem into (a) thick and (b) thin canes. Following this empirical classification, the varieties of cane found in this province may be grouped as follows:—

#### I.—CHEWING CANES—TALL, THICK, AND SOFT.

*A. Black or purple.*—It is known as Bombay or black Bombay cane in most district in Bengal, *Saheban* in Northern Bengal, and *Kalapura* or *Teli* in the Assam Valley. This variety was at one time largely cultivated, but it has proved extremely susceptible to disease (the red smut); nowadays it is grown in tiny patches near the rayat's homesteads and used only for chewing. It is a tall, thick, soft cane and is distinguished by the internodes being thicker in the middle than at the nodes. It is not, however, so rich in saccharine matter as some of the medium soft yellow kinds ordinarily grown for jaggery or the hard purple cane known as *Kajla*.

*B. Yellow.*—It resembles IA closely, except in regard to the colour of the rind which is of a yellowish green colour. It is variously known as *Pura*, *Bagapura*, *Bombay*, *Bom* or *Bompura* in different parts of the Assam Valley. This cane is grown largely by market gardeners in the vicinity of Dacca, and is known there as the White Bombay. It is the favourite cane of the Nepalese squatters in Upper Assam. It is subject to disease, but not to the same extent as the purple variety (IA). The *Vendumukhi* cane of Rangpur perhaps belongs to this class.

#### II.—JAGGERY CANES OF MEDIUM SIZE—FAIRLY SOFT.

*Yellow, white or green.*—Includes the largest number of sub-varieties which cannot be distinguished from one another without a close study of their appearance and character in the field. In this class will come the *Mag. Mugi* and *Bogi* canes of Assam, the *Dhalsundar* of Dacca and the *Dhal* or *Dhali* cane of the Surma Valley. These canes are the most important among the varieties grown for jaggery. They are also largely used for chewing. The *Sharang* cane of Dacca and the *Shamsha* cane of Sylhet and Cachar belong apparently to this class.

#### III.—REED CANES—THIN, TALL, HARD-RINDED.

*A. Yellow, white or green.*—These canes rank as the hardest of all. They are comparatively immune from injury by drought, inundation and wild animals, and are, therefore, grown exclusively in all situations where danger from these causes is feared. They also suffer less from insects and fungus disease. The commonest names for canes of this class are *Khari*, *Kheri*, *Khagra*, *Khagri*, *Ikuri Malaha*, *Magari*, *Majara*, etc., all of which are derived from the names of common reeds. These canes are poor in sugar-content, but as they grow freely and raton much better than any other, they seem to be coming into popular favour and to be supplanting the better kinds of cane in certain parts.

*B. Black or purple.*—Known variously as *Kajla*, *Kajli*, *Kali*, *Rangi Teliya*, etc., meaning either purple or black or of the colour of mustard oil. This variety ranks among the hardier canes, and next in this respect to III A.

#### IV.—WILD CANE.

In *chur* lands in Eastern Bengal, a kind of reed known as *latá* or *kháld* is met with, which is used extensively as fodder. The canes are sometimes given to children for chewing. This reed is cultivated as a fodder in the *churs* of the Meghna and the Dhaleswari river in the Dacca district. The Collector of Faridpur has reported a variety of reed cane, which also is called *lata* and has furnished the following description of the cane:—

It is a yellow cane with a shade of purple, hard and not much thicker than a man's finger. In several places it is confused with the *khagri*, which is a distinct variety of recent introduction. It is too hard both for white ants and jackals and is generally grown on land that will grow no other cane, namely,

lands on which 4' to 6' of water stands during the rains. The *gur* is of bad quality and of blackish colour, and sometimes this cane is used as fodder.

But the Collector does not include it among the wild canes.

It is not quite understood what is meant by Giant canes. The Black Bombay cane (IA) attains an enormous size in good soil and under good cultivation, and may then be known as a Giant cane.

In regard to quality, the medium yellow varieties (*Mac*, *Dhalsundar*, *etc.*) are said to yield the best jaggery, and are grown in preference to all others wherever the surroundings are favourable to the cultivation of sugarcane. The *Kajla* cane is said to be the richest in sugar-content. The *Khari* or *Khagri* canes (III A) are the poorest in point of the yield of juice and sugar, but are preferred in many places for reasons already mentioned.

6. *Recorded introduction of new varieties.*—The Bombay varieties of cane are admittedly of foreign origin. The Black Bombay cane is believed to have been brought to India by Captain Sleeman from Mauritius. This cane is known as *Shahaban* (*lit.* brought by *sahaba*) in Northern Bengal and was introduced in Rangpur by some European planters in 1840 (see Mr. Glazier's Statistical Account of Rangpur, 1873). It was introduced into Assam either at the time of Captain Welsh's expedition (1793-94) or by European sugarcane growers in Kamrup in the middle of the last century. Some of the district reports mention it as having been introduced some 50 years ago.

The *Sharang* cane of Dacca is believed to be identical with the *Samsara* cane of Bengal which is said to have been imported from Otaheite about the beginning of the last century. The Sylhet name of *Shamsa* might be only a variant of the word *Samsara*. These few constitute the only instances on record of exotic canes introduced in Eastern Bengal and Assam.

7. *"Sports" and seedling canes.*—Very few people in the province seem to know anything about "Sports" and seedling canes. Sylhet is the only district from which the phenomenon of "Sports" in sugarcane has been reported. The white *Khagra* cane there is said occasionally to give rise to the red or *Rangi* cane.

An instance of a new variety which has come into existence as the result of degeneration is the *Assamese Pura* (also called *Keteki Pura*) cane of Assam which is believed to have sprung from an exotic variety (yellow *Pura*) of which mention has already been made.

Seedling canes are wholly unknown. Except in Upper Assam, it is unusual to see any "arrows" in a cane-field, and there it is only the tall reed canes that are found to flower. It is not known whether any one in Eastern Bengal and Assam has ever attempted to raise sugarcane from seed, nor is it known whether the seeds produced locally are fertile or not.

8. *Other sources of sugar and spirit.*—The only other source from which sugar is produced in Eastern Bengal and Assam is the date-palm which is largely grown in the western parts of the Faridpur district bordering on Central Bengal. Date sugar is also produced to a small extent in many other districts of Eastern Bengal, but the total quantity of date jaggery produced in the Province is after all small, and except in a few of the south-western districts, it does not affect the sugar market in any way. Date jaggery is preferred to cane jaggery on account of its nice flavour, but it does not keep well and turns sour during the rains.

Spirit is produced in Eastern Bengal and Assam from jaggery, *mahua* flowers which are imported from Behar and the United Provinces, and rice.

## PART II.

### CULTIVATION.

9. *Planting and reaping seasons.*—The season of planting sugarcane in Eastern Bengal and Assam extends from January to May. In most alluvial soil, the planting takes place as a rule in the first three months of the year. Where the soil is liable to dry up during the hot weather, the planting is deferred till the spring showers in April and May have sufficiently moistened the soil, and in unfavourable years, the planting may be continued up to the first fortnight of June. In case of late planting like this, the invariable custom is to plant the sets in seed-beds, and transplant them later in the field. This

appears to be the common custom in most parts of the Assam Valley and in parts of the Dacca and Surma Valley Divisions. The market gardeners of Dacca commence to plant their canes as early as November, but these are used only for chewing.

The reaping season for jaggery canes is governed largely by the exigencies of general agriculture. It does not commence usually before the close of the winter rice harvest about the middle of January. The reaping commences with the ratoon cane which attains maturity in a shorter time than plant cane, and where there is much of it, the crushing may commence as early as the middle of November, that is, as soon as the weather has become fair and settled. In the inundated tracts of the Gangetic delta where reed canes are grown, the harvest commences as early as September. The long water-logging to which the crop is subjected, causes it to droop prematurely, and the cultivators commence to gather it soon after the flood has subsided and left the ground high and dry.

The bulk of the cane crop is reaped between the middle of January and the end of March, but in localities where sugarcane is largely cultivated, reaping may continue to as late a period as the end of April. A Bengali saying,

*Maghe una Falgune duna,*

*Chaitte mule mul, Baisakhe nirmul,*

embodies the wisdom of the raiyat in regard to the reaping season. Freely translated, it means that sugarcane reaped in *Magh* (15th January to 15th February) give slightly less (jaggery than the normal yield); if reaped in *Falgun* (15th February to 15th March), the yield is double; in *Chait* (15th March to 15th April), it just pays; but if reaped in *Baisakh* (15th April to 15th May), it ends in total loss. From this proverb, the best time for reaping cane in Bengal would appear to be the month from the middle of February to the middle of March. The weather at this time is moderately cool, and the cane after having reached its maximum growth about the beginning of December, has had time to complete those metabolic changes which result in the formation of sugar.

The cultivators know from external appearances, such as the drooping and withering of the leaves, the change in colour and glaze of the rind, etc., when the cane is ripe and fit for reaping; but they seldom look for any signs, and commence reaping as soon as the proper season has arrived and they are free to turn their attention to this work.

The period which elapses between planting and reaping may be said to vary from seven to twelve months. It depends chiefly upon the time of planting which, as stated before, extends from January to the end of May, varying according to the conditions of weather and soil, and upon the time when the cultivator is able to crush his cane. It would seem that the time of planting has little relation to the ripening of sugarcane. The crop, whatever be the time of planting continues in active growth all through the rainy season and during the first six weeks or two months of the dry weather which follows, and it is not until the growth of the plant has been arrested by the increasing dryness of the soil in January onwards that the ripening process comes into full play.

Very little is known in regard to the time which different varieties of cane take to ripen. In Dinajpur, the *Potashi*, *Sahaban* and *kheri* canes are reported to be ready for crushing as early as October and November, while the *Moogi* and *Basna* varieties which appear to be those mostly cultivated do not attain maturity till March and April.

10. *Rotations and mixed cropping.*—Fixed rotations for sugarcane appear to be very seldom observed in any part of the province. In old cultivated land, sugarcane is preceded and followed by such ordinary dry crops as early rice, pulses, jute and mustard, and in the case of edible canes by vegetable crops.

Mr. A. C. Sen, in his Report on the agriculture of the Dacca district, mentions an instance in which a regular system of rotation is followed. It relates to the cultivation of sugarcane by the market gardeners of Dacca, with whom cane cultivation is a speciality. They grow sugarcane for three years running (including two years for ratoon) on the same land. After this the

field is ploughed and sown with early rice or *mashkalai* (*Phaseolus Boxburghii*). It is followed again by sugarcane, which is again kept up for three years, and so on.

The practice of allowing land to remain waste for a number of years is a common one in many parts of the province. It may be said to be the general rule in the poorer classes of soil, such as the red clay soil of the old alluvium tracts in North Bengal and Assam and the *teela* soil of the Surma Valley. The land is broken up and cropped with sugarcane for one or two years, and is then left waste for several years before it is taken up again for sugarcane. In Assam, a crop of *phaseolus* pulse is taken after sugarcane before the land is abandoned to waste.

Mixed cropping in case of sugarcane is not a common practice in Eastern Bengal. In Northern Bengal, *rahar* (pigeon pea) is occasionally sown in rows among the sugarcane. The Nepalese cultivators in Lakhimpur (Upper Assam) grow a little maize mixed with cane in the first year, the planting of cane as well as maize being done more or less broadcast. The market gardeners of Dacca cultivate melons along with sugarcane. The melon is sown in December and harvested in March and April, and occupies the interspaces between the rows of young sugarcane, with which it does not in any way interfere. In the Chittagong Hill Tracts, maize and *bhindi* (ladies' finger) are grown among sugarcane. These crops are off the ground before the cane grows high enough to overshadow them.

A common practice in many parts is to grow *rahar* on the edges of sugarcane fields. It serves as a wind-break, and also as a fence against cattle. Near Dacca, the stems of *rahar* plants thickly sown on the edges of the fields are tied together with horizontal pieces of split bamboo and made to serve as a fence against jackals and cattle. In Northern Bengal and Kamrup, it is common to see jute sown as a border round cane fields. Another plant called *bilakhani*, is occasionally sown on the embankments with which it is the practice in Assam to enclose sugarcane fields. It serves the same purpose as *rahar* and yields a large quantity of fuel for the boiling of jaggery.

11. *Ratoons*.—The practice of ratooning cane is general in the province. It is believed to be more profitable. In most places, the crop deteriorates so quickly that not more than one ratoon crop can be taken with profit. In exceptionally favoured soil, *e.g.*, the virgin forest soil of Upper Assam and Sylhet and the rich alluvial soil in the Chittagong Hill Tracts, as many as three to five ratoon crops are taken. The hard-rinded varieties of cane ratoon better than the softer kinds. One or two of the district reports speak of ratoon cane being more subject to red-smut than plant canes, but on this point very little information has been received. In inundated land the practice of ratooning is hardly possible and is rarely found.

12. *Preparation of the land for planting*.—The actual mode of preparing the land differs in three different kinds of land :—

- (1) In the case of old cultivated land, which bears crops every year, the preparation of land does not commence till the commencement of the cold weather. Very often an early cold-weather crop, such as mustard, pulse or *til*, is taken off the land, and the cultivation for the sugarcane crop is not taken in hand till January. The land is ploughed up and harrowed with the ladder as many times as is found necessary to secure a good tilth. The number of ploughings varies naturally according to the character of the soil and the conditions of the weather, and has been variously estimated at from eight to twenty. The number of harrowings is about twice the number of ploughings given, the usual rule being to pass the ladder twice over the ground between two successive ploughings. The land is invariably manured with cattle dung except when it is enriched with silt. The manure is usually spread on the land either before the ploughings commence or in the intervals between the ploughings.
- (2) In case of land that has remained fallow, the custom is to dig it up with the spade during the rains or in the beginning of the cold weather, and leave it in this condition for some time. Then after the clods have weathered down to some extent, the land is



ploughed and harrowed repeatedly until the requisite tilth has been obtained. Such land also requires to be manured.

- (3) In case of virgin forest land, the first step towards preparation of the soil is to cut down the underwood and then after a time to fell down the overhanging trees. Fire is set to these heaps when sufficiently dry, and the ground is cleared as far as possible of partially burnt wood. These operations take place during the cold weather. The land is neither dug nor ploughed. All that is done is to dig out the pits in which the sets are to be planted. The pits are dug some time before the planting takes place in order to aerate the soil. No manure is used. The soil being rich in vegetable mould needs none beyond the ashes derived from the burning of the forest.

The use of the crowbar for cultivation is unknown in Eastern Bengal and Assam. The only implements used in the tillage of sugarcane land are the spade (*kodali*), the plough and the ladder (*mai*). In clayey soil, it often becomes necessary to use a wooden mallet for crushing the clods which cannot be reduced by the ladder.

Bare fallowing in the sense that the land after being broken up is left uncropped for a year is not known to be practised in any part of the province.

13. *Planting*.—The various points under this head will be considered in paragraphs 14 to 21.

14. *The source from which the seed is obtained*.—The cultivators purchase the seed only when they first start cultivating the crop and rarely afterwards. They preserve the "tops" of their own crop and use these for seed. The only instances in which cuttings are procured annually from a distance have been reported from Faridpur and Bakarganj. In the inundated parts of those districts, the cane crop is harvested as early as September and October, and the crop dies prematurely as the result of prolonged water-logging. Hence the necessity of obtaining cuttings from a locality where the crop is free from injury by floods. In the neighbourhood of Dacca City, the market gardeners occasionally purchase sprouted cane cuttings which are sold at Rs per thousand.

The "tops" are taken from plant as well as ratoon cane. The latter is preferred in some localities owing to the internodes being shorter. In Upper Assam, "tops" from ratoon canes are considered worthless and hence seldom used.

The practice of leaving a portion of the cane crop to stand over till it is required for use as seed cannot be said to be a general one in Eastern Bengal and Assam. It is possible only in those places where the sets are obtained by cutting of the whole cane into pieces. It is known in Manipur, in the Jabarmal mauzas of Bakarganj which supply seed for the inundated tracts in that district and Faridpur, and in the country round Dacca. In Rangpur, entire fields of ratoon cane are sometimes bought up for seed purposes and these also may be regarded as "stand-overs."

15. *The part of the cane used for planting*.—The general practice, as already mentioned, is to use the upper part of the cane, that is to say, the "tops" for seed; but there are localities in which the whole cane is cut up into sets for seed. The latter practice has been reported from Rangpur, Bakarganj, Sylhet, Manipur and the country round Dacca, but it is after all only secondary to the use of "tops" which are always preferred.

In using sections of the whole cane for seed, the lower rooting joints are always excluded. Sets obtained from the whole canes often fail to germinate, hence it is never safe to use them except where the sets are first planted in a nursery and only such as produce shoots are transplanted in the field.

The use of the whole cane as seed is reported to be practised in some villages near Kutubpur in the Rangpur district. The practice does not seem to be known elsewhere.

16. *The actual preparation of the sets for planting*.—In most places the "tops" which contain six or more joints are cut up into sets, each containing two or three internodes. In Rangpur, the tops used are about a cubit long and are not cut up into smaller pieces as is done elsewhere; but sets obtained from the whole cane contain three or four internodes each. In the Assam Valley

the general practice is to keep three or four joints in each set, and often so many as six to eight. In Sylhet and Chittagong a set often contains a single "eye" the practice being to plant the sets in the first instance in a seed bed to ensure germination.

Pickling the sets in various solutions before planting is a practice which may be said to be practically unknown in this province. In Rangpur the sets are sometimes pickled with kerosine oil and water as a preventive against white-ants. The soaking of sets in water before planting is a common practice in many parts of the Province, the object aimed at being to accelerate the germination. It is also said to reduce the sweetness of the sets and thus to render them less attractive to white-ants.

17. *The number of sets per acre.*—The number of sets used per acre has been variously returned at from 3,000 to 4,000 in Lakhimpur to 30,000 in Rajshahi. It depends, of course, on the distance at which the sets are planted from each other. The larger figures (15,000 and upwards) are reported from districts or localities in which the harder and poorer varieties of cane are grown. These are planted close and receive less attention than usual.

18. *The mode of planting.*—The mode of planting varies in different localities, and depends on the character of the cultivation pursued. A few typical examples are quoted below.

*In virgin forest land in Upper Assam.*—As already mentioned, the forest is cut down and burnt, and the land is neither ploughed nor hoed, and no manure is used. Pits are dug in the ground and into these the cuttings are placed. Reaping and planting usually proceed about the same time, and the sets are planted out straight off without receiving any preliminary preparation. No fixed distance is observed in digging the pits, but they are made equidistant as far as the nature of the ground, encumbered as it is with stumps of trees and partially burnt wood, allows. The pits are made about one yard from each other, so that about 4,000 cuttings suffice to cover an acre. The depth of the pits is about 12 inches.

*In old arable land in the Assam Valley.*—The soil is prepared by repeated ploughings and harrowings, preceded, in the case of fallow land, by digging with the spade. The planting takes place in April and May. The day chosen for planting must be preceded by sufficient rain, and if drizzling rain lasts throughout the day, so much the better. The field is partitioned into strips of 8 to 12 feet in width separated by drains, which communicate with a ditch which surrounds the field. Trenches 2 to 3 feet apart are made with the spade; these run at right angles to the drains, and in these trenches the sets are planted, about 9 inches apart from each other. A little soil, often mixed with cowdung, is lightly scattered over the cuttings and they are left to themselves until they strike root.

*In old alluvial land in Rangpur.*—The land is prepared by ploughings and harrowings as elsewhere. Furrows are made with the plough 12 inches apart, and along these the sets are laid down 4 or 5 inches from each other. The furrows are fairly straight and equidistant and about 6 inches deep. After planting the sets, they are covered over with soil taken from the sides of the furrows so as to make the surface level.

*In the flooded tracts of the Gangetic delta.*—After the land has been prepared by ploughing and harrowing, shallow trenches, about 2 inches deep and 12 inches apart, are made with the spade, the "tops" are laid in the trenches at intervals varying from 12 to 18 inches and buried 2 inches deep after which the trenches are filled up with earth. The sets thus lie about four inches below the ground.

*Near Dacca for chewing canes.*—Ploughing and harrowing is commenced about the middle of September, and the land is got ready by the end of October. Parallel lines are drawn all over the field, 36 inches apart, and along these lines, at intervals of about 12 inches, pits 6 inches to 9 inches deep are dug with the spade, about 12 inches square on the surface and with slanting sides. The bottom of the pits is stirred with the *kodali*, and the earth below is mixed with a little soil from the top and some well-rotted cowdung. While the field is being prepared, the sets are "hatched" in a nursery, and the young plants become fit for transplantation when they are about a foot high. In each pit are placed two cuttings with the shoots on, and the pits are then

partially filled with soil, which is pressed round the plants. The plants are watered daily from a pot until they strike root.

*In Manipur.*—The field is laid out into beds, 8 feet wide, separated by furrows which serve as drainage channels. Three parallel rows of pits are dug on the ridges, the rows being 2 feet apart from each other and the pits about 8 inches from each other along the rows and 4 or 5 inches deep. Well-rotted cowdung and ashes are placed at the bottom of the pits. The planting takes place in April and May. The sets are previously planted in a seed bed, and throw out shoots, when they are taken out for planting in the pits. Four sets are planted together in each pit, of which one set is from the stem of the cane and three from the "tops." The sets are carefully covered with soil, and are watered immediately after planting and thereafter daily for some days. A mulch of grass is spread over the land to conserve moisture.

19. *Supplying vacancies.*—Careful cultivators preserve sets for filling up vacancies, but in most places vacancies, unless too many, are left unsupplied. Vacancies seldom occur when sprouted sets are used. In Rangpur, the cultivators occasionally fill up vacancies from sets thickly planted on purpose in the outskirts of the field. In Dinajpur, large vacancies, when they occur, are sown with jute.

When vacancies are filled up with fresh sets, it is done, as a rule, at the time of the first hoeing and weeding, which takes place within a fortnight to a month from the time of planting.

Cuttings are preserved in various ways. If they are to be planted within a fortnight or at the longest a month, after the cane has been reaped, they are kept in a cool, moist place protected from the sun. In some places the cuttings are planted thickly in a slanting position and covered with rice-straw, plantain leaves or loose earth, over which water is sprinkled from time to time. In other places they are tied together into bundles with the bottom ends on one side and embedded half-way up in soft mud.

If the cuttings are to be preserved longer than a month, they are planted in a seedbed or nursery in the manner described in the following paragraph:—

20. *Seed-bed and nursery.*—The practice of planting the sets in a nursery and making them sprout and throw out shoots before transferring them to the field is in vogue in most parts of the Province. In Northern Bengal alone it seems to be unknown. The *raison d'être* of the practice is to be found in the fact that irrigation is all but unknown in the Province, and except where the rainfall is assured or the soil is naturally moist, there is always some risk in planting the cane in the dry season. The planting of the crop has, therefore, to be deferred in many places until sufficient rain has been received in April and May and the risk of loss from drought has passed away. The nursery is made in a cool moist spot in the raiyat's homestead or near a well or tank. The ground is carefully prepared and liberally manured with cowdung and ashes. The soil is heavily watered and converted into puddle. The cuttings are laid horizontally and half buried in the mud, so as to leave only the upper surface visible, and so placed that the eyes or buds remain level with the ground. They are placed so thickly as to almost touch each other. The seed-bed is kept wet by watering from time to time.

Near Dacca, where young cane plants are raised for sale, great attention is paid to the cultivation of the seed-bed. After the cuttings are laid in the puddled seed-bed, powdered earth mixed up with ashes is spread over the bed, about 1½ inches thick, and over it is placed a mulch of rice-straw. After a day or two, when the seed-bed is found sufficiently dry, the straw is removed and the surface soil is gently stirred and pulverized, after which the straw is again put back over the seed-bed. Within a fortnight the cuttings begin to sprout, and within another fortnight or three weeks the shoots will have grown to a foot or eighteen inches high and become ready for removal to the field.

21. *Stool-planting.*—The practice of propagating cane from stools is known only in parts of the Sylhet and Nowgong districts, and even there it is rarely found.

22. *Irrigation and drainage.*—It is a most unusual thing to irrigate cane fields in Eastern Bengal and Assam. The crop is occasionally watered from pots for a few days after planting, and that is the only irrigation which it ever receives.

The market gardeners of Dacca, however, occasionally irrigate their cane fields from *kutchas* wells. The soil of the country near Dacca is a red ferruginous clay of lateritic origin which is apt to suffer from drought during the dry season. The same soil is found all over the Madhupur jungle in Dacca and in the *khair* or *barind* tract of country on the opposite bank of the Bramaputra in Northern Bengal. The softer and more valuable kinds of sugarcane cannot be grown on such soil without irrigation.

The raiyats are careful in the matter of drainage. In all situations which permit of the water being drained off the field, the land is enclosed with a ditch partitioned into compartments by parallel drains or furrows communicating with the outer ditch. In flooded tracts drainage is of course out of the question.

23. *Cultivation after planting*.—The after cultivation of the crop consists in weeding, hoeing and earthing up the roots of the cane. The number of hoeings and weedings considered necessary in different places and the implements used are mentioned below :—

*Rangpur*.—Two weedings with the hand-hoe (*pasun* or *khurpi*) and two ploughings between the rows with the country plough.

*Rajshahi sadar*.—One hoeing and weeding with the spade, followed a month later by one inter-ploughing between the rows.

*Dinajpur*.—In May, the weeds are uprooted by hand, and the interspaces between the rows are ploughed with the country plough. The same is done again in July.

*Dacca chewing canes*.—The cane is planted early in the cold weather. When the plants have taken root, the field is weeded and the soil near the roots loosened with the hand-hoe (*pashuni*). A few days after, the whole of the interspaces between the plants is hoed up with the spade, and the pits in which the cane was planted are partially filled. A second hoeing with the *pashuni* is given a fortnight later, and this time some well-rotted cowdung is placed round each clump and the pits filled up with earth. Another weeding and earthing follow, in the course of which the plants are earthed up. Throughout the rains, the field is kept clean and the soil loose by weeding and hoeing at intervals.

*Faridpur*.—After the plants have germinated and taken root, the field is weeded and the soil round the plants loosened with the sickle (*kochi*). Hoeing with the *kodali* follows, and when the plants are a cubit high, they are earthed up in V-shaped ridges. A second and occasionally a third weeding and hoeing are given.

*Bakarganj*.—Three or four times with the spade.

*Chittagong*.—Two hoeings with the spade. Additional weeding is not considered necessary except in the upland farms where the thatching grass comes up with the canes and has to be removed.

*Tippera*.—Two weeks after germination the first hoeing is given. It is repeated after every shower. Five to seven hoeings are considered necessary. When the stumps have grown about 3 feet, earth is thrown up round the roots so that the plants stand in ridges with furrows between the lines.

*Chittagong Hill Tracts*.—Three times during young growth.

*Assam Valley*.—In old cultivated land, the surface soil is hoed and the weeds removed with the *khanti* (spade) three or four times, and the cane is earthed up when three feet high.

*Upper Assam*.—In new forest land, three weedings and hoeings are considered sufficient. In the first year, this is done with the *dao*, and in ratoons the *kodali* is used. Only the surface is scratched to break up the hard soil. Mulching the field with grass after the cane has been planted and before it has had time to cover the ground is not in vogue.

24. *Manuring*.—It may be stated at the outset that inundated land which receives a deposit of silt every year is never manured: nor is land newly reclaimed from jungle. But all lands which lie above the reach of the floods and which have long been under cultivation are invariably manured for sugarcane. The principal and in most parts practically the only manure used is cowdung. It is supplemented, wherever possible, with ashes and household refuse. The general practice is to spread the cowdung over the field before the ploughings commence, or in the intervals between the ploughings.

Cattle-folding is practised in the vicinity of large pasturage grounds, but the practice is not at all common. In the Assam Valley, the field is manured with cowdung in the beginning when it is being prepared and repeated doses of powdered cowdung are given to the young crop at the time of hoeing. The same custom obtains among the cane-growers of Dacca, but they do not use powdered dung like the cultivators of Assam.

Cane-fields on the banks of the Dulai creek near Dacca City are manured with heavy dressings of earth taken from the creek. It is said to be an excellent manure. Tank earth is occasionally used for manuring sugarcane fields.

Rape or mustard cake is the only oil-cake which is ever used as manure in Eastern Bengal and Assam. Except in Sylhet and Mymensingh and among the cane-growers of Dacca, the use of oil-cake for sugarcane cannot be said to be at all general, though its use as such is known everywhere. Oil-cake is always used in the powdered state. It is applied in small doses to the roots of the growing cane, when the crop is being hoed or earthed up. There is no information as to the quantity of oil-cake which a cultivator would ordinarily use per acre. The price of oil-cake in Eastern Bengal and Assam may be said to vary ordinarily from Re. 1 to Rs. 1-8, but this year it has risen quite 50 per cent. above the normal price.

The cultivators of Eastern Bengal and Assam are very careless in the matter of conserving cowdung for manure. The usual practice is to throw down the manure on a heap outside the cowshed and leave it exposed to rain and sun. In most parts of the Assam Valley and the inundated parts of Eastern Bengal, very little use is made of cowdung, the greater part being absolutely wasted. The only crops ever manured are sugarcane and vegetables. A happy exception to this rule is found in the Jorhat and Golaghat sub-divisions of the Sib-sagar district, where the land has been impoverished by continuous cultivation, and the cultivators have begun to pay attention to the supply and conservation of cattle manure. The dung is kept in pits which are protected from rain by thatched roofs, and is powdered before being used for sugarcane. Cowdung is seldom used as fuel in the Assam Valley, even when it is not used as manure.

The trash or dried leaves of sugarcane is nowhere utilised as manure. It is invariably burnt either in the field after the crop is removed or in boiling the juice.

The use of green manure, either before or after planting sugarcane, is totally unknown in Eastern Bengal and Assam.

The only trustworthy experiment in the use of artificial manures on record is one made with superphosphate on the Bangpur Farm in 1905-1906. It was found that a dressing with 3 maunds of superphosphate—costing Rs. 10, increased the yield of jaggery by 9 maunds and 32 seers, which at the least valuation meant an increase of profit of Rs. 40. Certain manurial experiments with sugarcane are now being made in the Rajshahi Farm, but the results will not be known till a month or two hence.

25. *Treatment of the canes during growth.*—The operations to be dealt with under this head are trashing, wrapping the canes with leaves tying the canes to one another or to bamboo supports to prevent them from falling down and protection of the crop from jackals and other wild animals. Trashing is done in most places, but it is often neglected in case of the thin hard-rinded canes which are planted in close lines and taken little care of. Wrapping is a less common practice. It is never done with the thin hard canes, but the softer kinds are always wrapped wherever the crop is liable to much injury from wild animals. With these canes, it is found necessary to tie a number of clumps together to prevent them from falling. Bamboos are occasionally used for supporting the clumps, but the use of props is not at all common, except with chewing canes which grow to a great height and require artificial support.

Jackals are fought by various means, of which wrapping the canes is one. The field is fenced in many places with a closely woven bamboo paling sufficiently high to prevent the jackals from jumping over them. Thorny plants are used in places to strengthen the fence. It is usual to watch the cane-field at night. Jackals are scared away by beating tins. There are various other devices for creating noise to frighten away these animals. One

reported from Nowgong is a kind of improvised clatter or bell consisting of an inverted tin canister inside which hangs a heavy piece of wood. The tin is suspended by a rope from a bamboo post, and as it sways to and fro with the wind, the piece of wood hanging inside strikes against the sides and produces a clattering sound. Another in common use consists of a bamboo, the upper half of which is split into two half way down. It is fixed to the ground. One of the split ends is fastened to a rope. A man sitting inside his hut pulls the rope and then lets it go, causing the two halves of the bamboo to clap each other with force and make a violent noise.

Traps or baits are seldom used for killing jackals. It is the custom in many places to plant hard-rinded cane on the outside and the softer cane on the inside of the field to protect the latter from jackals.

26. *Treatment of the field preparatory to reaping the canes.*—The field receives no special treatment preparatory to reaping, and the irrigation of cane being unknown, nothing can be said as to the effect of watering the crop immediately before reaping.

27. *Disease phenomena.*—The most serious pests and diseases of sugarcane in Eastern Bengal and Assam are the jackal, the white ant, the red smut and the mothborer. In certain parts, wild pigs prove extremely destructive to sugarcane, and even the hardest varieties of cane cannot escape from their ravages. In Assam sugarcane is often damaged by wild elephants.

No serious attempt is made by the cultivators to cope with any of the diseases and pests except jackal (see paragraph 25).

28. *Diseases affecting the sets after planting.*—The only serious pest is the white ant. It attacks cane in all stages. In Rangpur, the sets are sometimes washed in a mixture of kerosene oil and water as a preventive against white ants, and the insects are picked off when they appear. In Sylhet, paddy husk is sometimes applied to the roots, and in places diluted cow urine is used as a remedy. Rape cake is believed in Assam to be efficacious for white ants, and is applied in small doses to infested plants. Land which annually goes under water is free from white ants. Jackals do not cause any appreciable injury to sets or to young cane, and it is not till the cane has attained some sweetness that they turn their attention to the crop.

The pine-apple disease is not known in Eastern Bengal and Assam. Red smut is known. In Faridpur, the cultivators are said to examine the sets for red smut, and those found to be affected by it are thrown away. None of the other district reports mentions this practice.

29. *Diseases affecting the whole plant.*—The *serch* disease of Java is happily still unknown in the Province. It is reported from the Nowgong district that a kind of parasitic fungus is occasionally found on the roots of sugarcane and checks the growth of the plant. The black smut locally known as *andhar sap*, has been reported only from the Kamrup district. The disease is said to "turn the plant into a black powdery-mass." From the description it seems the disease is not black smut (*Ustilago sacchari*), but may be what Dr. Butler has described as "sooty" mould in his bulletin on the fungus diseases of sugarcane. A thin hard variety of cane known as the *majara* or *malaha* in Assam is peculiarly subject to sooty mould, the cane being covered with a dense black powder which comes off on rubbing.

The moth-borer is a common sugarcane pest in Eastern Bengal and Assam. It has been reported from most districts of the province. The insect is known as *majakata* in Assam, and *manjera* in Bengal. Other local names are *mandar-hera* in Mymensingh and *mandarluri* in Noakhali. Most of these names imply an insect eating the inside of the cane. It is described as living near the apex of the plant and causing the crown to wither. The insect is found in the upper joints of the cane, and is possibly the white-borer (*Scirpophaga auriflua*) described in pages 130—133 of Mr. Lafroy's Indian Insect Pests. Some of the district reports speak of *manjera* as the red-smut, and attribute the disease to an insect. The fact that red smut is often associated with a borer has been mentioned by Dr. Butler in his report quoted above; it is no wonder, therefore, that the cultivators should speak of red-smut as caused by an insect. Affected plants are sometimes cut and thrown away, but the cultivators are usually too careless and indolent to adopt such a laborious process. Near Dacca, cane

growers strew turmeric powder over the plants as a preventive of the pest. It is believed in Sylhet that a liberal manuring with oil-cake has the effect of driving away the pest, and that it is caused by manuring the field with fresh cowdung.

30. *Diseases confined to the underground parts of cane plants.*—Besides white ants, the grubs of a beetle called *karapoka* or *kerapoka* are reported from several places as causing injury to the young shoots. An insect called *gata-bhur* is said to feed on the roots of growing plants, but no description of the insect has been received. None of the district reports mention any flowering parasitic plant growing from the roots of the sugarcane plant.

31. *Diseases affecting the stems.*—The red-smut is universal over the Province. It is mentioned in almost every district report. In some districts the disease is known as *manjera*, a name which is also applied to the moth-borer. In Dacca it is also called *dhasa*, which literally means rot. It is known as *upara* in Noakhali and *sinduria* in Kamrup. The cultivators are aware of no means for fighting the disease when it appears. The rejection of cuttings affected with red rot at the time of planting has been recommended as a preventive remedy. As already mentioned, the cultivators of Faridpur throw away diseased cuttings at the time of planting and although the remedy is one which readily suggests itself to all interested in the cultivation of sugarcane, it does not appear to be generally followed. In Sylhet, there is an idea that plantain trees planted among sugarcane prevent the disease from spreading. The soft Bombay canes are more susceptible to red-smut than any other, and it is for this reason they are seldom cultivated for the manufacture of jaggery. The thin hardy varieties of cane (*Khari*, *Khagri*, etc.) are the least affected by red-smut.

Stem-borer and various other insect pests have been mentioned in some of the district reports, but the descriptions of the insects are so meagre and vague that no useful purpose would be served by mentioning them in detail.

32. *Diseases affecting the leaves.*—No serious leaf disease has been reported. In Noakhali, an insect called *gun gunia* is said to eat up the leaves, but the insect has not been described, nor is the extent of injury known.

33. *Reaping—Time of cutting the canes.*—All that is known on this point has been stated in paragraph 9.

34. *Deterioration after cutting.*—The raiyats appear to be fully aware of the deterioration that results from delay in crushing the cane. Limited as their resources are, they try to crush the cane as soon after cutting as they can. The mill is set up close to the field, and as much cane is cut in a day as the mill is expected to crush during the next twelve or twenty-four hours. The normal practice is to reap the cane in the afternoon and crush it during the night or the following morning. In Lakhimpur, where sugarcane is cultivated on a large scale by Nepalese squatters, the cane is often allowed during the cold weather to lie for a week before it is crushed, and in Kamrup two or three days may often elapse before the cane can be crushed. Such delays evidently arise from want of means to crush the cane quickly, and not from any want of knowledge on the part of the cultivators.

35. *Mode of cutting the canes.*—Except when a ratoon crop is to be taken, the cane is cut as low down as possible. For ratoon, the cane is cut one to two inches above the ground. In cutting the cane, the old leaves are first removed, then the tops are cut off, and finally the cane. In some places the tops are removed after the canes have been reaped.

36. *Yield per acre in canes.*—None of the district reports affords reliable information on this point. But trustworthy data are available for Assam from the Annual Reports on crop cuttings which have been published since 1883-84. The average yield of cane in 1,610 experimental cuttings made during the nineteen years from 1883-84 to 1901-02, and covering a total area of 18639 acres, was 19'833 lbs. or a little under 9 tons per acre. A large number of cuttings were carried out in the Assam Valley in 1882-83 in connection with a special enquiry made by the Director of Agriculture. The average of 24 cuttings made by District Officers gave a yield of 27'083 lbs. of cane, or a little over 12 tons per acre. The maximum yield obtained in these experiments was 19 tons and the minimum 6 tons per acre.

## PART III.

## MANUFACTURE.

37. *Manufacture of jaggery or gur.*—Three descriptions of mill are in use for crushing sugarcane in Eastern Bengal and Assam, *viz.*, (1) the iron mill, (2) the wooden roller mill, and (3) the *ghani* or wooden mortar and pestle mill, the same as is used for crushing oil seeds. Steam crushing mills are used in several large sugarcane farms in Chittagong and Sibsagar. Iron mills have been introduced within the last twenty years. They appear to have completely supplanted the primitive wooden mill in all the districts of the Rajshahi Division and in Faridpur, Bakarganj, Noakhali, the greater part of Chittagong Division and Cachar. The Nepalese cane growers of Assam use iron mills, though among the Assamese cultivators, the use of the wooden roller mill is still all but universal. The earlier type of iron-mills has two vertical rollers but it is slowly giving way to three roller mills, which are more effective. Most of the iron mills used in the Rajshahi and Dacca Divisions are supplied by Messrs. Renwick & Co., of Kushtia. The firm maintain depôts of their own at different cane-growing centres, and let out the mills on hire to the cultivators. Iron mills are also imported from Calcutta by Bengali and Marwari traders for hiring out to their clients. It is seldom that a cane-grower purchases his own mill. Very often the mill is let out along with the boiling plant. The rate of hire varies from 8 annas to Re. 1 per diem, and the average expenditure on this account has been estimated in different districts at from R9 to R30 per acre. The charge would no doubt vary according to the description and price of the mill and the yield of cane per acre, and also according as it is let out with the boiling plant or not.

The following description of the wooden-roller mill is taken from a note by Mr. E. Stack, Director of Agriculture in Assam, written in 1883:—

“The crushing mill (called *kherkha* in Goalpara and *hal* in Upper Assam) is a rude but tolerably effective machine, and a quicker and less dangerous worker than the heavy beam-and-pestle arrangement of Upper India. It consists of two vertical rollers (*bhim*) placed in juxtaposition, with their lower ends resting in a flat trough (*bhorai*) scooped in a solid and heavy block of wood (*toljoti*) resting on the ground, while their upper ends pass through a rectangular space cut in a horizontal beam above *borjoti* supported by uprights (*hol khota*) let through the lower block into the ground. The rollers are held in their places by vertical clamps (*ghara*) which grip them at the upper and lower ends, and are driven home by wedges (*khal*). The portions of the rollers which project the upper beam (*borjoti*) are grooved so as to work into each other on the principle of an endless screw. The driving power is a horizontal beam (*katari*) applied to the head of the taller or “male” roller (*matabhim*), upon which the shorter or female roller (*maiki bhim*) revolves in the contrary direction. The male roller is usually, if not invariably, that on the right hand as one faces the mill, and the direction of progress is from left to right, that is to say, the men at work walk round with the left shoulder inwards. The whole machine is made entirely of wood, without a nail or a piece of iron in its composition, and its value varies according to the kind of wood used. A mill can be built of tamarind wood for eight rupees, but in *jam* wood (*Eugenia jambolana*) it will cost twelve, and if *nahar* (*Mesua ferrea*) is used, as much as fifteen rupees.

“All being ready for crushing, the first thing the cultivator does is to bind two of the finest cane-stalks along the beam of the mill, as an offering to Viswakarma, the god of artificers. The canes are then passed through the mill in batches (*ana* or *kana*) of six or eight at a time, the juice falling into the trough, and thence through a hole on to a sloping wooden tray, which transmit it by a lip of plantain leaf to the earthen vessel placed to receive it in a pit dug below. In some places the tray (*roadhara*) is circular in shape, with a raised wooden edge and a funnel-shaped escapement for the juice, but usually a simple slab of wood, slightly concave, is considered sufficient. The working of the mill is accompanied by a loud and strident noise, which is welcomed by the raiyats as a sign that the rollers are biting well, and is moreover a cheerful and useful accompaniment while the work is carried on by night, as is the practice towards the end of the season when the heat of the day would be



injurious alike to the men and to the cane juice. Each handful of canes is passed through the mill three or four times until they begin to yield mere foam, where they are thrown aside, and a fresh batch take their place. *Mugi* and *pura* can squirt out their juice plentifully on the first compression, and give less afterwards, while the harder and tougher *teliya* passes through almost dry, and only begins to yield juice to the second squeeze. At the third and fourth crushings the flattened canes are usually twisted into a rope, so as to prevent a bulkier body for compression. A boy sitting in front of the mill draws them out as they pass through the rollers, and hands them back to the man who sits behind and feeds the mill. Four or five men drive the machine, resting their hands on the beam, and pushing against it with the chest and shoulders. The force required to put the mill in motion was ascertained in one experiment made by Mr. R. T. Greer, Subdivisional Officer of Golaghat, to be 5 to 6 lbs. without cane, and 40 lbs. with *mugi* cane between the rollers, but 60 lbs. with *teliya*. The rate of progress in crushing is about 2 maunds (165 lbs.) per hour. A good deal of trash and impurity-earth from the imperfectly cleaned canes, fragments of the stalk, dust carried by the wind, etc., enter the earthen pot along with the juice; in fact after a couple of hours work, mud can be plentifully scraped off the plantain-leaf lip of the tray, but the raiyats seldom trouble themselves to clean it. When the pot is full it is changed for another. As the work proceeds, the wedges holding the clamps have usually to be driven home from time to time, to counteract the tendency of the rollers to work asunder."

The wooden-roller mill is extensively used all over the Assam Valley except by the Nepalese cultivators, and it is also used by the indigenous cane-growers of Sylhet. It is also in use in the more backward parts of the Dacca and Chittagong districts.

The *ghani*, also called *kalhu*, is used in Noakhali and parts of the Dacca district. It is worked by bullocks in the same way as in crushing oilseeds. The canes are cut into two or more pieces to prepare them for the mill.

No experiments are known to have been made in Eastern Bengal and Assam to show the comparative yields of juice expressed by the different mills. The three-roller iron-mill is more effective than the two-roller. The District Engineer of Bangpur reports that with the softer varieties of cane the expression obtained by the three-roller mill may amount from 65 to 75 per cent. of the weight of the cane, while the two-roller may not be able to express more than 58 per cent. A very large number of experiments made in the Assam Valley during the 19 years from 1883-1884 to 1901-1902 gave an average expression of 47.48 lbs. of juice per 100 lbs. of cane with the wooden-roller mill used in that valley, and in some experiments as much as 60 per cent. of juice was obtained. The great majority of these experiments appear to have been made with the medium soft yellow *mugi* or *mag* cane of Assam.

Earthen pots are generally used for catching the juice as it comes out of the mill. Kerosine tins are now used in many places for this purpose, and brass and wooden pots are also occasionally used.

The juice is never kept longer than is necessary to get a sufficient quantity to fill the boiling pan. This would often mean a delay of four to six hours. The Nepalese cane-growers in Lakhimpur often allow the juice to stand over from 10 to 12 hours in winter and from 4 to 5 hours in the hot weather.

The juice is always strained when it is poured into the boiling pan, and in places also when issuing from the mill.

Special collecting pans are used only in the Assam Valley. The pan is a boat-shaped vessel scooped out of a log of wood. It stands at the edge of the boiling-house, a few yards removed from the mill, and sometimes contain leaves of the wild fig tree, which are supposed to be useful in keeping the juice sweet. The juice is transferred to the boiling pan when some 12 to 15 gallons have been collected. The vessel is never heated. In Eastern Bengal and Surma Valley, no special vessel is used for collecting the juice as it accumulates, but in some places, each pot or tin as it gets filled with juice is poured into the boiling pan, and the juice is kept simmering till the pan is full, when the full heat is applied, and the juice begins to boil.

Nowadays, shallow circular iron pans are used in many parts of the province in preference to the earthen pans which were universally used at one

time and which are still in use in the more backward parts of the province. It may be generally said that wherever the iron sugar-mill is in use, the shallow circular iron pan is in use as well. The two go together, and in many places they are let out together to the raiyats. Deep hemispherical earthen pans usually arranged in batteries of two, three or four, are still used in different parts of the province. In a few places brass or iron vessels of similar shape have taken the place of earthen pans. In Faridpur, there is an objection against the use of the iron evaporating pan. It is said to make the *gur* blackish and give it an acrid taste. The boiling plant used in Rangpur consists of a large circular iron vessel about 6 feet in diameter on the top and 3½ feet at the base, and 18 inches deep. It is used in conjunction with an iron *korha* of semicylindrical shape, 18 inches in diameter and divided into three equal compartments. In place of the iron *korha*, a battery of three earthen pans may be used, along with the large circular pan already described. When a large quantity of juice is to be boiled, two iron *korhas* or two batteries of three earthen vessels each may be used. The juice is at first put in the main boiling pan and heated for about half an hour. It is then removed to the three compartments of the iron *korha* in equal proportions, leaving about 10 to 12 seers in the main pan. When the juice in this pan is sufficiently concentrated, the contents of the nearest compartment (No. 1) of the iron *korha* are transferred back to the main pan in small quantities at a time, the juice from the second compartment being transferred to compartment No. 1, and that of No. 3 to No. 2 at the same time. This process goes on until all the juice from the iron *korha* has found its way back to the main pan. Near Dacca, the boiling pan is a semicylindrical iron vessel of the same shape as the iron *korah* of Rangpur, but it is not divided into compartments like the latter, and is used singly.

In the open thickly-peopled parts of the province, where wood is scarce, megass and trash form practically the only fuel used in boiling the juice. During the first day or two, other fuel would be necessary to make a start. In the Assam Valley, the hilly tracts of Sylhet, Noakhali and the Chittagong Hill Tracts megass or trash is seldom used, fuel being abundant in those parts. The use of megass or trash as manure is mentioned in none of the district reports. In many places, the trash is burnt on the land; it is never ploughed in as manure.

The scum which rises in the beginning of the boiling operation is everywhere removed, and it is either thrown away or given to cattle. The scum which rises in the later stages of boiling is skimmed off in most places, and is used generally for mixing with tobacco. In the Assam Valley, the cultivators are less careful in the matter of removing the scum.

Generally, the raiyats of Eastern Bengal and Assam do not use any substance for defœcating the juice. When *gur* of specially good quality is to be made, the juice is cleared by the addition of a little milk at the time of boiling. The use of lime has been reported from several places (Faridpur, Dacca, Rajshahi, Chittagong Hill Tracts, Sylhet and Nowgong), but its use cannot be said to be at all general. The difficulty in using lime is to ascertain the exact quantity which should be used, as the slightest excess turns the *gur* black. Soda and *khar* (impure carbonate of potash obtained by burning plantain leaves) are used in a few places for clarifying cane juice. In Nowgong *khar* and lime are used only in case of damaged canes to neutralize the excessive acidity of the juice. In Sylhet, the juice of *simul* bark (*Bombax malabaricum*) is occasionally used as defœcant. The juice of the *bhindi* plant (*Hibiscus esculentus*) is used for the same purpose in the Chittagong Hill Tracts.

The usual form of jaggery made in Eastern Bengal and Assam is the semi-liquid *gur* known in Bengal as *dând* (or crystal-mixed) *gur* and in Upper India as *râb*. Solid *gur* (called *dhima gur* in Rangpur) is prepared in certain localities; the *jaggery* is moulded into blocks or cakes of various shapes and sizes by being poured into pits dug in the ground and lined with sacking cloth or leaves or into pots or bamboo baskets of various shapes, and is taken out after it has cooled down into a solid mass. In certain parts of Sylhet a kind of *jaggery* called *lali* is prepared; it is more of a syrup than *gur*, and is either used as such or sold to wholesale traders who reboil it into the usual form of *gur*.

For ordinary *gur*, the correct point in boiling is ascertained by various means. The chief among these is the size and appearance of the bubbles which are known at different stages by different names. For instance, in Assam three stages are marked by the size and shape of the bubbles. These are vulgarly known as *ophulia*, *babori phulia* and *temi mulia*, implying that the bubbles in the first stage are as large as the fruit of the O tree (*Dillenia indica*), that is, about 3 inches in diameter; in the second stage they are more frequent and shrink to the size of the *babori* flower (*Chrysanthemum coronarium*, a pot herb); while in the final stage, they present a hollow in the centre and are thus compared to the little box (*temi*) in which the Assamese peasant carries his stock of lime for chewing with betel-nut.

There are other methods for ascertaining the correct point in boiling. A little *jaggery* is taken up with a stick; if it falls in drops, the *gur* is still too thin; on the contrary if it falls in a continuous line and the line after descending some way is drawn back towards the stick, the boiling is complete. Experts can tell the correct point by feeling a drop of *gur* between the fingers. If a little of the boiling mass is thrown into cold water and turns solid, instead of getting dissolved in the water, it implies that the *gur* has been sufficiently boiled.

The general practice is to cool the *jaggery* to some extent before it is transferred to the pots in which it is to be kept. In the Assam Valley, the liquid mass is received in a wooden vessel (*gholani*) about six feet long, and of the shape of a canoe with one end out square; it is stirred up with a Y-shaped instrument consisting of a triangle of bamboo fastened to the end of a stick (*hal bari* or *ghatani mar*). As the stirring continues, the liquid loses its dark brown colour, and assumes the hue and consistency of yellow mud. The process lasts half an hour. In those places where the shallow circular boiling pan is used, there is no special vessel for cooling the *jaggery* in. The pan is taken out of the fire, and the *jaggery* is stirred with a stick till the desired colour and consistency has been attained. Earthen and brass vessels are used in some parts for stirring and cooling the *jaggery*.

Semi-liquid and liquid *jaggery* are kept in earthen pots of various shapes and sizes. As a rule, no special care is taken to preserve *jaggery* beyond closing the mouths of the pots with earthen saucers and plastering them up with cowdung and mud. In Sylhet, solid *gur* is preserved by covering it with straw and plastering it over with cowdung and earth.

The usual price of *gur* in the different districts has been returned as follows. The figures denote the price per maund of 82½ lbs.

	Rs.
Rangpur . . . . .	4 to 8
Rajshahi . . . . .	4 „ 4-8
Dinajpur . . . . .	4 „ 5
Pabna . . . . .	4 „ 5
Dacca . . . . .	6 „ 7
Faridpur . . . . .	3 „ 5
Chittagong . . . . .	5 „ 8
Chittagong Hill Tracts . . . . .	4 „ 6
Tippera . . . . .	6
Calcutta . . . . .	4 „ 5
Sylhet . . . . .	3 „ 3-8 in Langai and Singla Valleys (same growing centres) and Rs. 4-8 elsewhere; <i>lati gur</i> Rs. 5.
Goalpara . . . . .	6-4 „ 10 (retail).
Kamrup . . . . .	5 „ 7-8 „
Nowgong . . . . .	4-6 „ 7-8 „
Lakhimpur . . . . .	2-8 „ 6-4

The prices will be found to vary within wide limits. *Jaggery* sells cheapest in the Dibrugarh subdivision of Lakhimpur, where sugarcane is cultivated on an extensive scale by Nepalese immigrants, and in the Langai and Singla Valleys of Sylhet and the northern parts of the Faridpur district.

Lakhimpur exports a large quantity of *jaggery* to different places in Assam. A great deal of *jaggery* is exported from Sylhet to Tippera, from Rangpur to Assam and different districts of Eastern Bengal and from Faridpur

to Dacca, Tippera and Bakarganj. Much of the *gur* consumed in the southern districts of Eastern Bengal is date *jaggery* imported from the Jessore district in Central Bengal. The high price of *jaggery* returned by some of the Assam districts is due to the fact that the article is usually sold retail by the cultivators and is seldom sold to wholesale dealers. The same may also be the case in other places.

There is no export of *jaggery* from Eastern Bengal and Assam to places outside the Province; on the contrary, a large quantity of *jaggery* as well as of refined sugar has to be imported annually from Bengal and the United Provinces to supplement local production, as will appear from the statistics quoted below.

For trade purposes, Assam and the transferred districts of Bengal, (*viz.*, Dacca, Rajshahi and Chittagong Divisions) have been hitherto considered as separate areas. The latter till recently formed part of Bengal and were included in three large trade blocks—Eastern Bengal, Northern Bengal, and Dacca—which covered, besides, a few districts of Bengal. The statistics of trade of these three blocks which will be quoted in this report should, therefore, be regarded as applicable to a somewhat larger area than the present sub-province of Eastern Bengal. They also exclude the trade by river between the blocks and the rest of Bengal (except Calcutta), which has never been registered. The plains districts of Assam are divided into three trade blocks—the Surma Valley, comprising the districts of Sylhet and Cachar, Upper Assam and Lower Assam, the last two comprising all the districts of the Assam Valley.

The average annual imports of raw sugar (*jaggery*) into the Assam Valley for the five years ending with 1905-1906 amounted to 101,409 maunds, out of which 78,467 maunds came from Bengal, and almost the whole of the rest from the United Provinces. During the same period, the imports of raw sugar into the Surma Valley amounted to an annual average of 225,330 maunds, all but 119 maunds of which came from Bengal. In these statistics, the imports from Bengal included those from Eastern Bengal, and there is no means to distinguish between the districts which now remain to the present Province of Bengal and the Eastern Bengal districts of this Province.

The imports of raw sugar into the three trade blocks of Eastern Bengal, Northern Bengal and Dacca amounted on the average of three years ending with 1904-1905 to 933,224 maunds, distributed as to their origin as below:—

	Mds.
Calcutta . . . . .	497,562
United Provinces . . . . .	246,105
Behar . . . . .	183,767
Rest of Bengal and other parts of India . . . . .	5,790
TOTAL . . . . .	933,224

The imports of refined sugar of country and foreign origin will be dealt with in paragraph 40.

38. *Profit and loss on sugarcane cultivation.*—The normal yields of *jaggery* per acre are given below for each district of Eastern Bengal and Assam. These have been obtained from the latest quinquennial return of normal yields of crops.

<i>Eastern Bengal—</i>	lbs.
Jalpaiguri . . . . .	2,000
Rangpur . . . . .	2,800
Dinajpur . . . . .	2,400
Malda . . . . .	2,800
Rajshahi . . . . .	2,400
Pabna . . . . .	2,800
Bogra . . . . .	2,400
Mymensingh . . . . .	2,400
Dacca . . . . .	2,400
Faridpur . . . . .	2,400
Bakarganj . . . . .	2,000
Tippera . . . . .	2,100
Noakhali . . . . .	2,400
Chittagong . . . . .	2,000

## Assam—

Cachar . . . . .	3,200
Sylhet . . . . .	2,400
Kamrup . . . . .	1,800
Darrang . . . . .	1,800
Newgong . . . . .	1,800
Sibsagar . . . . .	2,200
Lakhumpur . . . . .	2,400

The normal rate of yield in Eastern Bengal as a whole is taken at 22 cwt. or 2,464 lbs. per acre, and in Assam at 2,200 lbs. per acre. These are to be regarded as the normal or average yields of *jaggery*. Some of the district reports mention much higher yields, and although these have been reported as average yields, they no doubt represent the usual outturn that is expected from a good crop. Thus, the Collector of Faridpur gives 30 maunds of *jaggery* as the produce of one *bigha* or one-third of an acre, at Pangsa in the Goalundo subdivision and 24 maunds per *bigha* in the Sadr subdivision of his district. Calculated to the acre, these yields would amount respectively to 7,200 lbs. and 5,760 lbs., which are 3 and 2½ times as much as the accepted average for the district. The Superintendent of the Chittagong Hill Tracts returns the yield of one acre of cane at 100 maunds or 8,000 lbs. of *jaggery*. The area under sugarcane in that district is yet too small to affect the provincial average. From the Superintendent's report it would appear that the soil and climate of the district are eminently adapted to the cultivation of sugarcane.

Estimates have been received of the cost of cultivation, manufacture and outturn from several districts of the Province, but very few of these can be accepted as sufficiently trustworthy. With one or two exceptions, all the estimates are so far agreed that the cultivation of sugarcane leaves a handsome net profit to the cultivator. A few of the more carefully prepared estimates are quoted below:—

## At Pangsa in Faridpur.

Rent . . . . .	Rs. a. p.
Ploughing 12 times and harrowing . . . . .	3 12 0
Manure and cost of spreading it . . . . .	18 0 0
Seed cuttings, 15 <i>kahans</i> ( <i>kahan</i> =1,280) . . . . .	18 0 0
Cost of planting (36 men at 4 annas) . . . . .	39 0 0
After cultivation, including tying up . . . . .	9 0 0
	25 8 0
Total cost of cultivation . . . . .	118 4 0
Reaping and manufacture (inclusive of cattle) . . . . .	60 0 0
Other expenses . . . . .	6 0 0
Rent for mill . . . . .	9 0 0
Earthen jars . . . . .	6 0 0
Total cost of manufacture . . . . .	81 0 0
Grand total of cost . . . . .	194 4 0
Outturn: 90 maunds of <i>jaggery</i> at Rs. 3 . . . . .	270 0 0
Net profit [Rs.] . . . . .	75 12 0

## In the neighbourhood of Dacca City.

Rent . . . . .	Rs. a. p.
8 ploughings and harrowings . . . . .	3 12 0
Cost of manure (150 maunds of dung) . . . . .	15 0 0
Seed cuttings (19,500 at Rs. 2 per 1,000) . . . . .	7 8 0
Cost of planting cuttings in seed bed, making pits, trans-planting, and watering . . . . .	39 0 0
After cultivation and fencing . . . . .	27 0 0
	19 8 0
Total cost of cultivation . . . . .	111 12 0

	Rs. a. p.
Reaping (98 men) . . . . .	36 0 0
Hire of 3 pairs of bullocks for 9 days . . . . .	10 2 0
Fuel . . . . .	3 0 0
Hire of mill and pan for 9 days at 12 annas . . . . .	6 12 0
Quick lime . . . . .	0 3 0
Earthen pots . . . . .	7 8 0
Contingencies . . . . .	9 0 0
Total . . . . .	71 9 0
Grand total of cost . . . . .	138 5 0
Outturn 45 maunds of <i>gur</i> at Rs. 6 . . . . .	270 0 0
Net profit . . . . .	131 5 0

To this may be added another Rs. 30 from the sale of cuttings, after keeping enough for the raiyat's own field.

*In new alluvial soil in Rangpur.*

	Rs. a. p.
Rent of land . . . . .	3 12 0
12 ploughings with harrowings . . . . .	25 5 0
Cowdung 450 maunds Rs. 15, and cost of applying, 3½ men at 6 annas . . . . .	16 6 6
Seed cuttings, 7½ <i>kahans</i> ( <i>kahan</i> =1,280) at Rs. 4 . . . . .	30 0 0
Cost of seed beds, transplanting . . . . .	12 3 0
After cultivation (2 weedings, 2 ploughings filling up blanks, 4 tyings and 150 bamboos) . . . . .	50 10 0
Total cost of cultivation . . . . .	139 0 6
Harvesting and <i>gur</i> making, 105 men at 8 annas . . . . .	52 8 0
Fuel for first day . . . . .	3 0 0
33 earthen pots . . . . .	12 5 0
Hire of mill and bullocks . . . . .	30 0 0
Cost of clearing roots for next crop by ploughing . . . . .	8 7 0
Total cost of manufacture . . . . .	108 4 0
Grand total of cost . . . . .	245 4 6
Outturn 59 maunds at Rs. 5-5-8 . . . . .	315 0 0
Net profit . . . . .	69 11 6

In old alluvium the cost of cultivation is a little more, and the outturn is less, the net profit may be Rs. 45 to 50 per acre.

*In Tippera.*

	Rs. a. p.
Rent . . . . .	4 8 0
Seed cuttings . . . . .	40 0 0
Cowdung 36 cart loads . . . . .	12 0 0
8 ploughings, hoeings and weedings . . . . .	20 0 0
Fencing . . . . .	4 0 0
Total cost of cultivation . . . . .	80 8 0
Reaping and fetching home . . . . .	50 0 0
Cost of milling . . . . .	20 0 0
Earthen pots . . . . .	6 4 0
Total cost of manufacture . . . . .	76 4 0
Grand total of cost . . . . .	156 12 0
Outturn 35 maunds of <i>gur</i> at Rs. 6 . . . . .	210 0 0
Net profit . . . . .	53 4 0

To this may be added the income from the sale of cuttings, which is estimated at Rs. 60.

In the Dibrugarh sub-division of the Lakhimpur district, the cost of cultivation by Nepalese cane-growers per *pura* (1½ acres) is estimated as follows for three years in succession :—

	1st year.	2nd year.	3rd year.
	Rs. a. p.	Rs. p. a.	Rs. a. p.
<b>Cultivation—</b>			
Land revenue . . . . .	2 4 0	2 4 0	2 4 0
Jungle cutting (one month's wages of one labourer) . . . . .	12 0 0	...	...
Planting (ditto) . . . . .	12 0 0	...	...
Price of seed . . . . .	20 0 0	...	...
Weeding and hoeing 3 times (3 months' wages of one labourer) . . . . .	36 0 0	36 0 0	36 0 0
<b>Total . . . . .</b>	<b>82 4 0</b>	<b>58 4 0</b>	<b>58 4 0</b>
<b>Manufacture—</b>			
Labour for reaping, crushing and boiling (one month's wages for three labourers) . . . . .	36 0 0	36 0 0	36 0 0
Hire of mill, pan, and buffaloes . . . . .	15 0 0	15 0 0	15 0 0
Earthen pots . . . . .	6 0 0	16 0 0	16 0 0
<b>Total . . . . .</b>	<b>57 0 0</b>	<b>67 0 0</b>	<b>67 0 0</b>
<b>Grand total of cost . . . . .</b>	<b>139 4 0</b>	<b>105 4 0</b>	<b>105 4 0</b>

The total cost for the three years amounts to Rs. 349-12, or say Rs. 350. The outturn is estimated for the first year at 150 pots and for the second and third year at 400 pots each. Each pot holds from 6 to 8 seers of *gur* or say 7 seers in the average. The total outturn of *jaggery* in the three years, therefore, amounts to 166 maunds and the average price per pot being 12 annas, the total estimated income amounts to Rs. 712-8. Calculated to the acre, the cost of cultivation would be Rs. 119-1, and of manufacture Rs. 143-4 and the whole cost from commencement to end Rs. 362-5. The outturn of *jaggery* would be 712½ pots valued at Rs. 534-6, which would leave a net profit of Rs. 272-1 per acre in three years, or about Rs. 90 on the average per annum. During the first year of cultivation, there is a net loss, which is more than made up by the profit of the ratoon crop in the two following years.

The following is an abstract in round figures of the estimates quoted above :—

	Cost of cultivation per acre.	Cost of manufacture per acre.	Total cost per acre.	Yield per acre.	Value of yield per acre.	Net profit per acre.
1	2	3	4	5	6	7
	Rs.	Rs.	Rs.	Mds.	Rs.	Rs.
Faridpur (Fangsa) . . . . .	118	81	194	90	270	76
Dacca (near City) . . . . .	112	71	183	45	270	87
Bangpur (new alluvium) . . . . .	139	106	245	59	315	70
Tippera . . . . .	81	76	157	35	210	53
Lakhimpur (Dibrugarh, average of three years) . . . . .	40	48	88	42	178	90

Comparing the cost of cultivation and net profit in Dibrugarh with those of other districts, the extremely profitable character of cane cultivation in the virgin forest soil in that subdivision would be at once evident. But the system

of cultivation which the Nepalese pursue results in the wholesale destruction of forest, and it cannot be expected to continue for an indefinite time. The cost of cultivating forest land is so low that a few years ago *gur* was selling in the Dibrugarh market at such a low price as Rs 2-8 per maund. Unfortunately, the Nepalese cane-growers are in a state of chronic indebtedness to Marwari money-lenders who appropriate a large share of the profits that would otherwise remain to the cultivators.

39. *Character and richness of the juice.*—There is no analysis on record of the richness and purity of cane-juice in Eastern Bengal and Assam. In the experimental harvestings of sugarcane made in Assam during the nineteen years from 1883-84 to 1901-02 to which reference has been more than once made, the outturn of *jaggery* was found to average 8.42 per cent. on the weight of cane and 17.73 per cent. on the weight of juice. In some instances, 50 to 60 per cent. of juice and 10 to 13 per cent. of *jaggery* has been obtained from a given weight of cane, but these should be regarded as exceptional cases, and do not represent the sugar-yielding capabilities of the common cane of the Assam Valley.

40. *Sugar-making.*—Sugar is produced on a very small scale in Eastern Bengal and Assam. The only districts where it is known to be manufactured are Rangpur and Faridpur. The process of manufacture followed in Rangpur is as follows. The *jaggery* is mixed with water and boiled for an hour or so. The scum that arises is removed, and the concentrated mass is churned till it becomes reduced to powder. The resulting sugar (if sugar it can be called) is known as *bhura*. A better class of *bhura* is prepared by placing the *jaggery* in four bamboo baskets placed one above another and covering it with a kind of grass locally called *khar*. An earthen vessel is placed below to receive the treacle. After an interval of two days the *khar* is removed, and the sugar, which forms a coating an inch or so thick on the surface, is scraped off. Fresh *khar* is then placed on the exposed surface and the process repeated three or four times. The scraped mass is reboiled with water, the syrup being clarified with the help of milk; and when sufficiently thick it is churned into a powdery mass.

The process of manufacture followed in Faridpur is described in the following extract taken from Dr. Watt's Economic Dictionary :—

“The process of refining sugar is the same, whether it is obtained from the juice of the date or of the cane. Two modes of manufacturing sugar from *gur* are reported on. By the first method, the boiled juice in the form of *gur* is placed in stout gunny or sackcloth bags. The molasses or refuse is squeezed out partly by twisting and tightening the mouths of the bags and partly by laying weights upon them for additional pressure. The article thus produced is of a brownish colour. By far the largest quantity of sugar manufactured in the district, however, is prepared in a different way. The process, rather a cumbrous one, is as follows :—The *gur* is at first boiled with a certain proportion of water in a large iron vessel, a quantity of diluted milk being added from time to time to separate the impurities, which are skimmed off as soon as they form on the surface. When no more skim appears, the thickened liquor is poured into a number of circular earthen pots or strainers, made wide at the top and pointed below, with a hole in the centre, called *bharnis* and left for two or three days in the open air to cool. It is then removed to the refining house, where the final separation of the solid crystalline portion from the treacle is effected. The straining pots are generally arranged in rows on a bamboo frame at a certain height from the ground, and earthen pitchers are placed under each to receive the molasses as it slowly drains from the refining pot above. To complete the arrangement, as well as to quicken the operation, fresh moist leaves of a water weed called *pata saola* are now placed on the top of the refining pot, and as soon as a layer of sugar from one to two inches thick is formed at the top, it is removed by scraping with the knife, fresh weed being laid on the remainder, and the same tedious process is repeated several times until the entire quantity of sugar is made. The native confectioner makes extensive use of this sugar for the purposes of his art; but before it is fit for use, it has to be clarified again by further boiling with the addition of a solution of milk as in the last process. When this is allowed to cool, it forms a hard crust which requires to be broken and pounded before it can be



employed. The molasses which drains off from the sugar in the process is employed for preparing *hooka* tobacco, inferior sorts of sweetmeats, etc., and the rest is sold for making country rum."

There is no sugar factory in Eastern Bengal and Assam which is equipped with modern machinery, if we leave out of consideration the few sugarcane farms in Chittagong and Sibsagar, where steam-power mills are employed in crushing the cane. Very little information is available about these farms or about the exact character of the machinery employed. The Barpathar farm in the Sibsagar district grows cane for its own mill and does not purchase any from the neighbouring raiyats. The same is probably the case with the cane-planters in Chittagong. *Jaggery* is the only product produced in these farms.

Two old rum or sugar factories existed many years ago at Gauhati and at Dobapara in the Goalpara District. Nothing is known at this day of their history or of the cause of their failure. The efforts of Mr. Herriot, who owned the factory at Gauhati, to introduce a better kind of cane were so far successful that the best cane of the present day in Kamrup and Darrang traces its origin to them. There also existed in the eighties two rum factories near Golaghat and Dibrugarh. Situated as they were in the centre of thickly-peopled tracts, these factories stimulated the production of cane considerably within the limited area on which they drew for their supplies of *jaggery*.

The crushing of oilseeds, cotton-ginning and rice-husking are industries which can be suitably carried on in a sugar factory during the season when the machinery would have to remain idle.

We might get an answer to the question as to what price the raiyat will be willing to accept for his canes placed at the factory door from a consideration of the cost of production and the profit which he can reasonably expect therefrom. The cost of transport to the factory should also be taken into consideration. We may assume that the yield of *jaggery* is 10 per cent. on the weight of cane, and that the raiyat would expect 20 per cent. on the cost of cultivation as his profit (besides being remunerated for his own labour). The cost of transport would vary with the distance from the field to the factory. Taking the average distance to be (say) 3 miles, the cost of conveyance by cart may amount to about an anna per maund. Now, if we turn back to the estimates of cost of cultivation quoted in paragraph 38, we may calculate the cost of a ton of cane as below:—

	Yield of cane (ten times <i>jaggery</i> ).	Cost of cultivation.	Add 20 per cent. for profit.	Add cost of transport at one anna per maund.	Total cost.	Cost per ton (27½ mds.)
	Mds.	Rs.	Rs.	Rs.	Rs.	Rs. a.
Faridpur . . .	900=33 tons	113	23	56	192	5 13
Dacca . . .	450=16½ "	112	22	28	162	9 13
Rangpur . . .	590=21½ "	139	28	37	204	9 7
Tippera . . .	350=12½ "	81	16	22	119	9 5
Lakhimpur . . .	420=15½ "	40	8	26	74	4 12

The cost of a ton of cane would then seem to vary from about Rs. 5 to about Rs. 10. Whether it would pay a factor to pay for cane at the lowest of these prices is a question to which it is not possible to give an answer without knowing the cost of manufacture in a factory. The Agricultural Department does not possess any data on the subject. The cost of cultivation can no doubt be reduced to a considerable extent by improved cultivation; and it may not be too sanguine to expect that in favourable conditions a raiyat should be able to deliver cane at the factory door at Rs. 4 or even less per ton. If people could take their canes to a factory, and dispose of it there at a rate which would leave them a fair margin of profit, many persons who are now deterred by the cost and trouble involved in the crushing of sugarcane and the manufacture of *jaggery* would be induced to engage in the cultivation of sugarcane. The great majority of raiyats keep barely enough cattle to cultivate their holdings, and

cannot spare any for the crushing of sugarcane. Central mills, where the cane would be crushed by steam-power, are expected, therefore, to be popular, once the raiyats are persuaded to sell their canes instead of making *jaggery* for themselves.

There are several classes of refined sugar imported into the Province. These are (1) country sugar, which comes mainly from the United Provinces and Behar and is ordinarily known as Benares sugar, (2) foreign sugar imported through Calcutta, (3) country date sugar from Central Bengal, and (4) Cossipore sugar from the Cossipore sugar factory near Calcutta.

The average annual imports of refined sugar into Assam during the five years ending with 1905-1906 amounted to 80,514 maunds; out of this quantity, 59,387 maunds came from Calcutta; and 6,725 maunds (Benares sugar) came from the United Provinces.

The three trade blocks already mentioned, in which Eastern Bengal is included, imported 565,264 maunds of refined sugar annually on the average of the three years ending with 1904-1905. Out of this quantity 508,680 maunds, or almost 90 per cent was obtained from Calcutta. The balance of the imports was, for the most part, Benares sugar from the United Provinces and Behar.

It is not possible to ascertain the countries from which the sugar imported from Calcutta into Eastern Bengal and Assam was derived, but presumably the bulk of these imports was of foreign origin. It appears from a perusal of the Bengal Customs Reports that the countervailing duties on bounty-fed sugar imposed by Act XIV of 1899 had no visible effect on the importation of sugar from the continental countries of Europe. But it received a serious check when additional duties were imposed in 1902 to meet what is known as the cartel system. While the imports of beet sugar have greatly fallen off in recent years as the effect of these duties, those of cane sugar have steadily increased and more than made up the decrease in the imports of beet sugar. The bulk of the cane sugar imported into Calcutta comes now from Java, which has thrown every other sugar-producing country in the shade in the Calcutta market. *Pari passu* with the increasing imports, the price of imported sugar has fallen, with the result that the imports of sugar from Calcutta into the interior of the country have greatly increased in recent years, as will appear from the statistics of price and imports quoted below:—

*Refined Sugar.*

	Imports into Calcutta by sea.	Average price per cwt.	Imports from Calcutta into Assam.	Imports from Calcutta into Eastern Bengal and Assam.	
	Cwt.	Rs. a. p.	Mds.	Mds.	
1896-1897	483,500	11 3 1	36,644	Not available.	
1897-1898	1,063,878	11 4 5	41,475		
1898-1899	989,925	11 12 1	54,385		
1899-1900	750,965	10 13 1	33,973		
1900-1901	1,340,844	11 2 7	56,126		
1901-1902	1,514,727	10 2 10	41,506		
1902-1903	1,506,623	9 0 8	54,603		420,793
1903-1904	1,876,965	9 5 5	63,422		575,910
1904-1905	2,107,460	9 7 6	60,628		529,336
1905-1906	.....	.....	78,977		.....

PART IV.

IMPROVEMENTS.

Mr. Barber has suggested the various directions in which improvements may be effected. These are briefly considered below.

*First introduction of new varieties of canes.*—Any effort to introduce new varieties should necessarily be preceded by an investigation of their merits. It will be necessary to study their field, milling and chemical characters. A research of this kind can only be successfully carried out on a properly-equipped experimental station conducted on the same lines as the

sugarcane stations in the West Indies, under the control of the Imperial Commissioner of Agriculture and the Samalkota Farm in Madras. An experimental station to be devoted mainly to the sugarcane crop has been recently started at Jorhat in the Assam Valley, and it will be one of its main objects to investigate the merits of the indigenous varieties of cane and of new varieties imported from abroad.

*Secondly, more careful attention to the details of cultivation.*—Not much improvement is to be expected under the existing conditions of the country, so far as the tillage of the land and the after treatment of the crop are concerned. There is no doubt that the cultivation of sugarcane as practised in Eastern Bengal and Assam can be improved in many respects, but the general apathy of the agriculturists and the low standard of agriculture current in the province stand in the way. The use of rape-cake as a profitable manure for sugarcane appears to be known in most districts, and although it is available everywhere, it is but seldom used except in a few localities such as Sylhet. The reason why a manure so readily available is not used as widely as it could be is not quite clear. If it be that the raiyats are too poor to purchase the manure, the problem should be one which the rural Co-operative Credit Societies now being established might well take in hand. But it seems the real reason is not poverty, but is to be found in the fact that the cultivation of sugarcane in Eastern Bengal and Assam, though it may be less careful than in other parts of India, is still found to be so profitable that the cultivators have no stimulus to improve their methods.

Mention has been made of several large sugarcane farms in Chittagong and Shibsagar. The cultivation of these farms is decidedly less careful than what obtains among the cultivators. These farms consist of land newly reclaimed from jungle, and do not demand an intensive cultivation. But sooner or later the owners will have to adopt improved methods of cultivation if they intend to continue growing cane on the same land.

*Thirdly, increased facilities for irrigation.*—Not much is to be expected in this direction in Eastern Bengal and Assam. Most parts of the Province are sufficiently damp to be able to dispense with irrigation altogether. The old alluvium tracts in Northern Bengal and Dacca may be benefited by irrigation, but where so much land needing no irrigation is available, it is hardly to be expected that these tracts will be preferred for sugarcane cultivation. It is possible that the old alluvium soil is more suitable for sugarcane than the ordinary alluvial and deltaic soils of the country, and may pay better under an intensive system of cultivation than the latter. But the point is one on which no opinion can be expressed without a critical study of the methods and results of sugarcane cultivation in the two classes of soil.

*Fourthly, improvements in the manufacture of jaggery or gur.*—The quality of jaggery can certainly be improved, and by means which are well within the power of the raiyats. Jaggery of excellent quality is prepared at the Burdwan and Sibpur Experimental Farms. The same appliances as are used by the neighbouring cultivators are used, but attention is paid to a few simple details about which the raiyats are as a rule careless. The juice is received in pots, which are cleaned and sweetened every day; and as soon as the pot is full, the juice is poured into the boiling pan and kept sufficiently hot to prevent fermentation until the full charge has been collected. The pan used is of iron and of the shallow circular type now used in many parts of Bengal. The pan is so placed over the fire that its outer six inches or so projects beyond the furnace, the object being to prevent the burning of the jaggery as it thickens in the pan. After the juice has been clarified and the first scum that rises has been removed, the boiling is pushed on as fast as possible. This simple method, which entails no additional cost, can be further improved by defecating the juice with the help of such substances as soda and the mucilaginous extract obtained by crushing the stems of the *bhindi* plant.

But unfortunately the raiyats are too slow to change their methods. The jaggery they produce is sufficiently good to meet the taste of the consumers. No general improvement is, therefore, to be expected until the public have acquired a taste for a better product.

It is doubtful whether refined sugar can be prepared on a large scale from country-made jaggery so as to be able to compete with imported cane and beet

sugar in the open market. The products of the Cossipore Sugar Factory do not enter into competition with imported sugar. The factory caters for a select class of customers, and has after all a very limited market. If India is to compete successfully with foreign countries in her own market, she should be able to produce sugar direct out of the cane. *Jaggery* has a very large market of its own, and its price is governed by causes other than the demand for it for refining purposes. Hence it will never be safe for a refinery to depend for its raw material on country *jaggery* if it has to compete with the outside world. It is said the Cossipore Sugar Factory has of late been using raw sugar from Java as being cheaper than the country product.

*Fifthly, introduction of small plants for sugar-making.*—The questions mooted by Mr. Barber are such that no opinion can be expressed without a minute study of the system of sugar manufacture followed in modern factories.

B. C. BASU,

*Assistant Director of Agriculture.*

SHILLONG.

*The 28th January 1907.*

## APPENDIX.

## Varieties of Sugar-cane.

District.	Local name of variety.	Description.
1	2	3
Dacca . . . . .	<i>Khagra</i> . . . . .	White hard rind. Rich in sugar, is grown for <i>gur</i> .
	<i>Deahi</i> or <i>Normi</i> . . . . .	Looks like <i>khagri</i> , but is thicker and softer, not so rich as <i>khari</i> , but produces better <i>gur</i> .
	<i>White Bombay</i> or <i>Gandari</i> (chewing cane). . . . .	Rind very soft; internodes long; very sweet to the taste, and is used generally for chewing purposes; yields also very good <i>gur</i> .
	<i>Sharong</i> . . . . .	Very soft rind; internodes long, tallest and thickest; rich in juice and best for chewing purposes.
	<i>Kajli</i> . . . . .	Deep violet, with very hard rind; not liable to attacks of wild animals.
Bakarganj . . . . .	<i>Ikri</i> . . . . .	Ash-coloured, with hard rind; rich in sucrose; good for making <i>gur</i> ; not liable to attacks of wild animals.
	<i>Khagri</i> . . . . .	Very hard canes of reddish yellow colour; good for <i>gur</i> ; resists disease, and not liable to attacks of jackals.
	<i>Bombai</i> or <i>Turpen Nara</i> . . . . .	Yellow, with soft rind; juice poor in sucrose. Red; rich in sucrose; liable to disease and attacks of wild animals.
	<i>Kajla</i> . . . . .	<i>Pinkish</i> cane; poor in sucrose.
Fardpur . . . . .	<i>Dhalsundar</i> . . . . .	White with a reddish tinge.
	<i>Kajla</i> . . . . .	Deep purple, with hard rind; can stand stagnant water; makes good <i>gur</i> .
	<i>Khala</i> or <i>Lata</i> . . . . .	Yellow, with a shade of purple; hard and thin; too hard for jackals and white-ants; can stand stagnant water.
	<i>Choona</i> . . . . .	Yellow; thinner than <i>khala</i> ; <i>gur</i> produced is black.
	<i>Khagri</i> . . . . .	Reddish with hard rind; not liable to disease; produces good <i>gur</i> .
	<i>Ikri</i> . . . . .	Yellow, can stand 8 feet water
Chittagong . . . . .	<i>Bombay</i> . . . . .	White; grows thick and very tall; a chewing variety.
	<i>Chewing cane</i> . . . . .	Soft rind.
Tippera . . . . .	<i>Khari</i> . . . . .	Hard rind; grown for <i>gur</i> -making.
	<i>Khagra</i> . . . . .	Greenish white; hard rind.
	<i>Bombay</i> . . . . .	Red; soft rind.
	<i>Dhalsundar</i> . . . . .	White, with dark blotches; hard rind; richest in juice.
Rajshahi . . . . .	<i>Kajli</i> . . . . .	Red hard rind, richest in sucrose.
	<i>Khari</i> . . . . .	Reddish brown; thinner than <i>Khagra</i> ; soft rind, rich in juice and is grown for <i>gur</i> -making.
	<i>Khagra</i> . . . . .	Dark colour, hard rind; rich in juice, and is grown for <i>gur</i> -making.
	<i>Bombay</i> . . . . .	Purple; chewing cane; poor in sucrose.

## APPENDIX—continued.

District.	Local name of variety.	Description.
1	2	3
Dinajpur	<i>Sakaban</i>	Reddish ; very soft rind ; rich in juice.
	<i>Patasi or Kajli</i>	Deep purple with dark tinge ; hard rind ; not subject to attacks of wild animals.
	<i>Kheri</i>	Ash coloured ; softer than <i>Patasi</i> .
	<i>Moogi</i>	Pale brown ; soft rind ; rich in juice.
	<i>Basna</i>	Greyish ; hard rind ; poor in juice.
Bogra	<i>Bhelan Mukhi</i>	Reddish white ; cultivated for <i>gur</i> .
	<i>Bombai</i>	Yellow ; grown for chewing.
Pabna	<i>Dhalsunder</i>	White.
	<i>Kajla</i>	Red.
	<i>Khatia</i>	Ashy.
Malda	Chewing cane	Red.
	Chewing cane	White.
	<i>Khagri</i>	Greenish yellow.
Rangpur	<i>Venda Mukhi</i>	Yellowish brown ; soft rind and tall ; gives high class of <i>gur</i> .
	<i>Kajli</i>	Purple ; harder than <i>Venda mukhi</i>
	<i>Kheri</i>	Thin and tall ; hard rind ; very rich in sugar and is grown for <i>gur</i> -making.
	<i>Mugi Malei</i>	White ; hard rind ; poor in sugar.
	<i>Samras</i>	A small variety, with short internodes.
	<i>Sakaban</i>	Red, with violet tinge, soft rind ; tallest and thickest, used for chewing.
Assam Valley Districts.	<i>Bagi</i>	White ; soft and juicy ; grows 7 feet long and the canes measure a little more than an inch in diameter ; makes good <i>jaggery</i> .
	<i>Mugi or Mag</i>	Amber colour ; otherwise same as <i>Bagi</i> .
	<i>Rangi</i>	Deep red ; hard and thin ; 5' or 6' high and $\frac{1}{2}$ in diameter ; hardy.
	<i>Kais or Teliya</i>	
	<i>Bangala or Bambo or Bam (Bombai cane)</i>	Red or yellow ; soft and juicy, grows 8' long and $1\frac{1}{4}$ " in thickness. An imported variety.
		Juice poorer than the preceding varieties, and cane apt to break into small pieces in crushing ; cultivated as a garden plant and eaten as chewing cane.
	<i>Asmaiya or Ketekipura</i>	A degenerate variety of <i>Bangala</i> or <i>Bombai</i> cane.
	<i>Malaha Mahla, Magora, Megala or Majara (reed cane)</i>	Hard, thin and dry. Requires no protection from beasts.
	<i>Bhabeli</i>	Resembles <i>Mugi</i> , but with shorter internodes.
	<i>Kamraugi</i>	A cross between <i>Mugi</i> and <i>Teliya</i> .
Manipur	<i>Tekhao-chu</i> (Assam-cane)	White, but sometimes violet. Soft, juicy and tall.
	<i>Chu-nagang</i>	Red, harder and thinner, and less juicy than <i>Tekhao-chu</i> .
	<i>Awa</i>	Yellow ; softer and larger than <i>Chu-nagang</i> ; introduced from Burma.
	<i>Chunagaw</i>	White, with soft rind, and is the softest variety.
	<i>Haucha</i>	White, harder than <i>Chunagaw</i> .

## BARODA STATE.

The cultivation of sugar-cane varies greatly in the different districts three distinct kinds of cultivation being practised in the Baroda, Naosari, and, Amreli Divisions of the State. Even within the districts, minor differences in practice are noticeable due to variations in soils.

*Baroda District.*

2. The average rainfall in Baroda is 30 inches distributed in one monsoon period from June to September. The average temperature is 50° mean minimum of January and 107° mean maximum of May, and the atmosphere is generally dry for the greater portion of the year.

3. The cultivation is practised from ancient times and no recent introduction of cane has been heard of in any part.

4. The area under sugar-cane was being gradually reduced even before the great famine of 1899-1900, but the reduction has been heavy since the famine which has reduced the capital of cultivators and the waters in wells, and increased the attack of white-ants. The area in 1905-06 was 128 acres against 724 acres before the famine.

The cultivation of cane is fairly intensive and takes its place in regular rotations. The soil is alluvial of a rather sandy character. In the preparation and manuring of land, in the adoption of the system of rotation, in the selection of seed and in the system of irrigation, cultivators seem very well up.

5 & 6. Only a red hardy variety of cane is generally grown, the full grown cane is 8 to 12 feet long and has a diameter of 1½ to 2 inches. It has a hard rind and is moderately juicy. It stands the ravages of jackals, grubs, borers, &c., better than white canes which were tried by people in various places on account of their superior qualities, and given up as unsuitable.

7. At times sports have been found, e.g., a whitish colour was found in red canes in isolated places, but no attempt seems to have been made to multiply them. Similarly inflorescence does appear in canes at times and seeds are formed from it, but in trials by some curious cultivators, the seed has failed to germinate.

8. No sugar is made in the district, jaggery (*gur*) of a very superior kind being made from the cane. Sorghum has been tried and given up as the jaggery produced was too sticky and dark. No spirit is made in the district from the jaggery as the Mahua flower (*Brassica*) is an abundant and cheap source for the manufacture of spirit. A syrup made from these flowers is also used in mixing with tobacco for the *hukkah*.

*Cultivation.*

9. The planting season lasts one month from the beginning of the bright half of *Vaisakh*, that is, the month of May. The earlier in the month of May, the better, as hot moist climate which conduces to good development, prevails at the time. Planting before and after May is not considered good.

The harvesting season lasts about 7 weeks from the first week of February to the end of March. If cut later, the people think that the jaggery will be very liquid. Labour is dear at the reaping time, but if cut early, the cold season interferes with the formation of jaggery. At this time labour is employed in cotton picking, watching castor, *tur*, etc.

10. The following rotation is generally practised:—

- (1) Fallow, with rabi castor or brinjals at very wide intervals to allow of repeated ploughings; or a green manuring crop of *san* (only lately introduced).
- (2) Sugar-cane.
- (3) *Kodra* mixture, including *tur*, *til* and *sheria*.
- (4) *Bajri* mixture, including *mug*, *math* and other pulses.
- (5) *Kodra* mixture.
- (6) *Bajri* mixture followed by fallow.

So sugar-cane comes again after the 6th year and it is not considered good practice to take another irrigated crop in the interval.

The cane is never rotated with rice and attempts to grow it in *Kyari* land have failed, resulting in stunted growth of the cane on account of these lands being lowlying and water-logged. In the cane field no catch crops are taken and no mixed cropping is practised. People grow *tur*, castor, *cal* and other vegetables of the cucurbitaceæ order on the outskirts to utilize the moisture, but they never grow sorghum as a trap crop, for moth borer Maize as a trap crop has recently been introduced since last year and efforts are being made to extend the practice.

11. Ratoon is never practised probably on account of the white-ants and other diseases.

12. Before setting-in of the monsoon, previous to the cane crop, about 25 tons of well rotted cattle manure per acre are applied to the land and ploughings begin with the first fall of rain. Sheep folding is also practised if available. In all 20 or 22 ploughings with the indigenous plough are given while the land is kept fallow throughout the rainy season and the winter, wide intervals being left between the plants of the fallow crop for this purpose.

13. On removal of the fallow crop, the land is well ploughed and made even, furrows and ridges are formed, and beds are made. Each bed contains at least 4 ridges and is 12' x 10' each. Water is then allowed to pass in the furrows, and soon after sets of cane each having 3 eyes are put in the furrows in a line and pressed with the foot nearly 4 to 5 inches deep. Each furrow contains nearly 10 sets.

14. As there is an intervening period of from 2 to 2½ months between harvesting and planting in the middle of the hot season, the canes intended for seed have to be kept standing and irrigated. On this account it has been the practice of some villages to grow cane only for seed and all the others buy the seed from them. There is also a belief that seed brought from a place where well water is a little saltish gives a good yield. The result most often is that a man has to buy even diseased seed or go without it.

15. Sets from all parts of these standover canes are used, those from the middle portion being considered the best. The rooting lower portion of the cane is rejected and there is no special belief one way or the other about tops.

16. No solutions are used for dipping the sets against diseases; people do not seem to believe in such preventives.

17. The number of sets per acre for planting is from 18,000 to 22,000 sets, each having 3 eyes. 20,000 is considered average, more sets being planted in poorer and less in better class of soils.

18. Planting in rows is considered better as it facilitates digging between the rows. The distance between the individual sets is generally from 4 to 6 inches and the distance between the rows themselves nearly one foot. The planting and reaping seasons are not at the same time as said before, and the depth to which the sets are put is nearly 4 inches. The soil is light and free and does not retain moisture for more than 5 to 6 days. Again at the time of planting the weather is very hot and withering of the sets is possible if planted less than 4 inches deep.

19. Ryots are not in the habit of supplying vacancies and do not consider it feasible as no sets can be preserved for more than 4 to 6 days. The practices of keeping extra sets in pits or of planting the outskirts too thickly are unknown.

20. The system of making seed beds for canes is unknown here as there is no uncertainty as regards the supply of water.

21. Stool-planting is not practised and has never been known to be practicable.

22. Irrigation is the all-important item in the cultivation of cane. When people think that the supply of the underground current of water may be weakened they never attempt the cultivation. The only mode of irrigation is from wells by native methods of using leather *Kos* and rope. People understand the superiority of using oil-engines in preference to *Kos* and an individual or two have set up the plant on their wells, but the initial investment is too great to venture and the supply of water in many of the wells is not sufficient for a full day's pumping. Cane is irrigated every 6th day except in the four months of the rainy season, when, if the rain holds off for more



than 8 days at a time, the cane requires watering. Cane lands being sandy no draining is necessary.

23 The object of the after-cultivation are to destroy weeds and to conserve moisture. In a period of 2 to 3 months the canes shade the ground and the after-cultivation ceases. Cane crop is weeded 20 days after planting and after putting castor-cake top dressing (1,000 lbs.), the whole field is dug with a spade. Again after 15 days the above-mentioned processes are repeated. Thus 4 to 5 weedings and as many diggings with a country spade are given in 2 to 3 months' time. After the canes have reached 4 feet high permanent furrows and ridges are made and nothing is done after that except giving waterings at regular intervals. The process of weeding is of course very deep and thorough.

24. The system of manuring has already been explained. The essential idea is not only to apply well rotted manure, but to give it time enough for a thorough mixing with the soil and oxidation, &c., as a safety from white-ants which are believed to be fond of fresh manure. The place of artificial manures is taken by castor-cake which is applied in two top dressings of thousand lbs. each. The cake is broken into rough powder and it is either applied plant by plant or put in bags and placed in the water channel. The water easily dissolves it and distributes it evenly. Trash is burnt after the crop is removed and believed to remove the ill-effects of the heavy irrigation and to act as a manure for the next crop in the rotation.

Manurial experiments:—Manurial experiments carried out for several years with locally available manures have shown that an application of 20 cart-loads of dry night soil per acre can well replace 25 tons of farmyard manure and 2,000 lbs. of castor-cake. Experiments with artificial manures are now in progress.

25. Stripping of old leaves does not exist as it is believed to scorch the canes and expose them to the attacks of jackals.

The practice of tying the canes with lower leaves is prevalent instead, as that is believed to prevent the canes from falling and lodging and affords some safety against jackals.

Another method resorted to for guarding against animals is to build a mud wall all round the plantation. But this is done only by careful cultivators in places where few other cane fields exist. People are too religious to kill them.

26. Watering the cane crop just before cutting is universally prevalent.

It tends to increase the quantity of juice and withholding water before cutting is said to spoil *gur* and make it sticky.

36. The yield of cane in Baroda is from 50,000 to 60,000 lbs. per acre and the yield of jaggery is from 6,000 to 7,000 lbs. per acre.

#### *Naosari District.*

The cultivation of cane in the Naosari District is the best in the whole State. It is intensive and the people seem to possess a good knowledge of the cultivation of cane and the manufacture of *gur*.

2. The average rainfall in Naosari is 43 inches, distributed in one monsoon period from June to September. The average temperature is 47° mean minimum of January and 102° mean maximum of May and the atmosphere is warm moist with sea-breezes.

The cultivation is practised from ancient times and no recent introduction has been heard of in any part.

4. As in Baroda Division, the area under cane has been considerably reduced since the last famine and the subsequent bad years. The capital of the cultivators has been greatly reduced and the water in wells has gone low and in some cases turned saltish. The area in 1905-06 was 1,044 acres against 1,704 acres before the famine.

The cultivation is not uniform. In some parts, for instance, cane is rotated with rice and is grown in *Kyari* land having embankments, and where cane of a particular variety called Malbary which stands water-logging to some extent is grown. In others, other varieties of cane as Khajuri, Rati, &c., are grown in ordinary black soil called *Talia* land having no embankments, where cane is rotated with *fur*, castor, beans, &c., which will be considered later on. This

*Talia* land is a loam of a rather clayey nature and retains moisture splendidly.

5. The following varieties of cane are grown :—

- (1) *Malbari*—a white variety with plenty of juice.
- (2) *Kajuri* or *Surti*—also a white variety but moderately juicy.
- (3) *Bati* or red variety moderately juicy.

There are sub-divisions of *Bati* as *Kali Jadi* having a darker appearance, *Kharedi* having stripes, *Goli* having a lighter colour, and *Bati* proper.

(4) *Vansi*—white, very thin, hard, and with little juice.

People having very humble means and thus not affording money for seed of superior variety of cane grow *Vansi*—the poorest variety.

*Gandi Sherdi* is another variety of *Vansi*. There is a cane called *Masi* which is believed to be poisonous. When small-pox prevails, some low caste people dedicate it to the goddess to cure the sick. This cane is only found grown in the courtyards of houses of lower people.

Of all these canes, *Khajuri* is the softest and *Vansi* the hardest.

6. *Malbari* cane was introduced some 75 years ago from Bassein and it is believed to be an original Mauritius variety. This variety is taller, thicker, heavier and produces a more abundant crop than all the rest. But it has since been deteriorated both in weight and juice. However it is still considered best amongst all the varieties mentioned above.

No cases have been reported of local canes having been exported.

7. The varieties named *Kharedia* or *phus-bhuri* having stripes and *Kali Jadi* are believed to be sports from the red variety. In cane fields flowers do appear at times, but no seeds are formed and hence no seedlings.

8. The State tried to produce sugar in a sugar factory and the results have been noted under manufacture. People used to manufacture spirit from flowers of *Mahua* tree (*Brassica*) and from the scum of boiled juice, but these practices have ceased to exist since the manufacture of spirit has been considered illegal.

#### *Cultivation.*

9. The planting season begins soon after the rains have ceased and it lasts for two months, October and November, and should cease when cold season begins to set in.

The reaping time lasts for 8 weeks, from the beginning of October to the end of November, and lasts up to the end of January for late varieties. Thus eleven months are believed to be sufficient for ripening. But this period differs with different varieties of cane; thus *Malbari* ripens first, then comes *Bati*—red variety and next comes *Khajuri* and lastly comes *Vansi* in maturity. *Bati*, *Khajuri* and *Vansi* can stand for 12 or 13 months, not so the *Malbari*. At the reaping time labour is dear, being employed in cutting rice, grass, *Kodra*, &c. It runs as high as 6 annas a day with food and little of cane juice.

10. The following rotation is generally practised in *Kyari* lands :—

- (1.) Sugar-cane after rice is cut.
- (2.) Rice in the rainy season and beans (*Val*) in the Rabi season.
- (3.) Do. do. do. do.
- (4.) Do. do. do. do.

So sugar-cane comes on the 5th year again and the land gets manure every year.

In other lands the following rotation is practised :—

- (1) Sugar-cane.
- (2) *Tur* and coarse rice.
- (3) *San* and after ploughing in the *San* plants, castor and beans as *Rabi* crops.
- (4) *Udid* and *san* ploughed up.

So sugar-cane comes again on the 5th year. The cane field is manured in the year in which *San* and *Udid* are grown.

People thoroughly understand the value of *San*, *Tur*, *Udid* being leguminous plants in the rotation and of the green-dressing of *San* and *Udid*. No irrigated crop is taken in the interval. Tobacco is sometimes grown as a catch crop in the beginning, but this is considered bad practice. People grow vege-

tables of the cucurbitaceæ order on the outskirts to utilize the moisture, but they never grow sorghum as a trap crop.

11. Batoon is generally not practised and in some trials by cultivators the resulting crop had been a failure, the plants having been withered.

12. In *Kyar* land, manure is applied every year. In the cane year, after the rice is cut, nearly 10 ploughings with the native plough are given and the land is made level with the *samar*.

In the *Talia* land previous to the cane crop, about 25 tons of well rotted cattle manure per acre are applied in the month of May and ploughings begin with the first fall of rain. Sheep folding is also practised if possible. In all, 20 ploughings and in some places even 25 ploughings are given and a crop of *San* and *Udid* is sown. After it has reached some height it is ploughed up and the land is made thoroughly even. It is believed that the greater the number of ploughings, the lesser the amount of irrigation required. People know the value of tank-mud and put it on the land whenever they can.

13, 14 & 15. After bringing the land in good heart, whole canes are planted with a very heavy plough called *Nangar* drawn by from 6 to 8 bullocks. By this plough, canes are laid in the soil fairly deep, *viz.*, 6 to 9 inches. The bullocks are driven in a circle round the field and canes are laid underground in concentric furrows. Three to four men drive the bullocks according as the number of bullocks are (6 or 8); one man passes the canes in the tube in the *Nangar* and one man hands over the canes to the former. Thus in the planting operation 5 to 6 men are employed.

Whenever the crop is without diseases, people are in the habit of keeping a portion for seed. Otherwise they purchase seed from the neighbourhood. This is easy as harvesting and planting are practically done at the same time. Tops are not considered good for seed.

16. The people do not seem to believe in dipping the canes in any solution against diseases.

17 & 18. The number of canes used as seed for one acre is 1,750 whole canes having the length of 6 cubits each. If the canes are longer or shorter, the number varies accordingly. Generally speaking there is a tendency to plant too many rather than too few. People prefer whole canes to sets as they want to plant them deep in the moist under soil and save irrigation for at least 2 months after planting.

19. If vacancies occur, canes of inferior quality which can be had a month after planting are planted by hand. Seed canes are planted within 2 days after cutting.

20. Seed beds or nursery are not in vogue.

21. Stool planting is not practised and has never been known to be practicable.

22. Irrigation is necessary but more or less according to the nature of the soil and the ploughings given to it. The crop is irrigated either from wells or tanks. The soil is very retentive and not many waterings are needed. Thus in certain lands on the banks of rivers where cane fields are kept fallow a whole year before planting and ploughed throughout to conserve moisture, the first watering is given three months after planting and in all 5 to 6 waterings only are given. No watering in the monsoon and after the rains have ceased, one more watering before harvesting is given. At other places 10 to 12 waterings in *Kyari* land and 15 to 20 in *Talia* land are needed. The water in wells is not plenty and no oil-engine will get work for a full day's pumping. Two oil-engines with pumps have been set up by people on rivers and water is pumped for sugar irrigation for the owners' fields as well as sold to neighbours.

23. The object of the after cultivation is to conserve moisture. No weeding is done, as there are few weeds.

Nearly 20 to 25 days after planting, land is ploughed keeping the share shallow so as not to touch the canes below with a view to loosen the surface. Another month after, the land is dug and watered. Such diggings and waterings continue till the following June when they cease with the arrival of monsoons. The objects of digging between furrows are to keep down weeds, to loosen the surface and to cut the surface roots of the cane.

24. The system of manuring has already been explained. The essential idea is not only to apply well rotted manure, but to give it time for a thorough

mixing with the soil. The practice of green-dressing with *san* is universal and the place of artificial manure is taken up by castor-cake. People are not very particular about giving cake, and in *Talia* soil many people do not put it. Whenever it is applied, it is given at the rate of 1,600 lbs. per acre and in monsoon only with a watering. It is believed to stimulate the growth of cane and to kill white-ants. People believe that the application of cake is a safety against water-logging.

25. The practice of burning trash exists but no green-dressing after the canes are planted.

Stripping of old leaves does not exist as it is believed to scorch the canes and expose them to the attacks of jackals.

Similarly, canes are not tied and neither bamboo nor any other thing is used as a precaution against lodging or for straightening. A hedge of castor plants and thorns is made round the field and the fence is covered with fisherman's net against jackals and other wild animals. In the centre of field, a raised platform is made and a figure resembling a man with a bow and arrow is erected upon it to frighten the animals. *Vansi* has a very hard rind and is not touched by jackals, so it is planted round the field as a protection for the main crop. Some men hire the services of some low class people who keep hounds and thus get the jackals destroyed. Beating of drum is also practised, but is of no avail.

When the canes are very young, rabbits destroy the shoots and a watchman is kept throughout night with fire by his side.

26. Cane is watered 8 to 12 days before cutting as watering cane immediately before cutting is believed to make *gur* sticky and increase the cost of fuel.

36. The yield of cane in Naosari is from 45,000 to 60,000 lbs. and of jaggery is from 5,600 to 7,000 lbs.

#### *Amreli Division.*

The cultivation of cane in the Amreli Division of the Baroda State comes last in importance from all the rest.

2. The average rainfall is only 20 inches distributed in one monsoon period from June to September. The average temperature is 60° minimum and 107° maximum and the mean is 89°. The atmosphere is warm for the greater portion of the year tempered with sea breezes.

3. The cultivation of cane is known from ancient times and no recent introduction has been heard of in any part.

4. The area under sugar-cane was being gradually reduced even before the great famine, but the reduction has been heavy since the famine which has reduced the capital of cultivators and the water in wells and increased the attacks of white-ants. The area in 1905-06 was 150 acres against 934 acres before the famine. The cultivation of cane comes only once in 12 years and the crop is irrigated from wells. The cane soil is dark coloured and is fairly deep derived from Kathiawar trap rock.

5. Two varieties of cane are cultivated, one red variety with hard rind and the other white variety with soft rind. The white variety is richer in juice and yields more *gur*. However white cane is not much planted as its seed is very costly and requires a richer soil and wants more irrigation. Of the white variety there are two kinds:—*Dhokadiya* thick and having short internodes, and *Vansada*, having long and thin internodes. Of these two, *Dhokadiya* is considered higher as it weighs more and produces more *gur* than *Vansada*.

A good white cane weighs from 10 to 20 lbs. each and the red one from 5 to 7 lbs. each.

6. It is believed that the white variety of cane has been introduced some 100 years ago from Mahua port in Bhavnagar territory, but ultimately from the Konkan coast. This white variety is spreading but the red variety, though poor, will not disappear as it is believed that a soil upon which the white variety has been once grown will not produce sugar-cane next time until after 25 to 50 years, as it is very exhausting.

7. Sports have been found in canes. Sometimes stripes of yellowish or white colour have been found in red cane. In white canes though no change

of colour is visible the internodes become smaller. Such sports are believed to be sweeter than the original canes.

Similarly, flowers have appeared on individual plants of the white variety but no seeds are formed and consequently no seedlings have resulted.

8. In the District no Sorghum nor palm nor any other plant are used for making *gur*.

Similarly no spirit has ever been produced from the scum or any other thing. The whole tract is treeless and hence palm or Brassica are few there. Beet was once grown by a curious cultivator, seeds having been supplied by the Department. According to his opinion the roots were large and well developed but no attempt could be made to make sugar out of it.

#### Cultivation.

9. The planting season begins after the cold season is over and it lasts for one month in the whole of March. The harvesting season lasts about six weeks from the middle of January to the whole of February. At the harvesting season, labour is dear as cotton picking and wheat cutting are in progress. The white cane ripens a bit earlier, say a fortnight. If allowed to stand longer it would be hollow and the *gur* will be decreased.

10. The following rotation is generally practised :-

Sugar-cane.  
*Bajro* and *Mug*.  
 Cotton and *Udid*.  
*Jowar* and *Mug*.  
*Bajro* and *Mug*.  
 Cotton and *Udid*.  
*Jowar* and *Mug*.  
*Bajro* and *Mug*.  
 Cotton and *Udid*.  
*Jowar* and *Mug*.  
*Bajro* and *Mug*.

Fallow with *tii* ploughed up in September.

Thus sugar-cane comes again after 12 years, and no irrigated crop is taken in the interval. But as said before, white sugar-cane is not grown on the same soil except after a very long period, say 25 to 50 years. Cane is never rotated with paddy. *Mug* is sown broadcast and then cane is planted. This is considered a good practice, as *Mug* plants are considered a protection of the cane against sun. *Mug* plants are not dug up in the soil but are cut up and fed to bullocks and the roots allowed to rot in the ground.

On the outskirts castor and vegetables of the cucurbitaceæ order are grown to utilize the moisture. Similarly *okras*, *guar*, watermelon, &c., are grown on the water channels for green vegetables, but sorghum as a trap crop is never grown. There is a practice of sowing *Bajri* along with *Mug* with a belief that *Bajri* plants will act as a preventive against rabbits who will eat them as they are soonest out.

11. Ratoon is not practised. It is believed to be unprofitable as the resulting crop is much attacked by diseases and there is a good deal of foliage and not much of cane stem.

12. The land is kept fallow and ploughed throughout the year. In all, 20 to 25 ploughings are given. With the arrival of the rains, *tii* is sown and ploughed up in September. The plough is used in the hot and cold seasons, while in the rainy season only *karab* is used.

No manure is used except just before planting the cane sets. There are cases where people do not keep the land fallow, and after removing the monsoon crop, the land is ploughed 4 to 6 times and cane is planted though on a small scale. The soil can be ploughed at any time and no puddling is necessary. Manure is put on the soil after the land is well ploughed and ready for planting canes. Nearly 30 tons of cattle manure or village manure along with, are applied to the land. Sheep folding is practised wherever practicable. As people are in the habit of burning cattle dung owing to scarcity of firewood, it is largely replaced by village manure which is of a very poor quality.

13. When the land is well ploughed and made level, beds are formed and manure is put and spread on the top of the beds. Then the beds are filled up to the brim with water and one man standing in the beds with cane sets, each having three eyes, in a banging cloth behind his back, throws the sets in two rows at a time and presses them with his feet alternately. He tries to throw sets in rows judging by the eye but generally the sets are not in perfect line as is the case in Baroda. The rows are one foot apart.

14 & 15. Cane takes nearly 11 months to ripen and sometimes crushing and planting are carried on simultaneously. Whenever this is the case, tops and lower portions are set apart for planting as they are considered bad for making jaggery, and the rest of the canes are crushed. As a practice, a portion of the crop is kept apart for planting and the rest is crushed. Whenever one month elapses between planting and crushing all parts of the cane are used for seed, but as said above, tops and lower portions are preferred when both the processes are carried on at the same time.

16. No solutions are used for dipping the sets against diseases. People do not seem to have heard of such practices.

17. The number of sets per acre is from 20,000 to 25,000, more sets being planted in poorer and less in better class of soils. The sets are pressed some 6 inches deep as sets pressed less deep are liable to wither.

18. Vacancies are never supplied, and canes are never kept purposely but planted soon. In an emergency, however, 8 to 10 days elapse before cut canes are planted. In such cases canes are kept in shade and water is sprinkled over them.

20. The system of making seed beds for cane is unknown as there is no uncertainty as regards supply of water.

21. Stools are not planted but they are considered good for planting.

22. Irrigation is the most important point in cane cultivation. When it is feared that the supply of underground water is weak, people do not attempt the cultivation. The usual mode of irrigation is from wells by *Sundhia Kos* and rope. Since leather became very dear after the famine, a kind of iron bucket locally manufactured has been introduced and an iron bucket with a leather trunk is considered the best. In the southern part of the District, the Persian wheel is used. Irrigation is continuous throughout the period of growth every 8 to 10 days, except when it is actually raining. The rainfall being small, a day after the rain ceases the crop is irrigated. The land is naturally drained. Oil engines have in no place replaced the *Kos*, as the wells generally are small.

23. No digging or hoeing is attempted or is possible as the sets are not in perfect line. In all, 4 weedings and stirrings of the soil with a *Khurpi* are done after *mug* plants are cut up in June, and up to September when the cane shades the ground and weeding is impossible.

*Bajri* plants which are planted as a protection against rabbits are taken off in April.

24. The system of manuring has already been explained. As cattle dung is burnt as fuel, as is to be expected in a treeless country, village manure generally of a very inferior kind is used. Unlike the system in other places, manure is spread on the ground after the thorough cultivation is finished. The place of artificial manure is taken by castor cake. It is not always that castor cake is applied, but when the crop looks poor and yellow, it is applied as a top dressing only once in September at the rate of 500 lbs. per acre.

25. No practice exists to burn trash and no green dressing applied after planting. The catch crops are taken off in June and July.

The stripping of old leaves does not exist as they are considered a protection against wild animals. The disease called 'salo'—insect boring into the stem—is believed to increase its attacks by stripping the leaves. The practice of tying the canes with lower leaves is prevalent instead, as that is believed to prevent the canes from falling and lodging and thus from putting adventitious roots. No bamboos are used to support the canes, but several canes are tied up together by a string.

26. The practice of guarding the canes against jackals and other wild animals are :—

- (1) Bamboo trellis is made round the cane crop and the thorns of *bor* (*kusuba*) are put round it.

- (2) People engage the services of *Vaghari*, Mahomedans, &c., who keep hounds to kill them. These *Vaghari*s put a pot in which pieces of bread and *gur* are put in the run of jackals and when they come they are destroyed. This latter practice is not very general.
- (3) Beating of tin boxes is practised, but to no purpose.
- In spite of these expedients the damage done is very great.

*Paragraph Nos. 27 to 35 are common to all the districts.*

27. The cultivation of cane is not only expensive but is considered to be most risky due to various diseases.
28. Diseases affecting sets—  
White ants destroy them and jackals eat them up.
29. Diseases affecting the whole plant—  
*Kasdo*—the growth is arrested and the cane turned into a tuft of leaves. This is rare and occurs in poorly manured fields of low class cultivators.  
*Koylo*—This is a fungus disease, as a result of which the top turns into a black powdery mass.  
*Ratdo*—Red rust.  
Borer.
30. Diseases affecting the underground parts—  
A large white little grub over an inch in length and with an orange red colour.  
White ants.  
Root parasite—called *agio*.
31. Diseases affecting the stem—  
Mealy bugs.
32. Diseases affecting the leaves—  
Weavils, flea beetles, some caterpillars and scale insects (*mashis*), the last being the most important.
33. *Harvesting*.—When the rind gets yellowish and the top leaves concentrated and tufted the cane is considered to be ripe for cutting.
34. Cut and striped canes are not allowed to remain uncrushed for more than a few hours, and people know that the juice becomes acrid if cut cane is kept uncrushed for a longer period.
35. The cane is cut very low, a little below the ground, with a hand *khurpi*, the roots, leaves and tops being removed at the same time.
36. The yield of cane is from 40,000 to 60,000 lbs. and of jaggery is from 5,000 to 7,000 lbs.

*Manufacture.*

37. *Mills*.—In Baroda two roller wooden mills are used. The rollers are over a foot in diameter and have corresponding screws in the top part for motion. In Nacsari wooden rollers are being gradually replaced by three roller iron mills of Poona type, the rollers being placed side by side. The cane is fed between rollers 1 and 2 from one side and fed for repressing between 2 and 3 from the other side. In Amreli two roller wooden mills are used but the rollers are thinner and larger than the Baroda rollers and there is a greater space between the rollers necessitating repressing a greater number of times.

The percentage of juice to cane varies so much between cane and cane and also among the roller mills of the same type that no general average can be given.

The juice is collected in a large round earthen pot wider at the top than the bottom. This pot is sunk in the ground near the mill in Baroda and Amreli and beyond the bullock run in Naosari. The juice passes through a bamboo sieve into this pot. The pot is big enough to hold juice for one charge of the boiling pan which averages 50 to 60 gallons.

The juice is not kept standing for any length of time, but removed to the boiling pan by *chattis*. The removal of juice gives time for changing bullocks and rest to the workers at the mill and after a little more rest the crushing begins again. Crushing cane for one charge takes a little less time than boiling and the work is continuous. The juice is poured into the iron pan through a basket which serves the purpose of straining.

The boiling pans are shallow, evaporating pans about 7 inches deep in Baroda and Amreli and a little deeper in Naosari.

Megass is used everywhere for fuel but it is not quite enough and it has to be supplemented by tamarind twigs and *tur* stalks in Baroda and by thick *Jowar* stalks in Amreli and Naosari.

The juice is not allowed to boil till the scum comes up. The scum is then removed and the fire increased. During boiling also any little scum that may come up is removed. In Baroda the scum is thrown into the oven. In Naosari it was formerly used in making spirit for the labourers, but is now thrown away as spirit making is now illegal, while in Amreli it forms part of bullocks' feed. Fine white ash is used for cleaning the juice in Baroda and ash and Soda-bicarbonate are used in Naosari and Amreli. Liming is not done in any part.

The correct point for striking a pan is determined by taking a little of the mass between fingers and drawing out the threads. Cooling iron pans are used in all places. The boiling mass is removed to these pans and worked for a time with flat wooden ladles till it is sufficiently cool and consolidated. In Baroda round pits are made in the ground each large enough to hold the full charge of a pan. The pit is lined by a piece of cloth and the mass thrown in and covered over. The jaggery settles hard in a day and is removed. The weight varies with the quality of the cane and juice from 60 to 100 lbs.

In Amreli the boiling is a little harder than in Baroda and the mass is removed from the cooling pan on to a *leaped* floor and divided into small masses of about 6 to 10 lbs. each, and worked into shape by hand. In Naosari, the pan is struck a little softer and after working in the cooling pan the jaggery is poured into earthen pots which are covered over and sealed.

These are the forms in which the jaggery is put on the market. In Baroda and Amreli, it is sold by weight of jaggery while in Naosari by weight of the full pot, and a fixed deduction is made on account of the pot. On account of this system, pots are being manufactured with a very heavy bottom.

No process of preservation is either used or necessary as the jaggery in these forms can be kept without deterioration.

The prices realised by the cultivator vary from Rs. 7 to 10 per pucca maund in Baroda, Rs. 6 to 9 in Amreli, and Rs. 4 to 5 with pots in Naosari, one-sixth being deducted for the pot while it may actually weigh into a third.

The markets being usually fully stocked according to requirements, there are no heavy fluctuations in bazar prices.

In Baroda, local jaggery is the heaviest priced lot; it is not enough to meet the demand and jaggery is imported from Naosari, Poona, Sangali and Cawnpore.

In Amreli also the local demand is higher than the supply and jaggery is imported from Naosari and Cawnpore.

Naosari exports jaggery to Gujarat and Kathiawar and even to Bombay in addition to supplying local demand.

The pots for export are weighed by professional weighers and the weight scratched on the pots by nails. This weight is accepted wherever the jaggery goes and whole pots change hands.



33. The following is the profit and loss account on sugar-cane cultivation:—

*Expenditure per Bingha.*

	Rs.	As.	P.
20 ploughings, a pair of bullocks and one ploughman, one rupee per day . . . . .	20	0	0
10 <i>Karabing</i> . . . . .	10	0	0
Manure-cartage and spreading 15 tons . . . . .	22	8	0
Ridging, making water channels, beds, &c., one bullock and six men at 4 annas each . . . . .	2	0	0
Castor cake, 1,200lbs. . . . .	15	0	0
Value of sets . . . . .	30	0	0
Carrying sets and planting them, 4 bullocks per 6 annas and 6 men per 4 annas each . . . . .	3	0	0
Hand weeding 6 times, 10 labourers each time at 2½ annas each . . . . .	9	6	0
Digging 4 times, 4 men each time at 4 annas each . . . . .	4	0	0
Putting castor cake plant by plant 2 times, 2 men at 4 annas each . . . . .	1	0	0
Making new furrows and ridges once, 3 men at 4 annas each . . . . .	0	12	0
Tying canes once . . . . .	2	0	0
For crushing and cutting canes, 13 men at 4 annas each and 6 pairs of bullocks at 8 annas a pair for 15 days . . . . .	93	12	0
Hire of cane-crushing mill and pans . . . . .	7	8	0
Fuel . . . . .	10	0	0
Irrigation from wells for 6 to 7 months when there is no rain, four waterings each month, five men and four bullocks . . . . .	70	0	0
TOTAL . . . . .	300	14	0

So there is expenditure of nearly Rs. 300 per bingha and Rs. 525 per acre. We get from 150 to 175 maunds of *gur* (maund=40 lbs.) per acre and one maund fetches Rs. 4 to 5, consequently the income from one acre is from Rs. 600 to 900.

39. No careful analysis has been made of the canes and juice but the variation in the quality of the juice can be gauged to some extent by the pan results in Baroda, where the same volume of juice, *viz.*, 55 gallons from the same variety of cane gives in different fields and even in different parts of the same field, *gur* varying from 60 to 100 lbs.

40. *Sugar-making*.—No native process of manufacturing is in vogue in any part of the State. The central factory system was introduced in Gundevi in the Naosari District by the State, where cane was brought from the cultivators and sugar made direct. This however did not pay and refining of palm jaggery had been added. The factory has recently been sold and it is being re-arranged for working sugar-cane in the season and refining palm jaggery throughout the year. The failure of coarse jaggery to compete with palm jaggery for refining purposes is probably due more to its first cost than a smaller percentage of crystallizable sugar. Palm jaggery can be brought from all the way from Malbar and carried in the factory at Rs. 100 per ton against Rs. 120 to 150 per ton, the price of local jaggery.

*Imported sugar*.—Three kinds of sugar are imported, beet, Mauritius and Java cane, and Bengal dabhota (*khand*). The first which is cheapest is used for all general purposes, the second for sweets in which milk forms a part, and the last which is the dearest is used for sweet balls at large caste dinners. All crystal sugar is locally called *Morus* (Mauritius) and although it is believed to be not so sweet as dabhota or jaggery it is slowly gaining ground on account of its cheapness.

*Improvements.*

Direction of improvements.

*Manuring*.—Some cheaper manuring that would give an equal effect and release the local manure for other crops.

*Irrigation*.—This forms the largest part of the improvement in sugar-cane cultivation.

*Seed.*—In the Baroda District seed difficulty is great and some system of preserving cut seed for two months without deterioration will not only save the cost of seed but also check a great lot of diseases which come with the sets.

RAOJIBHAI B. PATEL, M.B.A.C.,

—*Director of Agriculture.*

## APPENDIX I.

## PAPERS ON VETERINARY MATTERS.

## SUMMARY OF OPINIONS RECEIVED FROM VARIOUS OFFICERS.

*Curtailment of grazing grounds.*

Lieutenant-Colonel Raymond says :—

I have consulted the District Officers of Bengal and their reports go to show that the curtailment of grazing lands has taken place, more or less, in almost all the districts of this Province. This is attributed chiefly to the extension of cultivation due to the gradual increase of population and partly to other minor causes—such as construction of railways and dwelling-houses, encroachment of lands by mill-owners and brick-manufacturers, etc. Some District Officers report that the curtailment of grazing lands has caused deterioration of the cattle, while others report that, although a certain amount of grazing lands has been utilised for other purposes, there is still sufficient waste land for grazing purposes. In some districts sufficient pasture lands have been set apart during the settlement operations and protected by law against encroachment, while in others they are not diminishing owing to the gradual decrease in population of recent years, and are not likely to diminish much in extent in the immediate future. Little or no land has been absorbed by the extension of irrigation work. The Conservator of Forests, Bengal, reports that there has been practically no change in grazing arrangements in the Bengal forests for over 20 years, and there is nothing to show that the forests which are now closed to grazing were ever largely used for that purpose, or that their closure has affected one way or another the breeding of cattle. The Deputy Commissioner of Darjeeling, on the other hand, contradicts this statement by saying that his district appears to be eminently fitted to illustrate in a striking manner the gradual tendency of the Forest Department to bring, within its reserve, lands which hitherto afforded sufficient space for cattle to graze on.

None of the District Officers have been able to state definitely to what extent the grazing lands have been curtailed during the last 20 years and what encroachment is likely to take place in future. It is, however, apparent that there is a general tendency towards the encroachment of grazing lands and it is probable that it will continue if steps are not taken to check it.

The measures suggested by the District Officers for the preservation or extension of grazing lands are—

- (i) The reservation of existing grazing lands by legislation.
- (ii) Owners to be prohibited from leasing out their grazing lands to the tenants for crops.
- (iii) The zamindars and land-holders to see that a fair share of their land is always preserved for grazing purposes.
- (iv) The existing grazing lands should be demarcated and the Local Officers should be directed to report further encroachment, which must be disallowed. Also a register of existing grazing lands might be maintained in the district and sub-divisional offices.
- (v) The preservation of lands for pasturage may be effected through the agency of the new Chaukidari Union System by reserving lands for a convenient group of villages, if Government gives the power to do so by some legal enactment.
- (vi) Reafforestation by the Forest Department.

My own opinion is (Lieutenant Colonel Raymond's):—

That encroachment in Bengal of grazing land proceeds steadily owing mainly to an equally steady increase of population and to the demands of commerce; the absorption of grazing land is inevitable, but may be regulated,

retarded and controlled by carefully considered legislation. If, however, the population continues to increase, grazing, except on a small scale and on fallow land between crops, is doomed, for it must give way ultimately to land hunger.

There is yet time to work out remedies and I think they will be found in the study by the Agricultural Societies of forage crops and the simplest method of storage of forage. I am inclined to suggest that these subjects as well as the further consideration of legislation are perhaps ripe for systematic study in Bengal.

The subject of water-supply in very dry seasons appears to be an important one.

United Provinces. For the purpose of this enquiry the provinces fall into three divisions, the submontane districts, Bundelkhand, and the rest.

In Bundelkhand, cultivation has contracted during the last 20 years, while the grazing-grounds of the breeding-tracts consist either of ravine-systems (which tend naturally to extend), or of hill sides and valleys which are not suitable for cultivation. There is therefore no question as regards this tract.

The rest of the provinces show no extension of cultivation during the last 20 years. There was not then, and there is not now, any breeding industry in them. People who can afford it keep cows for milk and the male progeny is reared for field-work; but the extraordinary diversity of the type of cows renders it practically impossible to do anything to help this form of breeding. In this tract there are, with local exceptions, no regular grazing-grounds; the extensive barren plains are used as exercise-grounds, but by December any grass that may have grown is usually grazed off, and for six or seven months they afford no feed at all.

In the remaining tract (submontane), considerable curtailment of the grazing-grounds is undoubtedly in progress. It is not due to canals, as none exist, while the additions to forest area during the period specified are immaterial. It is the normal result of the progress of the country; the land is almost entirely in private hands and its owners find that cultivation pays better than grazing.

The question of securing sufficient grazing land to save the great breeding industry in these tracts has at my instance been referred to a small committee for enquiry during the present cold weather. Pending their report, it is unnecessary to say anything further on this point.

Mr. Oliver, Officiating Superintendent, Civil Veterinary Department, submits a detailed report on this subject as affecting each important district. From which it will be observed that of 38 districts reported on, it is said that although the cultivated area has increased, no noticeable decrease of grazing grounds has taken place in 22 districts, nor are the cattle reported to have suffered.

But in the remaining 16 districts, the reduction in the area of pasturage has told severely on the cattle.

Bombay  
Presidency.

Mr. Hewlett, Superintendent, Civil Veterinary Department, Bombay, states that as regards grazing grounds the conditions of the Presidency vary in different parts. In Gujrat there is no flow irrigation and no lands reserved by the Forest Department other than genuine forest areas—the Godhra forests, for instance. Grazing grounds are, at present, adequate in the Ahmedabad district—as well as in the districts of Broach and Surat. In the Konkan, including Thana, Kolaba and Ratnagiri, there has been no curtailment of grazing grounds, which is amply sufficient. In the Karnatak, Belgaum, Bijapur, Dharwar and Kanara districts some diminution has taken place in the last 20 years by waste lands—formerly used for grazing—having been brought under cultivation. In the Deccan there is but little grazing. The majority of land is under cultivation and affords very little grazing of any description after the middle of November. In parts of Khandesh there is still ample grazing as also in the vicinity of the Ghats. In Nasik, the grazing area has diminished and is likely to diminish still more, in the future owing to keen competition for waste lands for cultivation purposes. In Ahmednagar, Poona, Sholapur and Satara there has been little or no diminution of grazing grounds.

Is of opinion that the Forest Department is in the best position to arrange for the conservation of grazing areas, by preserving their Kurans and forests, as far as possible, for grazing purposes, and not with the object of attempting to grow forests where none have existed and where the more valuable varieties of timber cannot be grown. Some of the grazing grounds belonging to the Forest Department are sold, for grazing purposes, by public auction. Mr. Hewlett thinks that, if possible, this system should be discontinued as it introduces the middleman. Suggests that either the Forest Department collect grazing fees of 2 to 4 annas from cattle owners, or, if this is not practicable, to give the villagers of the villages adjoining the Kurans, &c., preference at the auction sales.

Mr. Hewlett is of opinion that except a few favourable localities, the majority of districts in the Bombay Presidency are not specially suited for cattle breeding.

In Sind, large areas of land have been, are being, and will be brought under flow irrigation; but as these areas were, more or less, waterless deserts, their being brought under the plough will not effect pasturage for cattle. Reservation by the Forest Department has not caused diminution of grazing grounds as the Forest areas are available for grazing on payment of a small fee.

Sind, Baluchistan  
and Rajputana.

Fodder crops are the main feeding stuffs of Sind cattle; therefore increased irrigation and consequent increased yield of fodder crops makes up amply for any diminution of grazing areas.

In Baluchistan there are 234 square miles of reserved forests, of which 69 square miles are available for grazing. In some districts, the diminution of grazing grounds is severely felt by the people, especially in the Quetta District.

In Ajmer-Merwara, (Rajputana) grazing grounds are stated to be sufficient if the rains are good. There has been no increase of forest reserve for the last 20 years, and no encroachment on grazing grounds by cultivation.

Mr. Hewlett states he is not sufficiently acquainted with the districts to warrant his offering an opinion or making any suggestions.

The Collector of Sukkur (Sind) informs Mr. Hewlett that the want of suitable grazing grounds is leading to a deterioration in the stamp of camels bred in Sind. Increased irrigation has brought under cultivation much land that was formerly waste and on which any number of camels could graze without restriction.

Captain Walker submits copies of correspondence with the Director of Land Records and Agriculture, and the Conservator of Forests, and states that the curtailment of grazing grounds during the last 20 years has been great; but has been counterbalanced to some slight extent, by the extension of forests. Recommends for each group of villages, a certain forest reserve, and the grazing rights of these areas to be held by the villages concerned under the usual payment of fees.

Punjab.

From Major Evans' report as well as from its enclosures, it appears that there is no curtailment of grazing grounds in Burma. Necessary grazing grounds have been provided and demarcated and the boundaries, from time to time, are verified. Persons found encroaching are prosecuted and ejected.

Burma.

#### THE PROVISION OF FODDER IN TIMES OF FAMINES.

Lieutenant-Colonel Raymond says:—

Fodder-famine is of rare occurrence in this province. As far as I can see from the Famine Reports of 1873-74, 1896 and 1897, there was never any great difficulty about fodder, as there was enough to feed the cattle with a reduced allowance. The proposals for the provision of fodder, in times of famine, laid down in Chapter XV of the Bengal Famine Code, appear to be sufficient (copy below). The storage of forage in years of bumper crops would, no doubt, render great help in times of famine.

Bengal.

251. *General.*—It may be noted, as a matter of general experience, that, where possible, it is far more effective to bring fodder to cattle than to take cattle to fodder, and that to keep cattle in a village helps to keep the inhabitants of the village together.

252. *Growth of fodder crops.*—When, therefore, fodder-famine is imminent, liberal advances should be given to the cultivators, with a view to the construction of temporary wells for the growth of fodder crops. The influence of land-owners and others may also be usefully employed, with the object of stimulating the growth of such crops.

253. *Importation of fodder.*—The importation of fodder and other food-stuffs, such as cake, shall be left mainly to private enterprise; but the District Officer shall—

- (a) assist private enterprise by publishing the fact that fodder is wanted in any tract;
- (b) give liberal advances for the purchase of fodder; and
- (c) report to the Local Government for orders any case in which he thinks the State should guarantee the sale of fodder imported.

254. *Report to Local Government.*—When a fodder-famine is imminent in any district, the District Officer shall report the matter, through the Commissioner, to the Local Government, which may, if it thinks that this course is desirable, order that the provisions of the four following sections of this chapter shall be applied.

255. *Levy of fees for grazing in State pasturages.*—In a fodder-famine the preservation of agricultural cattle is a matter of far greater importance than any revenue which might be obtained from grazing fees levied on account of the admission of cattle to State pasturages. If, therefore, such fees are levied at all, they should be imposed on administrative grounds, and not as a source of income.

256. *General principles.*—Areas in which grazing is ordinarily permitted should be thrown open to free grazing, and areas which are ordinarily closed to grazing should be reserved for the supply of grass for export. It may be necessary to supplement the latter by reserving portions of the former areas for grass-cutting; or it may be possible to throw open portions of the latter at once, when the supply is in excess of the demand for export. But, the needs of local cattle being provided for, the supply of grass for export should be the first consideration. When the grass has been cut from the areas thus reserved, they also may be thrown open to free grazing, if necessary. Browsers should not be admitted without payment to any areas which contain forest growth of any importance and should in no case be admitted to areas ordinarily closed to grazing. No grazing should ever be allowed in areas under plantation or regeneration, unless the trees are old enough to be safe from attack.

257. *Restrictions.*—If it is found that cattle are resorting to a State pasturage in numbers greatly exceeding its grazing capacity, it may become absolutely necessary to limit their number. This may be done by restricting admission to cattle of villages in the immediate vicinity of a forest, such villages having the first claims upon its pasture.

258. *Fees to be levied in special cases.*—The cattle of professional graziers and cattle-breeders may properly be charged for grazing, even when agricultural cattle are admitted free.

259. *Cattle Camps.*—When a fodder-famine is severe, a cattle camp may, with the previous sanction of the Local Government, be instituted in each district under veterinary supervision. Only selected cows and a few selected bulls shall be accommodated in the camps, the chief object of which is to preserve valuable breeds. The District Officer may, if he considers this desirable, purchase the cattle admitted to the camp, and at the end of the famine, re-sell them.

260. *Selection of pasturages.*—The Local Government shall, in communication with the Commissioner, the Director of Land Records and

Agriculture, and the Conservator of Forests, determine what areas of Government forest or waste land are, in accordance with the principles enunciated in section 256, available for pasturage in each district which is liable to famine, and what number of cattle can advantageously be admitted to such areas in the event of a fodder-famine. The list of such areas shall be revised annually in the month of January. The orders of Government shall be communicated to all officers concerned.

261. *Register of pasturages.*—From the information received under the previous section, the District Officer shall prepare and maintain a register in Form J showing—

- (a) the pasturages available; and
- (b) the number of cattle that may be sent to them.

## FORM J.

*Register of pasturages and cattle in the District for 190*

1	2	3
Description and general indication of boundaries of pasturages available.	Number of cattle that may be sent from the district to the pasturages.	REMARKS.

The Director of Land Records and Agriculture states :—

The call made for suggestions on this grave question has had very little result; the suggestions that have reached me are either not new or are obviously impracticable. United Provinces.

A fodder-famine is much rarer in these provinces than an ordinary famine and cannot be expected more than once in 30 years. It would obviously be bad economy to devote cultivated land to meet this emergency as the loss would be greater than the capital value of the stock saved; and apart from this there is no chance of our landholders doing anything of the kind. Something can be done in particular villages if it is found practicable to turn the bare ravines into rough grazing, but this would have a very local effect. Our experience is that fodder-famines are least felt where the practice of stall-feeding is most developed; and all indications point to the conclusion that the best measure to take is the extension of irrigation, which not only minimises the loss of fodder in a drought, but enables special fodder crops to be grown and—more important still—increases the wealth of the people.

As regards utilization of forests, there are certain well-known regions of migration, where the cattle are transferred seasonally according to need. These should of course not be interfered with, but apart from them all recent experience goes to prove that the forest grass should be railed to the cattle—except only in the case (very rare in these provinces) where water is available in the forest and not available in the famine-tract. The Conservator of Forests is at present working out for use in emergencies a table showing the price at which grass can be laid down at each important railway station in the tracts liable to fodder-famine; and this step might possibly be found useful elsewhere.

The large question of storing grass in the forests for, say, a year ahead is one on which I cannot enter for want of data regarding the cost involved and the annual loss in good years. I hope it may be possible to get the Forest Department to experiment on this question on an adequate scale, but I fear that where fodder-famines are as rare as they are with us the process on a large scale would be very costly.

Speaking generally then, the best safeguard in these provinces is the increase of wealth of the cultivators, which extends the local resources; to supplement these, the forests must be utilized to the utmost.

In these provinces, the Civil Officers whose opinions and suggestions were asked by the Superintendent, Civil Veterinary Department, have submitted various proposals for the provision of fodder during famine, viz. :—

- (a) Opening of closed forests for free grazing.
- (b) Storage of a year's produce to meet demands in a year of drought.
- (c) Waste land within reach of Canal Water to be reserved for growing grass and be watered free of cost.
- (d) Minimum area of land be left uncultivated in each village and be planted with such trees, the leaves of which can be used as fodder for cattle.
- (e) Sale of grass on Government lands, or on lands in possession of District Municipal Boards, to cattle owners.
- (f) Cutting and stacking hay at close of rains.
- (g) Railways to carry fodder at rates sufficient to cover cost of haulage.
- (h) Establishment of fodder reserves by Government and big Zemindars.
- (i) Takavi advances to cattle owners to purchase grass.
- (j) Government to purchase cattle, transport them to the forests, and re-sell at the end of famine to the districts from which they were exported.

**Bombay Presidency.** Mr. Hewlett says he does not think he can give any information or can arrive at any conclusion which is not contained in the Report of the Famine Commission of 1901. The question of the classes of cattle worth preserving in famine camps and supplying them with fodder, are :—Gujarat—Krishna Valley—Khilari—Gir—and the Malvi breeds—also the Jafferabadi and Surati breeds of buffaloes.

**Sind, Baluchistan and Rajputana.** Mr. Hewlett refers us again to the Report of the Famine Commission of 1901.

**Punjab.** Captain Walker recommends the establishment of fodder reserves by the Agricultural and Forest Departments. The scheme to be run on commercial principles. Fodder to be supplied on the spot at a moderate price.

**Burma.** Major Evans states that the trouble in Burma, usually, is excess of water—floods, &c.

Many cattle die from starvation during the rains when the high floods occur, owing to all grazing land having been suddenly submerged. He thinks that the cattle might well have been saved had the people been less indolent, as there was no lack of such fodder as young Kaing-grass and Bamboo leaves, which, in default of better, could have been stored against such a possible contingency.

Should famine occur, forest reserves would be thrown open for grazing. When fodder is short, cattle appear to eat all sorts of bushes. Suggests the planting up of dry areas with fodder bushes that grow in other arid, hot countries.

THE BEST METHODS OF UTILIZING THE SERVICES OF VETERINARY ASSISTANTS, *i.e.*, BY STATIONARY WORK IN DISPENSARIES, BY ITINERATING WORK IN VILLAGES.

**Bengal.** Lieutenant-Colonel Raymond's opinion :—

Though itinerating work is the better at present, the services of both itinerant and stationary Veterinary Assistants are essential. The establishment of dispensaries at the district and sub-divisional head-quarters is very necessary, inasmuch as most of the well-to-do people reside there, and they keep valuable animals, which, when sick, require treatment. With regard to the treatment of village cattle, the services of peripatetic Veterinary Assistants are important. They tour in the villages, advising the villagers how to look after the health of their animals and treating and inoculating the cattle during outbreaks of epizootic diseases. Itinerating men in large outbreaks require assistance from a reserve kept at head-quarters for that purpose. They also require constant supervision.

I am in favour of both systems: they have their advantages and will develop.



On this point Major Maxwell writes as follows :—

" I have for some time been of opinion that the best way to get the most satisfactory work out of all Veterinary Assistants would be to have a dispensary in every district, with all Veterinary Assistants of that district attached to it. Only one man to remain at head-quarters at a time, then the dispensary would never be closed, and a man (or men) would always be moving about as Sanitary Officer in their districts. The men could advise as to treatment and get cases sent in to the dispensary. Under the present system there is a great waste of money in supplying two or three sets of instruments and large quantities of medicines for one district, for, as you know, if there were 20 Veterinary Assistants in one district they would all want to have exactly the same things to work with; if one man has a paper of pins all the others will immediately indent. Of course I am aware that at present there are only a few dispensaries in working order, but I would recommend a trial of this system where they do exist. I think it could be so organized that we might find out more as to the individual value of our men as they would all have a turn at both medical and sanitary work, and would not get into such grooves as they now do."

United Provinces.

The Director of Land Records and Agriculture states :—

" I have not heard of this suggestion before; it seems to me to be well suited to all districts containing three or more Veterinary Assistants, and I commend it as deserving of full consideration. But for the present, when most of our districts have either one or two Veterinary Assistants, its defect is that it would (by retaining one man at the dispensary) weaken the very small force available for fighting epidemics. In these provinces (outside the localised breeding-tracts) the employment of Veterinary Assistants can be justified only by their success as Sanitary Officers, and so long as not more than two men are available in a district, I consider that to fulfil their chief duty they must both be peripatetic. Experience shows that a dispensary which is liable to be closed at irregular times is of very little use, as persons who come and find it closed give it a bad name among their neighbours; and I would avoid starting more dispensaries until it is certain that they can be kept open continuously without trenching on the staff required for handling epidemics."

Mr. Oliver, the Officiating Superintendent, Civil Veterinary Department, points out that, at present, the subordinate Veterinary staff is much below actual requirements; and that as it stands, it would be unwise to withdraw itinerating Veterinary Assistants and place them in charge of dispensaries; but is convinced that as the subordinate establishment is increased, it will be essentially necessary to augment the number of dispensaries in each district.

Mr. Hewlett is of opinion that in each district there should be one stationary man in charge of the Head-Quarter Veterinary Hospital. This man's services could also be utilized in visiting a few neighbouring villages within a radius of, say, 10 miles, and should also be available for emergent outbreaks of contagious disease.

Bombay Presidency.

Considers itinerating Veterinary Assistants very useful, if men of the right stamp are available and if they are not given too large an area to tour over. Does not think that such men can do any real good work if he is given a bigger charge than 2 Talukas.

Mr. Hewlett—the reporting officer—records precisely the same opinion as above under the head "Bombay Presidency."

Sind, Baluchistan and Rajputana.

Captain Walker sends a copy of a note he has prepared at the request of the Director of Agriculture. In this note Captain Walker explains at some length—the formation of the subordinate establishment—the present position—the disadvantages of the present system—&c., &c. Captain Walker is not in favour of itinerating Veterinary Assistants and gives preference to stationary men. Ample reasons and instances are quoted to warrant his arriving at the opinion expressed, and adds :—" Instead of having one stationary Veterinary Assistant at the head-quarters of the district, and one itinerating man in each Tehsil, it is proposed to have a stationary man in each Tehsil, and one itinerating man for the whole district." Full details are given as to the respective duties of the stationary and itinerating Veterinary Assistants.

Punjab.

In the note above alluded to, Captain Walker has embodied recommendations as to the best method of obtaining reports concerning outbreaks of contagious diseases, and the registration of the total mortality for the province. Forms of monthly returns and Post Card intimations are attached. Briefly the method recommended is:—

- (a) At the end of every month all Veterinary Assistants to send copies of their Diaries to the Tehsildar concerned who will forward them to Deputy Commissioners.
- (b) At the end of every month every Patwari to send a Return of epidemic disease among animals, to the Sudder Kanungo.—
- (c) The Sudder Kanungo to hand over the Returns to the itinerating Veterinary Assistant who will, after perusal, send them to the Superintendent, Civil Veterinary Department, through the Veterinary Inspector.

Burma-

Major Evans lays great stress on the necessity of Veterinary work in Burma being, in the first instance, directed towards the suppression of contagious diseases among cattle. He states that, in his opinion, Dispensary (stationary) Veterinary Assistants would only treat such cases as might be brought to them; they certainly would not seek for work. He further adds:—

“I personally would have every man I could on district work. I can see no real advantage to the bulk of cattle owners in maintaining Dispensary Assistants; in fact, I think it would be necessary for them to seek cases here (Burma) to make a decent show of cases treated.”

NOTE ON VETERINARY MATTERS, BY THE DIRECTOR OF LAND RECORDS AND AGRICULTURE, UNITED PROVINCES.

(a) CURTAILMENT OF GRAZING GROUNDS.

For the purpose of this enquiry the provinces fall into three divisions, the submontane districts, Bundelkhand and the rest.

In Bundelkhand cultivation has contracted during the last 20 years, while the grazing grounds of the breeding tracts consist either of ravine-systems (which tend naturally to extend) or of hillsides and valleys which are not suitable for cultivation. There is therefore no question as regards this tract.

The rest of the provinces show no extension of cultivation during the last 20 years. There was not then, and there is not now, any breeding industry in them. People who can afford it keep cows for milk, and the male progeny is reared for field work; but the extraordinary diversity of the type of cows renders it practically impossible to do anything to help this form of breeding. In this tract there are, with local exceptions, no regular grazing grounds; the extensive barren plains are used as exercise grounds, but by December any grass that may have grown is usually grazed off, and for six or seven months they afford no feed at all.

In the remaining tract (submontane), considerable curtailment of the grazing grounds is undoubtedly in progress. It is not due to canals, as none exist, while the additions to forest area during the period specified are immaterial. It is the normal result of the progress of the country; the land is almost entirely in private hands, and its owners find that cultivation pays better than grazing. The question of securing sufficient grazing land to save the great breeding industry in these tracts has at my instance been referred to a small committee for enquiry during the present cold weather. Pending their report, it is unnecessary to say anything further on this point.

(b) EMPLOYMENT OF VETERINARY ASSISTANTS.

On this point Major Maxwell writes as follows:—

“I have for some time been of opinion that the best way to get the most satisfactory work out of all Veterinary Assistants would be to have a dispensary in every district, with all Veterinary Assistants of that district attached to it. Only one man to remain at head-quarters at a time, then the dispensary would never be closed, and a man (or men) would always be moving about as sanitary officers in their districts. The men could advise as to treatment and get cases

sent in to the dispensary. Under the present system, there is a great waste of money in supplying two or three sets of instruments and large quantities of medicines for one district, for, as you know, if there were 20 Veterinary Assistants in one district they would all want to have exactly the same things to work with; if one man has a paper of pins all the others will immediately indent. Of course I am aware that at present there are only a few dispensaries in working order, but I would recommend a trial of this system where they do exist. I think it could be so organized that we might find out more as to the individual value of our men as they would all have a turn at both medical and sanitary work, and would not get into such grooves as they now do."

I have not heard of this suggestion before; it seems to me to be well suited to all districts containing three or more Veterinary Assistants, and I commend it as deserving of full consideration. But for the present, where most of our districts have either one or two Veterinary Assistants, its defect is that it would (by retaining one man at the dispensary) weaken the very small force available for fighting epidemics. In these provinces (outside the localized breeding-tracts) the employment of Veterinary Assistants can be justified only by their success as sanitary officers, and so long as not more than two men are available in a district I consider that to fulfil their chief duty they must both be peripatetic. Experience shows that a dispensary which is liable to be closed at irregular times is of very little use, as persons who come and find it closed give it a bad name among their neighbours; and I would avoid starting more dispensaries until it is certain that they can be kept open continuously without trenching on the staff required for handling epidemics.

#### (c) PROVISION OF FODDER IN FAMINE.

The call made for suggestions on the grave question has had very little result: the suggestions that have reached me are either not new or are obviously impracticable. A fodder-famine is much rarer in these provinces than an ordinary famine and cannot be expected more than once in 30 years. It would obviously be bad economy to devote cultivated land to meet this emergency as the loss would be greater than the capital value of the stock saved; and apart from this there is no chance of our landholders doing anything of the kind. Something can be done in particular villages, if it is found practicable to turn the bare ravines into rough grazing, but this would have a very local effect. Our experience is that fodder-famines are least felt where the practice of stall-feeding is most developed: and all indications point to the conclusion that the best measure to take is the extension of irrigation, which not only minimises the loss of fodder in a drought, but enables special fodder crops to be grown and—more important still—increases the wealth of the people.

As regards utilization of forests, there are certain well-known regions of migration, where the cattle are transferred seasonally according to need. These should of course not be interfered with, but apart from them all recent experience goes to prove that the forest grass should be railed to the cattle—except only in the case (very rare in these provinces) where water is available in the forest and not available in the famine-tract. The Conservator of Forests is at present working out for use in emergencies a table showing the price at which grass can be laid down at each important railway station in the tracts liable to fodder-famine, and this step might possibly be found useful elsewhere.

The large question of storing grass in the forest for, say, a year ahead is one on which I cannot enter for want of data regarding the cost involved and the annual loss in good years. I hope it may be possible to get the Forest Department to experiment on this question on an adequate scale, but I fear that where fodder-famines are as rare as they are with us the process on a large scale would be very costly.

Speaking generally then, the best safeguard in these provinces is the increase of wealth of the cultivators, which extends the local resources; to supplement these, the forests must be utilized to the utmost.

## APPENDIX J.

NOTE ON AGRICULTURAL ENGINEERS BY SIR EDWARD BUCK, K.C.S.I.,  
LL.D.

Attached to my Report on the utilization of silt is a note by Professor Giglioli, Principal of the Agricultural School at the Milan University, in which it is explained that Germany was the first to train a corps of Agricultural Engineers, that France followed the example and that the agricultural leaders in Italy are anxious to do the same. The position in these countries was, as it is still in Italy, much the same as that which existed in India when I came to the North-West Provinces. All engineers in the districts as well as in special departments were under professional direction and control. A step in advance has since been made in placing district engineers under the control of local authorities, their duties being mainly concerned with communications, roads, bridges, &c. They have few functions which can be classed as agricultural.

The fact remains, however, that we have in India what they had not or have not in the European countries, an existing machinery. We have not, that is to say, to create a corps of agricultural engineers. We have only to train an existing corps of engineers (or perhaps I should say the recruits of the future for that corps), in agricultural engineering.

It will be asked what would be the duties of an agricultural engineer as distinct from those of an ordinary professional engineer. The answer does not seem to be difficult. One main duty would be in each district the promotion of irrigation other than canal irrigation, and the execution of works connected therewith. They would have the direction of boring operations; of well construction; of lifts and other irrigating machinery; of the construction of dams and bunds and so on. Another would be the control of surface drainage, with the objects detailed in my report, *viz.*, the utilization of silt and the prevention of erosion. A third duty would be the introduction and general supervision of new agricultural machinery. This would probably involve eventually the maintenance and supervision of district workshops. They could also study the needs of the agricultural population for wood, timber, iron and other material for the construction of agricultural implements, of houses, &c.—a question which does not appear to come, at present, within the scope of any other department. This duty would include the formation of plantations in co-operation with land-owners. An important duty would also be the maintenance and supervision of the working plan for famine relief which it may be hoped will become more and more agricultural in character and include such operations as the 'doctoring' of ravines; the trenching of fields; the construction of dams and bunds and of temporary wells. This principle is indeed followed in the United Provinces where a working plan for temporary wells is under preparation.

It may be conceived that, as time goes on, a working plan would be prepared for each district not merely in connection with famine relief, but also for the improvement of agricultural conditions in every direction in which engineering assistance is required. Such working plans would require the initial direction of professional engineers in co-operation with the agricultural department of the province. Executive operations of important character would of course also demand the general supervision and direction of professional engineers.

At present, in the north of India, the only class of engineers who are brought into direct contact with agricultural interests are those employed on canals. The ability with which our irrigation works have been constructed, developed, and maintained, has not been surpassed in any country in the world. But it is a question whether the absence of association of the professional engineer with those authorities who are more directly concerned with agricultural interests has not been the cause of occasional incompleteness in results.

The immediate question, *i.e.*, if it is desired to manufacture agricultural engineers, is how they are to be trained. In Italy the suggestion is engineering training first, agricultural education second. It is possible that in India the best course might be agriculture—engineering—agriculture. Boys could be selected from the agricultural school to be sent to the engineering college and return to study higher class agriculture and the practical application of engineering methods afterwards. I will not, however, offer further suggestions. It is essentially a question for discussion by the Board.

I may only add that if selections are to be made from our corps of agricultural recruits the prospects offered them in the engineering line should not be inferior to those open to them in the establishments of revenue administration.

E. C. BUCK.

PROCEEDINGS

OF THE

BOARD OF AGRICULTURE IN INDIA

HELD AT

PUSA

ON THE

17th February 1908, and following days

WITH APPENDICES



CALCUTTA  
SUPERINTENDENT GOVERNMENT PRINTING, INDIA  
1908

JP2, NO8  
D8

CALCUTTA  
SUPERINTENDENT GOVERNMENT PRINTING, INDIA  
8, HASTINGS STREET

# CONTENTS

	Page.
<b>PROCEEDINGS OF THE MEETING—</b>	
LIST OF MEMBERS . . . . .	1
OPENING ADDRESS AND APPOINTMENT OF SUB-COMMITTEES . . . . .	2
CONFIRMATION OF THE PROCEEDINGS OF THE LAST MEETING . . . . .	5
THE FUTURE CONSTITUTION OF THE BOARD OF AGRICULTURE . . . . .	5
THE FORM OF REPORT OF THE PROCEEDINGS OF THE BOARD OF AGRICULTURE . . . . .	6
<b>PROGRAMMES OF PROVINCIAL DEPARTMENTS OF AGRICULTURE—</b>	6
BENGAL . . . . .	8
UNITED PROVINCES . . . . .	8
PUNJAB . . . . .	8
BOMBAY . . . . .	9
MADRAS . . . . .	9
CENTRAL PROVINCES AND BERAR . . . . .	9
BURMA . . . . .	9
EASTERN BENGAL AND ASSAM . . . . .	9
PROGRAMME OF THE MYSORE DEPARTMENT OF AGRICULTURE . . . . .	10
PROGRAMME OF THE BARODA DEPARTMENT OF AGRICULTURE . . . . .	10
PROGRAMME OF THE KASHMIR DEPARTMENT OF AGRICULTURE . . . . .	10
THE SCOPE OF IMPROVED POULTRY BREEDING IN INDIA . . . . .	11
THE LINES ON WHICH ENTOMOLOGICAL AND MYCOLOGICAL WORK IN THE PROVINCES SHOULD BE CONDUCTED . . . . .	13
<b>PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE :—</b>	
AGRICULTURAL CHEMISTRY . . . . .	15
ECONOMIC BOTANY . . . . .	16
MYCOLOGY . . . . .	16
ENTOMOLOGY . . . . .	16
BACTERIOLOGY . . . . .	16
AGRICULTURE . . . . .	17
THE IMPERIAL COTTON SPECIALIST . . . . .	17
METHODS OF BRINGING EXPERIMENTAL WORK TO THE NOTICE OF THE CULTIVATORS . . . . .	17
THE CULTIVATION IN INDIA OF FIBRE PLANTS . . . . .	25
THE SYLLABUS OF STUDIES IN THE PUSA AND IN PROVINCIAL COLLEGES . . . . .	25
SCHEME OF INSTRUCTION FOR INDIAN AGRICULTURAL STUDENTS IN ENGLAND . . . . .	30
<b>APPENDIX A, PROGRAMME OF THE FOURTH MEETING OF THE BOARD OF AGRICULTURE . . . . .</b>	<b>31</b>
" <b>B. PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE . . . . .</b>	<b>33</b>
" <b>C. PROGRAMMES OF THE PROVINCIAL AND NATIVE STATES DEPARTMENTS OF AGRICULTURE—</b>	
BENGAL . . . . .	41
UNITED PROVINCES . . . . .	43
PUNJAB . . . . .	43
BOMBAY . . . . .	46
MADRAS . . . . .	50
CENTRAL PROVINCES AND BERAR . . . . .	51
BURMA . . . . .	53
EASTERN BENGAL AND ASSAM . . . . .	56
BARODA . . . . .	62
KASHMIR . . . . .	63
" <b>D. PROPOSALS FOR THE EXPANSION OF THE DIFFERENT SECTIONS OF THE PROVINCIAL DEPARTMENTS OF AGRICULTURE . . . . .</b>	<b>67</b>
" <b>E. POULTRY FARMING IN INDIA . . . . .</b>	<b>77</b>



No. C-1397, dated Camp Pusa, the 5th March 1908.

From—J. MOLLISON, Esqr, M R A C, Inspector General of Agriculture in India,  
To—The Secretary to the Government of India, Department of Revenue and  
Agriculture, Calcutta

I have the honour to submit the Proceedings of the 4th Meeting of the Board of Agriculture held at Pusa on the 17th February 1908 and subsequent days. These Proceedings have been recorded by Dr. Butler, who kindly agreed to again act this year as Secretary. The Proceedings have been approved by the Board.

---

*Proceedings of the 4th Annual Meeting of the Board of Agriculture in India, held at Pusa on the 17th February 1908, and succeeding days.*

---

#### LIST OF MEMBERS.

1. J. MOLLISON, M.R.A.C., *Inspector General of Agriculture in India, President of the Board.*
2. E. J. BUTLER, M.B., F.L.S., *Imperial Mycologist, Pusa, Secretary to the Board.*
3. B. COVENTRY, *Director, Agricultural Research Institute, and Principal of the Agricultural College, Pusa.*
4. J. W. LEATHER, Ph.D., F.I.C., F.C.S., *Imperial Agricultural Chemist, Pusa.*
5. H. M. LEFROY, M.A., F.E.S., F.Z.S., *Imperial Entomologist, Pusa.*
6. C. J. BERGTHEIL, *Imperial Bacteriologist, Pusa.*
7. E. SHEARER, M.A., B.Sc., *Imperial Agriculturist, Pusa.*
8. A. HOWARD, M.A., A.R.C.S., F.C.S., F.L.S., *Imperial Economic Botanist, Pusa.*
9. G. A. GAMMIE, F.L.S., *Imperial Cotton Specialist.*
10. F. M. HOWLETT, B.A., *Second Imperial Entomologist, Pusa.*
11. Captain A. T. GAGE, I.M.S., M.B., M.A., B.Sc., F.L.S., *Director of the Botanical Survey of India.*
12. FRED NOEL-PATON, *Director General of Commercial Intelligence.*
13. I. H. BURKILL, M.A., *Reporter on Economic Products to the Government of India.*
14. C. M. HUTCHINSON, B.A., *Scientific Officer to the Indian Tea Association.*
15. W. R. GOURLAY, I.C.S., *Director of Agriculture, Bengal.*
16. F. SMITH, B.Sc., *Deputy Director of Agriculture, Bengal.*
17. H. H. CORBIN, B.Sc., *Principal of the Agricultural College, Bengal.*
18. E. J. WOODHOUSE, B.A., *Economic Botanist, Bengal.*
19. C. SOMERS-TAYLOR, B.A., *Agricultural Chemist, Bengal.*
20. E. A. MOLONY, I.C.S., *Director of Agriculture, United Provinces of Agra and Oudh.*
21. J. HAYMAN, D.V.S., *Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
22. H. M. LEAKE, M.A., B.Sc., *Economic Botanist, United Provinces of Agra and Oudh.*
23. G. CLARKE, F.I.C., *Agricultural Chemist, United Provinces of Agra and Oudh.*
24. A. PARR, Ph.D., M.A., *Second Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
25. W. C. RENOUF, I.C.S., *Director of Agriculture, Punjab.*

26. S. MILLIGAN, M.A., B.Sc., *Deputy Director of Agriculture, Punjab.*
27. A. C. DOBBS, B.A., *Principal, Agricultural College, Punjab.*
28. D. MILNE, M.A., B.Sc., *Economic Botanist, Punjab.*
29. J. H. BARNES, B.Sc., A.I.C., F.C.S., *Agricultural Chemist, Punjab.*
30. H. H. MANN, D.Sc., *Principal, Agricultural College, Poona.*
31. J. B. KNIGHT, M.Sc., *Profes. or of Agriculture, Agricultural College, Poona.*
32. G. S. HENDERSON, N.D.A., N.D.D., *Second Deputy Director of Agriculture, Bombay.*
33. M. E. COUCHMAN, I.C.S., *Director of Agriculture, Madras.*
34. H. C. SAMPSON, B.Sc., F.H.A.S., F.B.S.E., *Deputy Director of Agriculture, Madras.*
35. C. J. W. SHEPPERSON, B.Sc., *Principal, Agricultural College, Madras.*
36. W. H. HARRISON, M.Sc., *Agricultural Chemist, Madras.*
37. RAO BAHADUR C. K. SUBBA RAO, B.A., *Acting Economic Botanist, Madras.*
38. F. G. SLY, I.C.S., *Director of Agriculture, Central Provinces.*
39. D. CLOUSTON, M.A., B.Sc., *Deputy Director of Agriculture, Central Provinces (South Circle).*
40. F. C. PLYMAN, A.C.G.I., *Agricultural Chemist, Central Provinces.*
41. G. EVANS, B.A., *Deputy Director of Agriculture, Central Provinces (North Circle).*
42. R. J. D. GRAHAM, M.A., B.Sc., *Economic Botanist, Central Provinces.*
43. S. G. HART, I.C.S., *Director of Agriculture, Eastern Bengal and Assam.*
44. RAI BAHADUR B. C. BASU, M.R.A.C., *Assistant Director of Agriculture, Eastern Bengal and Assam.*
45. A. A. MEGGITT, B.Sc., *Agricultural Chemist, Eastern Bengal and Assam.*
46. R. S. FINLOW, B.Sc., F. C. S., *Fibre Expert to the Government of Eastern Bengal and Assam.*
47. J. MACKENNA, I.C.S., *Director of Agriculture, Burma.*
48. A. MCKERRAL, M.A., B.Sc., *Deputy Director of Agriculture, Burma.*
49. L. C. COLEMAN, Ph.D., *Mycologist and Entomologist to the Government of Mysore.*
50. M. A. SITOLE, *Director of Agriculture and Industries, Baroda.*
51. L. C. SHARMA, M.R.A.C., P.A.S.I., *Bar-at-Law, Director of Agriculture, Kashmir.*

#### VISITORS.

52. H. E. ABBOTT, *Editor, Indian Fowl Fanciers', Gardeners' and Farmers' Gazette.*
53. A. G. BIET, B.Sc., *Supernumerary Agriculturist, Pusa.*
54. W. ROBERTS, B.Sc., *Supernumerary Agriculturist, Pusa.*
55. C. W. MASON, *Supernumerary Entomologist, Pusa.*
56. H. E. ANNETT, B.Sc., *Supernumerary Agricultural Chemist, Pusa.*
57. G. P. HECTOR, M.A., B.Sc., *Supernumerary Economic Botanist, Pusa.*
58. M. E. VANDERKERKHOVE, *Flax Expert to the Behar Planters' Association.*

---

#### FIRST DAY.

1. The President welcomed the members present at the 4th Meeting of the Board of Agriculture. He referred in an appreciative manner to the work done by Mr. Sly in organising the proceedings of previous meetings and to Dr. Butler's work in recording the proceedings. He suggested that some of the items put down for discussion on this occasion should be threshed out by Committees appointed to consider them before being discussed by the full Board. This

suggestion being adopted, the following Committees and terms of reference were decided upon.—

(A).—To consider and report on the future constitution of the Board of Agriculture.

*Sub-Committee.*—The President (Chairman), Mr. Noel-Paton, the Directors of Agriculture, Bengal, United Provinces, Punjab, Madras, Central Provinces, Burma and Eastern Bengal and Assam, Mr. Coventry, Dr. Butler, Mr. Gammie and Dr. Mann.

*Terms of reference.*—To consider carefully the suggestions† of the Government of India that the Board of Agriculture be reduced to 32 members as follows:—

†Revenue and Agriculture Department Circular No 23-23-24, dated the 15th August 1907, to all Local Governments

Imperial Officers.	Provincial Officers
Inspector General of Agriculture, President Inspector General, Civil Veterinary Department, Director, Botanical Survey of India. Director General of Commercial Intelligence, representing the Commerce and Industry Department	The Director of Agriculture and one Provincial Expert from each of the following Provinces to be selected by the Director.— Bombay Bengal Eastern Bengal and Assam. Madras Burma.
Director, Agricultural Research Institute, Pusa Imperial Agricultural Chemist.	Central Provinces. United Provinces. Punjab.
Imperial Mycologist	* A representative of the Provincial Biologists
Imperial Entomologist Imperial Agriculturist Imperial Economic Botanist	* A representative of the Provincial Chemists.
Imperial Bacteriologist	One member each of the Agricultural Depart- ments of Mysore, Baroda and Kashmir.

In addition to the members of the Board, the Government of India further trust that Local Governments will allow a certain number of their experts to be present as visitors, although they would not take part in the deliberations of the Board unless specially invited by the President to do so.

To consider whether the Chemical, Biological and Educational Sections of each Province should be more fully represented on the Board than above suggested.

To consider whether, in the event of expanding these suggestions, Provincial representation will not be fully secured by appointing the 8 Directors of Agriculture and 12 provincial experts, and whether the latter should be selected in consultation by the Directors themselves.

To make any other proposals on the subject.

(B).—To consider and report on the form of report of the Proceedings of the Board of Agriculture.

*Sub-Committee.*—Mr. MacKenna (Chairman), Mr. Renouf and Dr. Butler.

*Terms of reference.*—To consider the suggestions† of the Government of India that the arrangement now adopted for printing the Proceedings of the Board is not a convenient one and that the addition of an index would enhance their value for purposes of reference.

† Revenue and Agriculture Department letter No. 208-23-38, dated the 1st February 1908, to the Inspector General of Agriculture.

\*These two members to be selected as follows.—Three days before the general meeting of the Board, the Biological Experts, Imperial and Provincial, that is, the Botanists, Entomologists, Mycologists and Bacteriologists should hold a meeting for the discussion of matters specially affecting their branches of research and should arrive at their own conclusions on such matters, to be placed before the general meeting of the Board. The Provincial Biological experts should select one of their number to be their representative on the Board. Similarly the Imperial and Provincial Chemists would hold a separate meeting three days before the general meeting of the Board, would draw up their conclusions on chemical matters, and appoint a Provincial Chemist to be a member of the Board.

To consider whether such voluminous appendices as were published in the report of the Proceedings of the 3rd Meeting of 1907, should not be excluded from the report and otherwise dealt with.

To give an opinion regarding the best means of publishing notes like those submitted by Mr. Clouston on "Sann hemp, Agave and Ambari as Fibre crops in the Central Provinces and Berar" and "the Introduction of Improvements into Indian Agriculture," and whether these notes are not more suitable for the Agricultural Journal than for the report of the Proceedings of the Board of Agriculture.

(C).—To consider and report on the programme of work of the Imperial Agriculturist and how the other experts of the Imperial Department should collaborate in this work.

*Sub-Committee.*—The President (Chairman), Messrs. Sly, Coventry, Couchman, Dr. Leather, Mr. Lefroy, Dr. Mann, Messrs. Shearer, Bergtheil, Sampson and Milne.

*Terms of reference.*—To consider and report how far the permanent experiments proposed for Pusa are likely to give work-a-day results which will have general practical application in Indian Agriculture and also the important directions in which the work of the Pusa Experts should be collaborated in relation to these experiments.

(D).—To consider and report on the best methods of bringing experimental work of proved value to the notice of cultivators.

*Sub-Committee.*—Mr. Sly (Chairman), Mr. Gourlay, Dr. Mann, Messrs. Hayman, Clouston, Knight and Subba Rao.

*Terms of reference.*—In addition to recommending methods, specific instances of agricultural improvements which have been introduced by Agricultural Departments should be given with details.

(E).—To consider and report on the cultivation in India of fibre plants and the probable effect of extending such cultivation on the material prosperity of the country.

*Sub-Committee.*—Messrs. Gammie (Chairman), Burkill, Finlow, Clouston and Subba Rao.

*Terms of reference.*—To consider and report in concise form all that is generally known on this subject in each province in which important fibre crops are now grown.

(F).—To consider and report on the scope of Poultry breeding in India.

*Sub-Committee.*—The President (Chairman), Messrs. Abbott, Shearer and Evans.

*Terms of reference.*—To consider the following request\* of the Government of India in forwarding a letter (Appendix E) from Mr. H. Abbott on this question :—  
"The Government of India are inclined to think that something might be done by the Agricultural Department to improve the breed of poultry in India, but before making any definite suggestions to Local Governments on the subject, they would be glad of the advice of the Board of Agriculture and I am to request that the subject may be considered at the next meeting of the Board."

(G).—To consider and report on the Syllabus of studies in the Pusa and in Provincial Colleges.

*Sub-Committee.*—Mr. Renouf (Chairman), Dr. Mann, Dr. Leather, Mr. Dobbs, Dr. Butler, Messrs. Evans, Gammie, Clarke, Barnes, Knight, Sampson, Meggitt, Howlett, Shepperson, Plyman and Leake.

*Terms of reference.* (a) To make recommendations as to what class of instruction, given at Pusa, will be of the most advantage to the Provinces, and submit a suitable syllabus.

(b) Whether an advantage will lie in the appointment of a permanent committee of officers from the Provinces to co-operate with the Pusa staff in regulating the courses of instruction at Pusa, so as to secure the requirements of the Provinces.

(c) To report if any alteration is needed in the standard curriculum for Provincial Colleges as drafted in the Board's Proceedings for 1906 and, if so, to submit a revised curriculum.

(H). -To consider and report on the Agricultural Chemistry Section of the Programme of the Imperial Department of Agriculture for 1908-09.

*Sub-Committee*—Mr. Sly (Chairman), Mr. Coventry, Dr. Leather, Mr. Bergthell, Dr. Mann, Messrs. Barnes, Hutchinson, Harrison, Clarke and Molony.

*Terms of reference.*—To suggest whether any modification in the Programme of the Agricultural Chemistry Section of Pusa is necessary.

## SECOND, THIRD AND FOURTH DAYS.

These days were occupied in the deliberations of the Sub-Committees appointed on the first day.

## FIFTH DAY.

### CONFIRMATION OF THE PROCEEDINGS OF THE LAST MEETING.

2. The minutes of the Proceedings of the last annual meeting of the Board of Agriculture held at Cawnpore on the 18th of February 1907, and following days were confirmed.

A note was presented by the President showing the action taken on the recommendations of the last Board.

### THE FUTURE CONSTITUTION OF THE BOARD OF AGRICULTURE.

3. The report of Sub-Committee (A) on the future constitution of the Board of Agriculture was considered.

Mr. Smith advocated the holding of an informal conference of all members of the Agricultural Departments in India and the limiting of the official Board to 10 members, composed as follows :—The Inspector-General of Agriculture (President), one representative of each Province, and the Director of the Imperial Institute. If necessary, one representative each of the Chambers of Commerce, the Zemindari interest, and the Planting industry might be added. Mr. Milligan held that it will be impossible to criticise the Provincial programmes if the men specifically responsible for the work be not present at the meeting. Mr. Hayman suggested that the expert mentioned in item 13 should be selected at a meeting of the whole of the staff in each Province with the Director as Chairman. Messrs. Hayman, Milligan and Knight considered that the Provincial Deputy Directors of Agriculture are not sufficiently represented in the proposed constitution. Mr. MacKenna pointed out that, ordinarily, the expert selected by each Director of Agriculture under item 13 would belong to this class. The President also explained that the six nominations suggested in item 15 are intended to secure additional representation in regard to specific subjects set down for discussion in any particular year; and that Deputy Directors are likely to be included in these.

The Board adopts the report of Sub-Committee (A) as follows :—

4. The Sub-Committee recommends that the Board of Agriculture be constituted as follows :—

#### *Imperial Members—*

1. The Inspector General of Agriculture (President)	..	..	1
2. The Director, Agricultural Research Institute, Pusa	..	..	1
3. The Imperial Agricultural Chemist	..	..	1
4. The Imperial Mycologist	..	..	1
5. The Imperial Entomologist	..	..	1
6. The Imperial Bacteriologist	..	..	1
7. The Imperial Agriculturist	..	..	1
8. The Imperial Economic Botanist	..	..	1
9. The Imperial Cotton Specialist	..	..	1
10. The Director General of Commercial Intelligence, representing the Department of Commerce and Industry	..	..	1
11. The Reporter on Economic Products or an Economic Botanist from the Botanical Survey of India	..	..	1

Total Imperial Members .. 11

*Provincial and Non-Official Members—*

12. The Directors of Provincial Departments of Agriculture .. ..	8
13. One member from the Expert Staff of each Provincial Department of Agriculture to be nominated by the Provincial Director from any section of his staff .. ..	8
*14. Provincial Deputy Director of Agriculture .. ..	1
Provincial Agricultural Chemist .. ..	1
Provincial Botanist .. ..	1
Provincial Principal of an Agricultural College .. ..	1
	4
15. Members to be nominated each year by the President .. ..	6
16. One representative of the Agricultural Departments of Native States to be nominated each year by the President .. ..	1
	—
Total Provincial and Non-official Members .. ..	27
	—
Grand Total .. ..	38

\*The four officers under No. 14 to be elected by all the Provincial representatives of each section by correspondence before the nomination of the members in the item No. 13

The Sub-Committee further recommends that when the meeting is held at Pusa (i.e., in each alternate year) all members of the Agricultural Departments in India, including Native States which have an organised Agricultural Department, be invited to attend, not as members of the Board but as visitors.

**THE FORM OF REPORT OF THE PROCEEDINGS OF THE BOARD OF AGRICULTURE.**

5. The Board adopts the report of Sub-Committee (B) on the form of report of the Proceedings of the Board of Agriculture as follows:—

(1) The Sub-Committee is of opinion that the "Proceedings of the Meeting" should be recorded in the form hitherto adopted.

(2) With regard to appendices the Sub-Committee considers that the programme of the Meeting, the programme of the Imperial Department of Agriculture and the programmes of the Provincial Departments of Agriculture should be included, but that the latter should be as concise as possible.

(3) The Sub-Committee is of opinion that the inclusion of a note showing the action taken on the Proceedings of the preceding Board is unnecessary. In many cases it is improbable that the action taken on such recommendations can be completed within a year and such a note is apt to give a totally inadequate idea of what Agricultural Departments are doing in the matter.

(4) With regard to papers on special crops, e.g., wheat, sugarcane, etc., which form the subject of discussion by the Board, the Sub-Committee is of opinion that these papers, being absolutely relevant to the discussion and an instructive summary of past work in each Province, should be included amongst the appendices. It is recommended, however, that such notes should be as brief as possible.

(5) With regard to papers on general subjects, e.g., papers on commercial Fertilizers, the Improvement of Indian Agriculture, etc., the Sub-Committee is of opinion that such articles should not be incorporated in the appendices but should be published in the Agricultural Journal.

(6) The Sub-Committee considers that a detailed index is unnecessary. A carefully prepared table of contents appears to be all that is required.

**PROGRAMMES OF PROVINCIAL DEPARTMENTS OF AGRICULTURE.**

6. Mr. Sly proposed for consideration two matters of principle applying in greater or less degree, to all the programmes submitted to the Board. In the first place, it appears necessary to secure a fuller recognition of the essential function of the Board in helping Provincial Departments with advice and criticism regarding the lines of work proposed in each Province. To secure the proper exercise of this function the Board requires to have available in the printed

programmes a certain amount of detail in matters such as the objects aimed at in opening new experiment stations and the lines of work of new experiments. In the second place, the impetus given to the development of Agricultural work in the last few years appears to have led to the danger in some Provinces of a more rapid development of agricultural stations than the existing staff can cope with. The President and Mr. MacKenna expressed general agreement with these views.

7. The Board is of opinion that the Programmes submitted to it should show concisely (1) in the case of new experiment stations the general scheme of work to be undertaken, and (2) in the case of new lines of experimental work, an account of the methods which it is proposed to adopt.

8. It is further of opinion that the form of the Madras and Central Provinces Programmes is, with some additions, explaining more fully the schemes of experiments, the best suited to meet the requirements of the Board.

9. The Board deprecates increasing the number of Provincial experiment stations until the following essential requirements can be secured in each case:—

- (1) Efficient supervision by the superior staff.
- (2) Efficient management by a trained subordinate staff.
- (3) Sufficient equipment for all the experimental work that is to be under taken.

10. Mr. Renouf raised the question of the area with which it is advisable to commence in opening new farms or in extending existing farms particularly for seed distribution and demonstration work. In the Board's Proceedings for 1906, item 23, it is recommended that experimental farms should be opened in each definite agricultural tract. Seed production should be provided for, either on separate farms or on separate portions of existing farms. An area of from 300 to 500 acres has been recommended for combined experimental and seed farms. This he considered unnecessarily large in some cases and he desired the opinion of the Board, in view of the high value of the land in certain areas, whether a commencement cannot be made on a considerably smaller scale, say not exceeding 100 acres. When expansion for seed production is required it will be possible to take up land on hire for the purpose. This should also be done in the case of areas required for demonstration.

The President stated that in Bombay the commencement was made on a modest scale. The farms at first started were about 50 acres in area. Gradually, as occasion arose, an extension outside the farm was made. Small plots were taken up, such as a 5-acre patch in an outside cultivator's field, for purposes of demonstration. This was worked on methods within the reach of the ordinary cultivator and under his eye, and he was shown that practical improvements can be obtained by improved methods of cultivation. Seed growing and seed distribution can be arranged for in a similar manner.

Mr. Smith considered an area of 50 acres too small. In Bengal 200 acres have been taken up as a standard, part being reserved for experimental work and part for seed growing.

Mr. Coventry held that the area required depends entirely on the uniformity of the soil. Where the land is known it is usually possible to select 50 or 100 acres sufficiently uniform to provide for all the experimental work likely to be required. Where, however, the character of the land is not known, probably some 200 or 300 acres must be taken up from which the area required for experimental work can be selected. For seed-growing use can probably be made in most cases of the land of the cultivator.

Mr. MacKenna considered that the matter is one which depends largely on local conditions. In Burma it pays to take up considerable areas for farms because prices are low at present but are rapidly rising. Areas not immediately required can be temporarily sublet.

11. The Board is of opinion that the area of an experiment station should be limited to the land required for the conduct of the experimental programme and that each Provincial Department should be free to make such arrangements for seed growing and demonstration as it thinks best.

12. It further considers that when an experimental farm is founded, it should be established to solve a definite problem or series of problems. It deprecates

the founding of experimental farms merely in order to represent agricultural tracts unless the special requirements of the particular tract have been previously ascertained, and experiments are considered necessary in order to decide how best to meet them.

13. Mr. Knight suggested that in the case of a programme divided into sections, the name of the expert officer who is actually in charge of the work should be indicated. This is done in the Central Provinces programme which illustrates clearly what he means. Mr. Henderson supported this suggestion. Mr. Couchman did not believe that this procedure is advisable or even possible in some cases. It would mean splitting the programme up into sections and would emphasise a division which should not exist. This view was supported by Mr. Molony. Mr. Milne agreed with Mr. Couchman and said that the proposal would be most difficult of application in practice especially where collaboration between officers exists. The Board considers that this matter is sufficiently covered by the resolution (item 8) approving of the form of the Madras and Central Provinces programme.

14. The Board is of opinion that at least in the alternate years when it meets at Pusa, the Imperial and Provincial programmes should be referred to sectional committees of (1) Deputy Directors, (2) Chemists and (3) Biologists, to consider the items pertaining to their sections with a view to co-ordinating the work of the whole Department, and report their recommendations to the Board.

#### PROGRAMME OF THE BENGAL DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 41.*

15. The President stated that he was struck by the extent and varied nature of the Bengal programme. He would be glad to know whether the Bengal Director considers that his staff is sufficient to carry out the proposed work.

Mr. Gourlay detailed the available subordinate staff in Bengal. Besides the men previously available, three students with an advanced training have recently joined the Department. These men first graduated from the Calcutta University, then took the Agricultural course at Sibpur College, then went through a practical training in Bengal and finally were sent to one of the best Agricultural Colleges in the United States for a further course. Four more similarly trained men will be available shortly. These men will be put in charge of Agricultural Stations. Mr. Sly considered it unwise to place men of this class in independent charge of Agricultural Stations unless they are first put for a considerable time on one of the existing stations to become practically acquainted with the lines of work likely to be of advantage to the Province.

Dr. Mann feared that there is a tendency apparent from the Bengal programme to start farms without a definite object in view. He considered that in every case a definite object should be borne in mind. Mr. Milligan agreed that farms should not be started without a definite object in view. Mr. Smith said that in every case such an object was in view when founding the farm.

16. The Board accepts the Bengal programme.

#### PROGRAMME OF THE UNITED PROVINCES DEPARTMENT OF AGRICULTURE

*See Appendix C., page 43.*

Mr. Hayman, in response to an enquiry by Mr. Sly, promised to give the details of the investigation regarding the renewal of the seed stock of potatoes in the hills mentioned in the first paragraph of the programme, to any members of the Board interested in the matter.

17. The Board accepts the United Provinces programme.

#### PROGRAMME OF THE PUNJAB DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 43.*

18. The Board accepts the Punjab programme.



## PROGRAMME OF THE BOMBAY DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 46.*

19. Mr. Knight, in response to inquiries, explained that the experiments in dry farming mentioned in the programme of the Poona College Station are intended to ascertain the best means of conserving soil moisture in dry years by tillage and other similar methods.

20. Dr. Mann explained that no programme in Agricultural Chemistry was included in the programme as he had had no opportunity of submitting one.

21. Mr. Knight stated that the farm at Muvaha is situated in the most backward agricultural tract of the Presidency and is intended to introduce better general methods of cultivation in the neighbourhood. It is in some respects rather a demonstrational than an experimental farm.

22. Mr. MacKenna considered that no advantage is gained by inserting details of area, meteorology and the like into the list of farms given in the programme. Such details can be obtained from the special farm reports. Mr. Sly objected to the form of the programme, which he considered to be framed in such general terms as to render it impossible for the Board to express an opinion on its merits. Such items as that insect pests are being investigated or that an endeavour is being made to introduce into Sind a common Egyptian rotation may mean very much or very little according to the details of the work. Dr. Mann said that the Bombay officers would be glad to give details. Mr. Henderson said that the details of the alkali investigations could be furnished on the following day to any member interested in the question.

23. The Board decides that in the light of the remarks made above, the Bombay programme requires revision.

## PROGRAMME OF THE MADRAS DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 50.*

24. The Board suggests that the reference to systematic work performed by the Government Botanist in his capacity as an officer of the Botanical Survey be omitted in future from the programme of the Madras Agricultural Botanist.

The Board accepts the Madras programme.

## PROGRAMME OF THE CENTRAL PROVINCES DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 51.*

25. The Board accepts the Central Provinces programme.

## PROGRAMME OF THE BURMA DEPARTMENT OF AGRICULTURE

*See Appendix C., page 53.*

26. Mr. MacKenna stated that the full programme of the Hmawbi Farm cannot be carried out this year, owing to a recent curtailment of the Government grant for the purpose. Government sanction has now been received for the entertainment of the Assistant Botanist mentioned in the first paragraph of the programme. The enquiry in connection with silt will be carried out in consultation with the Irrigation Department.

27. The Board is of opinion, that, as the question of alkali lands is of minor importance in Burma, and is being treated in detail in other Provinces where it is of greater urgency, the Agricultural Chemist might be more usefully employed in other and more important investigations.

## PROGRAMME OF THE EASTERN BENGAL AND ASSAM DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 56.*

28. The Board is of opinion that the expert staff of this Department is insufficient to carry out the work set down in the programme.

29. Mr. Sly considered that the appointment mentioned in paragraph 2 of a student trained in Bengal and the United States, directly to the post of Agricultural

Supervisor, is unwise in the extreme. Considerable experience of local work and conditions is required before a student can be given a post of such responsibility. Mr. Hart explained that owing to the fact that the present staff contains only one expert Agriculturist (the Assistant Director), whose time is fully occupied by other duties, there is no officer who can undertake the training of the Agricultural Supervisor. The latter can, however, do much useful work in the shape of local enquiries and will be expected gradually to familiarise himself with the work on all the farms. Until he has acquired experience he will not be placed in charge of any farm and even then only under the immediate supervision of the Assistant Director.

30. In response to enquiries, Mr. Hart explained that the experiment outlined in paragraph 5, section 3, together with the whole of the Dacca Farm programme, had been discussed during the present meeting with certain members of the Board. The experiment is really an attempt to bring a barren field on the farm into a state of fertility for future use. It is in no sense an experiment intended to be applied in ordinary cultivation.

31. Mr. Sly considered that the experiments suggested in paragraph 13 to be tried on Government and Wards Estates can serve no useful purpose as they are not likely to be properly carried out. Such Estates may be useful for demonstration purposes. Mr. Hart agreed but wished to point out that demonstrations carried out in a new locality partake of the nature of experiments. They are experiments which the Department expects to succeed.

32. Mr. Couchman referred to paragraph 17 and considered that the supervision of road-side arboricultural operations is an enormous undertaking for an Agricultural Department. Mr. Hart explained that the work will be carried out by district Officers, the Department only advising. Mr. Molony described the method adopted in the United Provinces, where the whole administrative and executive work is in the hands of District Officers in localities where no Forest Officers are available. The details are submitted to the Agricultural Department which gives advice as far as it can.

33. The Board is of opinion (some members dissenting) that arboricultural operations of the sort referred to in paragraph 17 of the Eastern Bengal programme are outside the scope of the Agricultural Department.

#### PROGRAMME OF THE MYSORE DEPARTMENT OF AGRICULTURE.

34. Dr. Coleman stated that owing to considerable administrative changes, the programme of the Mysore Department as submitted is unlikely to be carried out, except in certain items where the work is already well advanced. It is impossible to decide on definite work until the intentions of the Mysore Government are more fully known.

35. The Board decides to omit this programme from its proceedings for the reasons stated above. It further regrets to learn that the prospective change in establishment of the Department will, in a great measure, bring agricultural work in Mysore to a standstill.

#### PROGRAMME OF THE BARODA DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 63.*

36. The Board is of opinion that the experiments in paragraph 2 of this programme are unlikely to lead to any useful results.

37. Mr. Bergtheil expressed the opinion that the experiment mentioned in paragraph 14 is useless, if by "nitrogen bacilli" are meant the ordinary nodule bacilli of legumes. It is well established that the presence of a rich organic manure tends to neutralise any benefit which may result from the application of these bacilli.

38. The Board considers that the programme of the Baroda State is much too ambitious to be efficiently carried out by the available staff.

#### PROGRAMME OF THE KASHMIR DEPARTMENT OF AGRICULTURE.

*See Appendix C., page 64.*

39. The Board considers that the varietal experiments in paragraph 1, section I, should be restricted to the more important crops of the State and should include only such as are likely to be easily improved by selection.

Mr. Sharma explained, in response to enquiries, that the "dal" soil referred to in paragraph 1, section 3, is the lake-bed silt, taken out and applied to the land.

Subject to the above restriction the Board accepts the Kashmir programme.

#### THE SCOPE OF IMPROVED POULTRY BREEDING IN INDIA.

40. The report of Sub-Committee (F) appointed to consider and report on the scope of improved poultry breeding in India was considered.

Mr. Dobbs enquired whether the Committee had considered the question of poultry breeding from the point of view of the fancier or as a commercial matter. The President replied that the latter was chiefly considered. Mr. Abbott remarked that he had expended at least Rs. 2,000 per annum in importing birds and had made it pay. Where a European can succeed there is much greater prospect of a native succeeding, as his difficulties in guarding against theft and other similar disadvantages are less.

Mr. Molony referred to the prejudices of Hindoos against poultry. If the question is taken up at Agricultural Stations it may interfere with the utility of the Station owing to these prejudices. Mr. Abbott said that even excluding Hindoos there was great scope for the work with Mahomedans, Parsees, Eurasians and others. Mr. Subba Rao stated that the prejudice against poultry only exists in the Brahmans amongst Hindoos. The Sudra caste and the lower castes are free from it.

The President said that if the work is to be attempted at all, it must be systematically and thoroughly taken up. A good trained Assistant will be required to carry out the experiments. A good Mahomedan would probably be the best class of man. Mr. Abbott considered that a special European Assistant such as a non-commissioned officer, who could be got for about Rs. 200 a month, should be appointed to supervise the experiments wherever they are being carried out to point out mistakes, select sites for runs and so on.

41. The Board adopts the report of Sub-Committee (F) as follows :—

Mr. Abbott, who has had long practical experience of poultry breeding in India gave much valuable information and stated that he had tested in India practically all breeds except Faverelles.

He considered that the following breeds were generally unsuited for India :—

- (i) Cochins, Brahamas and all breeds with heavily-feathered legs because they do very badly in the monsoon.
- (ii) Dorkings because they are too delicate.

He considered that the most suitable breeds for general utility purposes are :—

- (i) Plymouth Rocks—the best strain of these probably being the Barred Rock.
- (ii) Orpingtons of all strains.
- (iii) Wyandottes of all strains but probably Silver or White Wyandottes will be found best.

As regards the crossing of imported with indigenous breeds, the Sub-Committee has very little information but it is believed that the lighter laying breeds, especially the Minorcas and Leghorns, would be the most suitable imported breeds for a first cross and at a later stage Plymouth Rocks, Orpingtons and Wyandottes might be utilised to provide good table fowls. Mr. Abbott considers that the best of the native breeds for crossing purposes are :—

- (1) Hyderabad Black Games.
- (2) Penang Black Langshans.
- (3) Chittagong.

The Sub-Committee discussed the best means of obtaining well-bred birds for experimental work, and recognised the necessity of selection by a good judge when dealing with native breeds, as these are very often mixed and dealers often do not recognise the importance of selling for breeding purposes only birds of correct type. In introducing foreign breeds the only practicable way is to bring the birds, as the eggs are invariably bad after the sea voyage. The housing of poultry was next discussed and after pointing out the impracticability of a free range for the breeding stock owing to the loss caused by jackals, etc., it was decided that the method at

present in use at Pusa was the most suitable, but the runs though large in comparison with those used in Europe might with advantage be still larger. Growing chickens up to the age of four or five months can, on shaded grass land, run together in flocks (each flock not exceeding 100 birds) provided cockerels and pullets are kept separate. The position of breeding pens and of pens for young stock should be regularly changed and very frequently, if chicken cholera or other infectious disease occur. Absolute cleanliness and disinfection against disease, lice and such like, must always be secured. Defective ventilation in poultry houses is a frequent cause of death by heat apoplexy. This point always requires attention.

The feeding of fowls was next discussed and the Sub-Committee considers that many cheap Indian grains are very suitable. The best general food for grown fowls is crushed wheat or crushed oats, but where these are difficult to obtain or of prohibitive price, jowar, and the smaller millets will be found suitable. A mixture of the common small millets roughly crushed is well suited for growing chickens from 10 days to 6 weeks old. Maize is unsuitable in India as its effects are far too fattening; the importance of green food was insisted on and a regular supply of crushed green bone, broken kanker or broken shells and grit is essential. Bad water is a frequent cause of disease and a small quantity of Condry's fluid should be added to the drinking water before it is placed in the drinking troughs. In hot weather the water troughs should always be placed in the shade. The Sub-Committee then briefly touched upon the improvement of other classes of poultry.

*Ducks.*—Mr. Abbott stated that the Aylesbury breed is the most suitable as a pure breed and for crossing purposes in India. The Black and White Benares duck was the best indigenous Indian variety some years ago. The Sub-Committee recommends that the United Provinces Department be asked to make an enquiry as to the extent to which this breed now exists.

*Geese.*—It is known that geese of good type occur in India and that good breeds of the Chinese variety can readily be obtained in Calcutta. The Sub-Committee considered that good work can be done by selection and by crossing with European breeds particularly with the Embden variety.

*Turkeys.*—The Sub-Committee considers that local breeds can be greatly improved by crossing with the American-Bronze Turkey. This breed should also be maintained pure. Birds can best be obtained from Australia or England. These breeds in Australia are probably preferable for India.

*Guinea Fowls.*—Do not require much improvement as the present Indian breed is excellent in most respects.

The Sub-Committee then discussed the extent to which larger table birds and bigger eggs were likely to be in demand and whether the increase in prices necessitated by the increased cost of production could be realised.

The Sub-Committee recognised the difficulty experienced in most Indian towns in obtaining decent table fowls and believed that at least in the larger towns good fowls and large eggs would readily sell at profitable prices. Europeans and well-to-do Mahomedans and Parsees especially are anxious for poultry of better quality and are willing to pay any reasonable prices. Mr. Abbott estimated that a good cross-bred fowl would fetch Rs. 1-8-0 in the larger towns and considered that good eggs would easily repay the cost of production. The Sub-Committee recommends—

- (I) that the breeds indicated in this report as suitable for India should, in a practical way and on the lines suggested, be dealt with at Pusa.
- (II) that it is necessary to have a specially-trained assistant for the purpose.
- (III) that the chief object should be to provide a means of producing general utility fowls in India.
- (IV) that from Pusa selected birds should be distributed for pure breeding and for crossing.
- (V) that if the preliminary work at Pusa shows that poultry breeding on the above lines gives promise of becoming a remunerative industry, the work should be extended through all useful agencies in India, such as Provincial Agricultural Stations, Grass Farms, Missions, European Planters, Eurasians and well-to-do Parsees and Mahomedans,

THE LINES ON WHICH ENTOMOLOGICAL AND MYCOLOGICAL WORK  
IN THE PROVINCES SHOULD BE CONDUCTED.

42. The president opened the discussion of this subject by referring to the printed note (see Appendix D) containing his proposals for the expansion of different sections of the Provincial Departments of Agriculture. He suggested that the general question of the rates of pay and prospects required to attract the best sort of men to the Department should be first considered.

Dr. Mann held that the important point which the Board should consider is the possibility of suggesting an ultimate prospect of pay sufficient to attract the best men. The actual number required in each Province is immaterial at present. To obtain the type of men required for the upper subordinate posts in Agricultural Departments, it is necessary to offer prospects equal to those which obtain in other Government Departments.

Mr. Molony believed that the scale of pay must differ to some extent in the different Provinces. This is the case in most departments, and is due partly to difference in the cost of living. In the United Provinces the proposals are to form two divisions, a lower and an upper division. The latter is graded to make it about equivalent to appointments in the Revenue Service as Tahsildars. Five appointments are proposed at Rs. 125, five at Rs. 150, five at Rs. 175, four at Rs. 200 and four at Rs. 250. Among these if men of really first rate merit and administrative capacity should be found, they should have the prospect of becoming Assistant Directors on graded pay approximating to that of Deputy Collectors. Promotion from grade to grade in the upper division is by merit only, not by seniority. The Agricultural Department should at first offer terms a little better than those in the executive service, because being a new service it will carry less prestige.

Mr. Sly said that the present service in the Central Provinces is graded at from Rs. 50 to Rs. 250. In the short experience of this graded rate, it appears to be insufficient to attract the best men. The best solution is probably to have one general graded service so that any man in any section of the Department may rise to the highest scale of pay. This service should be approximately of the same standing, as regards pay and prospects, as the Revenue Service. There should further be an opportunity of nominating good men from the agricultural service to appointment as Deputy Collectors. He considered that the President's proposals are too definite, as the circumstances vary from Province to Province. In the Central Provinces a student passing into the service from college would begin on Rs. 50. If he is specially good he might pass at once to a higher grade. The ultimate prospect is the point to which the individual will look.

Mr. Hart agreed with Mr. Sly. In Eastern Bengal the higher grades would, if approximating to the Revenue service, be about from Rs. 200 to 800.

Mr. Hayman held that the pay should be somewhat better than that of Tahsildars to attract the same class of men. A subordinate in the Revenue Service is a great man in the village; an Agricultural Assistant will be at first at least a nobody.

Mr. Couchman thought that the Board is inclined to overlook the great competition in the Revenue Service and the very small proportion of men who ever rise even above Rs. 60. In Madras a large proportion of the Revenue Service serve a long apprenticeship on a pay of Rs. 15. Then they rise to Rs. 35. To the vast majority the ultimate scope of their highest ambition is to become a Tahsildar. He considered that for the present a maximum prospect of Rs. 250 would attract the best men. The student might spend a year on probation at Rs. 25 and then commence on Rs. 40 or Rs. 50. As a Farm Manager he will have a prospect of Rs. 50 to 100 at first and possibly Rs. 100 to 250 later on. Finally one or more Assistant Directors would be appointed on pay of Rs. 250 to 400.

Mr. Dobbs pointed out that the Agricultural Department ought to pay more than the Revenue Service, because their field of selection from the lower grades will be so limited that only good men should be taken into the Department from the start.

Mr. Renouf said that the present maximum pay in the Punjab was fixed at Rs. 300. This is probably too low and Rs. 500 might be better. The latter ultimate prospect should, however, be enough to get the right men, and there is, in his opinion, no need to equalise with the Revenue Department which is admittedly the

best in the Province. The scale proposed is Rs. 40 rising to Rs. 70, with further promotion to higher grades of from Rs. 80 to Rs. 120. The College Assistant Professors will get a maximum of Rs. 300.

Mr. MacKenna agreed with Mr. Sly's views since they merely equate the Agricultural Service to the Revenue Service and the actual pay will differ in different Provinces.

Mr. Gourlay considered that it will be necessary to offer definite prospects of high ultimate pay from the commencement, at least equal to those of the Provincial Executive Service.

Messrs. Knight and Bergtheil gave specific instances from their recent experience of the difficulty of keeping promising men in the Department on the present prospects.

43. The Board considers that the present prospects in the Agricultural Department are insufficient to attract the right stamp of men for the upper subordinate posts, such as First Assistants, Assistants to Experts, Superintendents of Experimental Stations and the like. That the prospects for the upper subordinate staff should be somewhat better than those offered in the Provincial Executive Service, in view of the fact that the service is new and specialised. The Board is not in a position to suggest the number of posts or particular grading required for each Province.

44. The specific question of the conduct of Entomological and Mycological work in the Provinces was next considered. The President referred the Board to the notes on this subject furnished by the Imperial Mycologist and the Imperial Entomologist (Appendix D).

Mr. Sly said that it is clear that under present conditions the research work in both these subjects must be done at Pusa. To assist the Pusa Experts it is probable that a small staff must be maintained in the Provinces. Similarly some staff is required to assist in the teaching of these subjects in Provincial Colleges. From the practical aspect he, however, disagreed with the notes submitted. Instead of having a specially-trained staff to do such field work in the checking of pests or diseases as may be required, he believed that this object will be most satisfactorily gained by using the regular staff of Agricultural Assistants. As regards the control of the men the Botanist may in some cases be the best man, but ordinarily the Deputy Directors should supervise the work of the fieldmen.

Dr. Butler expressed general agreement with Mr. Sly's views, except that in the case of the Assistant who would be concerned in teaching at the Agricultural College, he believed that he should form the part of the Botanist's staff. As regards the Field Assistants the opinion of Provincial officers appeared to be that the Deputy Directors could best control their work. He wished on further consideration and discussion with other officers to modify the staff suggested in his note, as it appears probable that immediate requirements in most Provinces will be met by having one College Assistant for teaching, demonstration and care of the collections, and one field assistant for general field work. A collector and mounter on small pay would complete the establishment.

Mr. Lefroy said that it will be impossible to work a scheme of practical work from Pusa. As he understood Mr. Sly's proposals, each Deputy Director would have one field assistant under his charge to assist the expert staff at Pusa. These men should, in his opinion, work up to one highly-trained Native Assistant Entomologist to the Provincial Department. Without this latter appointment Mr. Sly's scheme is incomplete. The latter should be on a pay of Rs. 250 to 500 and should control and co-ordinate the work of the rest of the staff. In cases of importance he should personally visit and advise on outbreaks of insect pests in any part of the Province. He would not be required for the teaching, since this, being elementary, could be conducted by a man of less high training. As regards the control of the staff he considered that it is immaterial under whom it should be placed.

Mr. Milne agreed with Dr. Butler that the Assistant concerned in teaching Mycology should be under the Botanist, since Mycology is merely a branch of Botany and the Botanist will always have some knowledge of it.

45. The Board is of opinion that the Provincial work in Mycology and Entomology should be limited to the employment of a special staff (1) to give such assistance as is required for the research work to be conducted at Pusa and (2) for

the elementary training required at colleges. The practical field-work for the prevention of pests and diseases should be undertaken by the ordinary staff of Agricultural Assistants. Further that the teaching in Mycology at Provincial Agricultural Colleges including any special staff required for the purpose should be under the control of the Provincial Botanist.

#### SIXTH DAY.

#### PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

##### I.—AGRICULTURAL CHEMISTRY.

46. The Board adopts the recommendations of Sub-Committee (H), appointed to consider this programme, that the enquiry into feeding stuffs should be abandoned and that general-analytical work for Provincial Departments and others should be excluded from the programme as they should properly be done by Provincial Agricultural Chemists.

47. The Board adopts the report of Sub-Committee (H) as follows :—

The criticism of the Advisory Committee of the Royal Society of London on the Agricultural Chemistry Programme in the Economic and Industrial Chemistry Section of the Report of the Board of Scientific Advice, 1905-06, was generally discussed.

The Sub-Committee considers that investigations of general problems which can be made as well or better elsewhere should not be taken up in India except in so far as is necessary for the investigation of problems which are of particular reference to Indian Agriculture. It recognises that full advantage should be taken of investigations made elsewhere, and their application to conditions of sub-tropical agriculture is an important aspect of the Indian problem.

The items in the programme were discussed *seriatim*.

*Available plant food in soils.*—With regard to the general question of the desirability of carrying on investigations into the determination of the available constituents of soil, the Committee considers that the study of plant nutrition is of importance in India; the question of availability of plant food is an essential part of that study in India as elsewhere. The application of existing methods of investigation must in the earlier stages be examined with special reference to Indian conditions.

An attempt is now being made at Pusa to determine what is the actual chemical and physical state of certain constituents of important Indian soils and the effect of some of these constituents on the others both during periods of fallow and when the land is occupied by crops.

The Sub-Committee believes that this line of work may lead to useful results.

*Gases in soils.*—The Sub-Committee considers that this investigation is an essential portion of the problem referred to above, and that it has special significance in regard to Indian conditions and should be continued.

*The testing of calcium cyanamide and calcium nitrate as manures.*—The testing of these manures was undertaken at the specific request of commercial firms who are prepared to undertake the manufacture on a large scale, provided the Agricultural Department could establish their utility. If the tests are successful there is every prospect that these materials will be manufactured in India on a commercial scale.

The Sub-Committee therefore considers that the tests should certainly be continued.

*The composition of field and garden crops.*—The Sub-Committee entirely agrees that the ultimate analysis of crops with the object of obtaining definite information with regard to their manurial requirements is not likely to lead to important results and should not be included in the programme of Agricultural Chemistry. This item was inserted without any reference to Dr. Leather.

*Water in soils.*—The Sub-Committee considers that this investigation is of particular importance in India, and will have an important application in solving the problem as to how much water various crops require; it should, therefore, be continued.

*Cyanogenetic glucosides.*—The Sub-Committee considers that this investigation should be looked upon as of minor importance.

*Feeding stuffs.*—The Sub-Committee considers that this item should be eliminated from the programme.

*General analytical work.*—As each Province has now an Agricultural Chemist, this item should be excluded from the Imperial Agricultural Chemist's programme.

*Training.*—This subject has been dealt with by the Sub-Committee (G).

In addition to the above the Sub-Committee considers that the chemical investigations connected with the permanent field experiments at Pusa should be included in the programme.

## II.—ECONOMIC BOTANY.

48. Dr. Mann desired the opinion of some of the Botanical members of the Board on the advisability of conducting investigations regarding the agricultural value of races of cultivated crops in any one locality, where these investigations are intended to apply to the whole of India. It appears to be still a moot question whether the characters of a plant do not undergo a certain amount of change when it is transferred to a new locality, especially if outside the natural area of the plant. Captain Gage said that from the botanical standpoint there appears to be no reason to doubt that the more important characters at least will be brought out wherever the work is done. It is not possible to talk of the natural area of a large number of important crops, as the origin of these is often only a subject for speculation. Mr. Gammie agreed with Captain Gage on both points and could see no reason why work of this sort should not be done at Pusa. Mr. Howard said that in any case there is no evidence available to permit of a full discussion and it appears better to await such evidence.

49. Mr. Sly enquired whether it is proposed to continue cotton work at Pusa. The President explained that this work had been started at Pusa because there appeared at one time a prospect of extending cotton cultivation in Behar. This prospect had not been realised and there seems to be no advantage in keeping it, except so far as it would help Mr. Gammie in his work. Mr. Howard said that all that is now proposed is to grow a series of types for students' information.

50. The Board accepts the programme of the Imperial Economic Botanist.

## III.—MYCOLOGY.

51. The Board accepts the programme of the Imperial Mycologist and further desires to add that the work in Systematic Mycology, mentioned in the programme, must for the present be done at Pusa in the absence of any other agency in India for the purpose.

## IV.—ENTOMOLOGY.

52. At Mr. Hart's request, Mr. Lefroy promised to arrange for a local enquiry into some important insect pests of paddy in Assam, should an outbreak be notified this year. Two other enquiries into important pests will probably be taken up if opportunity arises—the *surul* pest of ground-nut, and pests of stored potatoes. Mr. Henderson enquired to what stage the treatment of the boll-worm epidemic in cotton in Sind has advanced. Mr. Lefroy replied that experience both in the Punjab and Sind points to the re-introduction of the boll-worm parasite as having restored normal conditions. The parasite was introduced in Sind last year with a resulting better crop. The treatment is now beyond the experimental stage and full details will be published.

53. Mr. MacKenna said that lac appears to be a question for the Forest Department and not the Agricultural Department to deal with, so far as Provinces are concerned. Several other members agreed with this opinion.

54. The Board accepts the programme of the Imperial Entomologist and the Second Imperial Entomologist.

## V.—BACTERIOLOGY.

Mr. Bergtheil stated that he intentionally drew up as broad and general a programme as possible since he cannot decide, until work is actually commenced at Pusa, what items of the programme can be immediately taken up. The



programme is an outline of work which must necessarily require many years to complete.

55. The Board accepts the programme of the Imperial Bacteriologist.

#### VI.—AGRICULTURE.

The report of Sub-Committee (C) appointed to consider the programme of the Imperial Agriculturist was considered.

56. Mr. Shearer explained that the proposed permanent wheat and maize manurial series appended to the report has been prepared on the plan of the Rothamsted permanent manurial wheat plots, but as the Sub-Committee has not expressed a definite opinion regarding it, he desired the opinion of the Board whether it should be retained. After some discussion it was agreed to withdraw this series from the programme.

57. Mr. Clarke enquired how far it is intended to carry the work on sugarcane referred to in paragraph 3 of the programme. He considered that this work, especially that portion of it referring to selection, can only be useful if carried out on a large scale and regarded as work of the first importance. Mr. Howard pointed out that the matter was very fully discussed at Cawnpore last year and it was recommended to confine extensive sugarcane work to a very small number of stations. At Pusa there is no intention at present of undertaking extensive work. It is a minor question and, so far as it is confined to securing a good cane for local growing, there is no reason why it should interfere with other more important work. Dr. Mann held that it should be taken up at Pusa on a large scale and made a principal feature of the programme. Mr. Sly disagreed. Pusa is in a tract which is not at present an important sugarcane growing one, and so far as he could see, there are none of the local conditions referred to in last year's discussion which would justify work on a large scale.

58. Mr. Shearer explained that indigo will be grown in rotation with flax, as mentioned in paragraph 4, on the advice of the Flax Expert employed by the Bengal Government. Mr. Bergtheil enquired if improvement by selection will be attempted with both crops. The President stated that if the Indigo Research Station at Surseah be kept on by the Bengal Government, selection of this crop should be done there and not at Pusa.

59. The President explained that there is a prospect of securing assistance in the tobacco curing experiments, mentioned in paragraph 5 of the programme, from an American Tobacco Expert from Monghyr. Unless such assistance can be secured it is doubtful if any work can be attempted at present.

60. Mr. Shearer explained that the varietal work mentioned in paragraph 8 with wheat, rice, maize, opium and castor, was intended to be merely preliminary to other work, should need arise for this. Dr. Mann held that such work should include plant to plant selection. Mr. Shearer and Mr. Howard agreed to this. The Board accepts the remainder of the programme.

#### VII.—PROGRAMME OF THE IMPERIAL COTTON SPECIALIST.

61. Mr. Gammie stated that he has as yet no definite proposals to make, owing to the recent date of his appointment. Details of work will be arranged in consultation with the Provincial officers. He has arranged to tour in Madras in March and to visit the Central Provinces and Eastern Bengal and Assam probably in November. It will only be possible to visit a portion of the cotton growing tracts this year owing to lack of time.

#### METHODS OF BRINGING EXPERIMENTAL WORK TO THE NOTICE OF CULTIVATORS.

The report of Sub-Committee (D) was considered.

62. The President invited suggestions regarding the publication of the report which, he considered, should be more widely distributed than can be secured in the published Proceedings of the Board. Several members agreed and offered suggestions.

63. The Board recommends that report of Sub-committee (D) be separately printed in pamphlet form and distributed to all District Officers in India, to

the Press and to others interested in the subject. Several members gave specific instances of means of disseminating agricultural improvements and getting into touch with cultivators not included in the report.

64. The Board desires that specific instances mentioned by various members, of the means of bringing the work of agricultural departments home to cultivators, other than those noted in the report, be incorporated in the latter by the President and that the report thus amplified be again referred to the members of Sub-Committee (D) for revision, prior to publication in separate form.

65. Mr. Howard considered that some of the agencies for securing the dissemination of agricultural improvements mentioned in the report, such as vernacular publications, are of minor value, and that sufficient stress has not been laid on the all-important agency of example. In Java where the problems of agricultural improvement approximate to those in India, everything is subordinated to the work of demonstration. The experiment stations are few and good and in connection with these a system of travelling farms or gardens has been developed and the work of the stations is thus brought home to the cultivators in every district by actual demonstration. Mr. Milligan held that it is dangerous to over-emphasise any one line of work in this connection at the expense of other lines which may be of special value in some places. Mr. MacKenna and Mr. Couchman agreed with Mr. Milligan and gave instances where the publication of vernacular leaflets has been of considerable utility.

66. The Board recommends that the subject of the best means of bringing the results of experimental work to the notice of cultivators shall be included in its programme in each succeeding year in the immediate future. Details should be furnished each year of the methods adopted in the different Provinces and their results, so that officers of the Department and others should know what has been and is being done, year by year, in this matter.

67. The Board adopts the report of Sub-Committee (D), as follows :—

The Sub-Committee desires to acknowledge that much valuable information has been obtained from the note submitted by Mr. Clouston on the introduction of improvements into Indian Agriculture.\*

The Sub-Committee has considered in succession the methods which have been suggested for bringing experimental work to the notice of cultivators. It is convinced that it is impossible to lay down any general system which is universally applicable, as the conditions are too diverse for methods to be equally useful in all Provinces or even in all localities in a Province. It proposes, however, to consider the means which have been employed in the various Provinces, and which have proved a success, and also to indicate the conditions which appear to lead to success or failure in each case.

*Agricultural Associations.*—The formation of local Associations for agricultural improvements has been one of the most common methods of increasing interest in the subject. It has been successful in some cases and more especially in the Central Provinces. On the other hand the success has by no means been universal.

In the Central Provinces, the local Agricultural Association is most directly connected with the Agricultural Department of the Province. The district is taken as a unit and the Collector is Chairman of the Association. The influence and co-operation of the district officers is considered to be an essential condition of success. It is held that the Associations must be in close touch with the superior officers of the Agricultural Department, one of whom always attends the meeting of the Association. The meetings are held half yearly before the opening of the *khari* and the *rabi* seasons, and the Director and Deputy Directors devote some months each year at these times to going from meeting to meeting. Thus they know the members personally. The members are limited in number, and consist chiefly or almost entirely of substantial agriculturists, owners of villages who are also cultivators, heads of sub-divisions of cultivating castes and the like,—and the members undertake to carry out a demonstration of an improvement suggested by the Department. In this they are assisted with seed, implements, or other materials needed for the purpose, and their work is inspected by the Superintendent of the nearest farm or other member of the Departmental staff. At every

\*In accordance with the recommendation of Sub-committee (B) (see page 6) this note has not been included in the proceedings but will be published elsewhere.

meeting an actual programme of work is submitted, criticised by the members, modified, if necessary, and the several pieces of demonstration allotted to the members. At the meetings the method of lecturing without any actual programme of work is being given up. In the programme no piece of work is recommended by the Agricultural Department, unless it has been proved by the Department itself to be likely to succeed. Two meetings such as have been described are held annually and though the people clamour for more, it is considered advisable not to add to the number. The time of holding these meetings depends on the system of cropping.

These Associations have been largely instrumental in introducing superior varieties of *tur*, of *jowar* and of sugarcane, and the adoption of improved implements. The greatest advantage is, however, felt to be that they bring the Department into close touch with the best cultivators in each district.

In Madras, the development of Agricultural Associations has taken a more independent line. They are officially patronised but are independent bodies. They usually take the district as the unit, but branch associations are formed in smaller areas. Their utility generally depends on the activity of local men, generally educated men and often substantial land-holders. They have in the deltaic areas been the means of introducing the system of transplanting single seedlings in rice cultivation. Elsewhere they have brought into practice improvements in manure conservation; they have caused the use of the process of green manuring with wild indigo after paddy to be adopted in the Tanjore district, and have introduced iron ploughs. They have been instrumental in extending the cultivation of paddy in Tinnevely, jute in Tanjore and Malabar, and ground-nut in Malabar and South Kanara. They have, however, not been in existence long enough for a definite opinion to be formed of their general utility. There is a Central Agricultural Committee in Madras which forms a link between the various local Associations.

In Bombay there has been comparatively little development on this line, but three District and a number of Taluka Associations exist. They are always independent bodies and often combine in their functions other purposes as well as those of agricultural improvement. The two most active and successful are in Dharwar (a District Association) and in the Sangamner Taluka of the Ahmednagar District. In each case they depend largely for their success on the personal influence of an active local man, and they only have official patronage. In Dharwar the Association has been instrumental in bringing about the extension of the cultivation of Broach cotton in the district, the more careful selection of Dharwar-American cotton seed, and the adoption of the Turnwrest plough. In Sangamner the Association organizes an exceedingly important local agricultural show subsidised by the Agricultural Department and has introduced improved varieties of wheat. It has led to the establishment of a gram bank; while breeding bulls have been introduced as a result of its operations. Many of the Bombay Associations are continually asking for demonstration to undertake, and the difficulty has been and is now to find matters of proved value for them to try.

In Bengal a Provincial Agricultural Association and Divisional and District Associations have recently been formed but it is too early to say what their effect has been. These Associations are largely composed of townsmen, pleaders and Zamindars not themselves cultivators. In fact cultivators' holdings are generally so small that it is considered unlikely that Agricultural Associations on the model of those in the Central Provinces are likely to succeed.

The utility of Agricultural Associations seems to depend largely on the presence of a body of substantial men who are also cultivators, on the *personal* touch of the higher staff of the Agricultural Department with the members, on the definite engagement by the members to do definite pieces of work, and on the regularity of meetings, inspections and reports. In other matters conditions will vary with the districts. It may and will be advisable to have smaller associations than those of a district in some instances. If such smaller associations can be sufficiently substantial and intelligent, the Sub-Committee considers that they should be encouraged.

*Demonstration Farms.*—Demonstration farms have in some cases had considerable success in Bombay and in the Central Provinces in bringing improved methods to the notice of cultivators and in securing their adoption, but as such, they have not been used to any extent elsewhere. In the Central Provinces, the

system adopted is as follows. In the first place experiment is rigidly separated from demonstration. Nothing is tried in a demonstration farm, which, in the opinion of the officers of the Department, is not actually of proved value for the tract in question, and each demonstration farm has a definite purpose in view. A varying amount of land is taken, which should not be greater than the particular purpose demands and the assistant in charge can efficiently manage; a small area carefully cultivated is much better than a larger area inefficiently managed. The occupation of the land is purely temporary. It is lent to the Department by an annual arrangement and the cultivator to whom the land belongs is guaranteed against loss. He is given also a large share or even the whole of the profits. The plots are selected by the Deputy Director or one of the senior officers of the Department. No difficulty has been found in inducing a cultivator to lend a suitable piece of land. An assistant is then placed in charge specially trained in the particular problem to be demonstrated. Local methods entirely must then be adopted in working the land except as regards the particular point to be demonstrated. The demonstration plot is visited at frequent intervals by the senior assistant of the Department who is also the Superintendent of the experimental farm for that particular tract, and who has a special interest in the success of the demonstration. The assistant in charge sends a weekly diary to the Deputy Director through the Superintendent of the Farm. The final success of the demonstration is judged by the general adoption of the method recommended and demonstrated.

The chief difficulties have been in obtaining suitable men to put in charge of the demonstration and in securing adequate supervision. The assistants placed in charge must be themselves agriculturists and generally they are men who have passed through the Agricultural College.

The demonstrations have proved very successful in the Chhattisgarh District (where rice is as a rule sown broadcast) in bringing the methods of transplanting rice into general practice, in showing how to use irrigation water most economically and effectively, and in showing how to grow additional crops after early rice instead of the present plan of leaving the land bare.

The Sub-Committee considers that there is considerable promise of demonstration farms conducted on lines similar to those followed in the Central Provinces proving useful in other Provinces.

*Village Agencies.*—It has always been a problem of considerable difficulty to get improved implements of undoubted value adopted by the cultivators, but the institution of village agencies as devised in the United Provinces promises success. These are managed by a local agent with whom implements are placed and from whom they can be hired out or sold. Before the agency is established, the particular implement is always demonstrated carefully to cultivators at the agency. An agricultural assistant then from time to time visits such agencies, accompanied by a *mistri* who can repair the implements, and inspects, gets machines repaired if necessary, visits the cultivators who have adopted them, and ascertains whether they are working satisfactorily. A register is kept of all those who buy the implements and the Deputy Director sends out an occasional note enquiring whether customers are satisfied.

Various implements, but perhaps most notably pumps, have been distributed by this means and the methods seem to get over the difficulty felt in Bombay and elsewhere that new machines are not adopted largely because of the difficulty of repair.

In this connection, it may be noted that a number of cultivators in one of the Canal Colonies of the Punjab (Lyallpur) are this year obtaining reapers on the recommendation of and through the Agricultural Department. About 50 reapers have been supplied. A class for *mistris* has been formed in connection with the Lyallpur farm and these men are trained in the use and repair of the machines. The Sub-Committee would urge the necessity, in this and similar cases, of taking advantage of the experience in the United Provinces, and securing the keeping in order of the machines for some years.

*Vernacular Agricultural Journals.*—Vernacular Journals have been established in several parts of India.

In the United Provinces, a monthly vernacular paper of six to ten pages edited by the head clerk of the Agricultural Department, is published. It has not been

so successful as it might be made by more careful editing and the appointment of a separate editor is under consideration. It may be considered as principally an attempt to bring the work and aims of the Department to the notice of the cultivators.

In the Central Provinces there is a monthly Departmental vernacular paper. It has been found that to be really useful, it must be very carefully edited, up to date, thoroughly practical, and deal with the immediate needs and interests of the cultivators. The translation into the vernacular must be carefully made by a man who is himself connected with the land. The paper usually contains very popular statements of the work of the experimental stations, with practical directions to enable the cultivators to apply them to their own circumstances. It contains also a "query and answer" column in which the readers are encouraged to ask the Department for advice. It also furnishes a means of advertising improved strains of seed, agricultural machinery and other things for sale at the stations. It consists of about 15 to 20 pages, is published in three languages and has a circulation of 2,500.

In Madras, no vernacular paper is issued by the Department. The Agricultural Department patronises two privately owned agricultural publications.

In Bombay there are three private vernacular agricultural journals, all of which are patronised by the Department. The Department subscribes for a number of copies and contributes articles and plates.

The Sub-Committee considers that where vernacular agricultural journals privately owned and worthy of support already exist, it is wiser to encourage and contribute to these rather than to start a Departmental publication. In many cases it thinks considerable good can be done by vernacular journals, provided they are well edited.

In this connection the Sub-Committee wishes to state its opinion that any journal published by Provincial Departments should be designed to meet the requirements of the cultivators and land owners. They should be essentially vernacular publications, with possibly an English edition. To meet the higher English speaking strata the Agricultural Journal of India published from Pusa should be the only medium.

*Leaflets and Circulars.*—Leaflets have been published in several Provinces giving information as to the results of experiments and recommendations as to methods to be adopted.

In Bengal a regular series of such leaflets is issued both in English and the vernacular, and they are distributed through agricultural associations but it is too early to draw any conclusions concerning their effect.

In Madras agricultural leaflets have been published in the vernacular in the District Gazettes. So far the effect has not been traceable. The introduction of *Banku* paddy into a large area is partly due to information thus published. As a result of a leaflet widely circulated in Godavari, no compensation has been demanded, for palm trees destroyed in the palm disease operations although some 200,000 trees have been killed.

In the Central Provinces the issue of leaflets has been suspended and such information is published in the journal of the Department which is a better medium. Both in the Central Provinces and in Bombay printed directions in the vernacular are issued, when new seed, new manures, etc., are distributed.

In general the Sub-Committee desires to express its agreement with the resolution of the Board of Agriculture in 1905 that leaflets "to be successful in reaching their object should be brief, perhaps not exceeding a couple of pages, and should contain one definite fact or the description of a single process which it is desirable that the ryot should know or adopt."

*Utilization of General Vernacular Press.*—At present, in the Central Provinces and Madras no use is made of the general vernacular press for the dissemination of agricultural information, while in Bengal it is only utilised in connection with Co-operative Credit Societies. On the other hand in Bombay considerable advantage has been taken of the press in the past, and matter is freely taken. In the Punjab a press communique is issued once a month to the leading English and vernacular papers and is considered to have been distinctly successful where it is

confined to information on established successes. In 1906-1907 the press was successfully used to bring to the notice of the cultivator remedial measures to check boll-worms.

The Sub-Committee considers that where the local press has a wide circulation it should be recognised as being a possible medium of reaching the cultivators, more particularly where there is no local agricultural paper with a wide circulation.

*Agricultural Shows and Exhibitions.*—An attempt has been made to utilize Agricultural Shows in nearly all Provinces, but with very varying success. In the United Provinces the attempts have been neither very successful nor popular. Lately, however, there has been an improvement in the method of carrying out the shows. In Bundelkhand, cattle shows lasting one day only, at which substantial prizes are given, have met with success.

In the Central Provinces, agricultural shows have only recently been developed. It is considered essential that one of the leading members of the Departmental staff should be present. It is thought that thus conducted the Department is brought in contact with a class of cultivators who cannot otherwise be reached easily. By combining popular lectures on the exhibits with practical demonstrations of each, much good work is thought to be done. The lecturer carries with him a small travelling case of exhibits to illustrate his lectures. The Superintendent of the Experimental Farm is usually the lecturer, and he is supplied with his lecture from head-quarters.

In Bombay, the use of special shows and exhibitions is new and dates from the Bombay exhibition of 1904. Nearly 500 selected cultivators were taken to that show, the exhibits were demonstrated in four languages and as a result there has been an increased sale of improved implements, and enquiries to the Department have much increased since this time. Since 1904 exhibits have been arranged at Surat, Ahmedabad and Satara, in each case as part of an exhibition arranged by a non-official committee, and similar arrangements were made for instructing cultivators. A good deal of success has followed the organization of a regular agricultural show at Ahmednagar. Here Taluka committees presided over by the Mamlatdar were formed beforehand. Every exhibit was certified as a man's own production by the village officer and in the case of grain a sheaf in addition to the sample was exhibited, while similar methods were adopted with other materials. The prizes were substantial. An attempt to give prizes for standing crops did not meet with great success. The Departmental exhibits, such as "well-jumpers," Ransomes iron plough, etc., were shown in actual operation. Among cattle, prizes were given for the progeny of bulls introduced by the Department. A similar show is being organised in the same district by the Sangamner Taluka Association, with the help of the Department, which is freely given. So far the cultivators are very keen to send their exhibits and great interest is taken in the competitions.

Some successful efforts have been made to hold cattle shows in Madras in recent years, but so far the actual effect on the agriculture of the district is hardly traceable. Local festivals are frequently made use of in popularizing agricultural improvements.

In the United Provinces meetings for the grant of Takavi advances have been made use of to bring agricultural improvements to the notice of cultivators.

The Sub-Committee is of opinion that agricultural shows should usually form a means of bringing matters of importance to the notice of the agricultural classes. It is felt, however, that while local effort may arrange the show, the part taken by the Agricultural Department should be very carefully organised, and attended to by one of the superior staff of the Department. Every effort should be made to make the exhibits in such shows actual specimens of the cultivators' production. It should be remembered too, that a show to be successful must be essentially popular.

*Itinerant Assistants.*—In Bombay, some of the senior assistants of the Department have been employed in travelling in the districts to introduce new varieties of seed. Large quantities of Broach cotton and of better varieties of groundnut have been sold to cultivators by this means and reports of success have been collected by the same agency.

In the Central Provinces similar means have been adopted successfully to introduce new implements but not for other purposes.

In Madras, assistants employed in going from place to place have secured the adoption of improved sugarcanes in many cases, as well as of better types of ground-nuts.

In the United Provinces itinerant assistants have been employed to spread the use of new seed and implements.

In Bengal travelling Inspectors have been appointed comparatively recently.

On the whole the Sub-Committee thinks that especially for the introduction of new implements which can be demonstrated by travelling assistants and for that of new seed, itinerant inspectors are of great value. It considers, however, that men so employed, should, for each journey, have a definite object in view. It does not approve of mere travelling assistants without specific duties.

In the same connection mention may be made of the Divisional Inspectors recently appointed by the Bombay Department. Their function is to work in the districts, with the experimental farms as head-quarters, with the object of bringing the Department into touch with the agriculturists. The men so employed are among the best in the Department, are practical agriculturists themselves, and are chosen because of their capacity to obtain the confidence of the cultivators.

*Seed Farms.*—In Bengal two successful jute seed farms have been established and these have been able to spread selected jute seed over the country. The seed is in strong demand among the growers.

In the Central Provinces seed farms and seed selection have had considerable success. Farms for the supply of selected cotton seed have been established in special tracts, and the cultivators have already imitated them in giving more attention than is usual to the cultivation of the plots intended for seed, to the spacing of the plants, to selection of seed, and to the ginning of the cotton.

In Madras, seed farms have been established for cotton, while in the Punjab large quantities of Dharwar American cotton have been grown and distributed. In the latter case agricultural assistants have also toured in the villages regularly, and arrangements have been made to secure a higher price for the improved staple.

On the whole the Sub-Committee considers it has been proved that the general demand for good and pure seed is undoubtedly considerable. If the Departments can establish seed farms, it should be considered as a really good line of work particularly in places which have a local reputation for the production of seed of a superior quality.

*Seed Depôts.*—In the United Provinces great success has been attained in the spreading of the superior Muzaffernagar white wheat by the use of seed depôts where sale is effected on credit. This system continues to increase greatly in popularity and extension is limited only by the difficulty of providing responsible supervision. The amount of seed so issued in 1906-07 amounted to over 10,000 maunds. The successful restocking of Bundelkhand after the last great famine indicates a line of work that can be usefully followed under similar conditions.

In Bengal, a depôt has been established where a variety of useful seeds can be obtained. Here the quantity of seed available for a single buyer is limited. Almost all the sales are to members of the various local agricultural associations. This depôt seems likely to be very useful.

In Madras, a depôt for cotton seed was maintained at Bellary for several seasons, but has now been closed. There is also a depôt for ground-nut seed at Palur. A great demand for good seed always exists.

The Sub-Committee feels that the establishment of seed depôts is likely to lead to excellent results, provided that only the very best seeds are obtained and sold. A single distribution of inferior seed, by accident or carelessness, is likely to lead to great damage to the Department and should be avoided at any cost.

*Importation of Cultivators from district to district.*—Two or three cases have been brought before the Sub-Committee where great improvement in local practice has been obtained, by the introduction of cultivators from one district to another. These were the bringing of men to Cawnpore and to Nagpur, to work land treated with night soil and poudrette. In both cases success was ultimately achieved and

the local cultivators have followed the improved methods. A case of failure of a similar method in the Chingleput District of Madras was, however, noted.

In the opinion of the Sub-Committee this is a method which should be considered. It may be possibly applicable in connection with the introduction into Sind of the improved methods of cultivation demanded by Egyptian cotton.

Allied to this, is the method of sending a gang of sugar boilers from the Poona district round the Bombay Presidency (even to Sind) and to the Central Provinces to show better methods for preparing *gur* from sugarcane.

This has been fairly successful in many centres.

*Short courses for Cultivators at Experimental Farms.*—The only Department which has adopted the system of having short courses of instruction in specific subjects at the experimental farms, is that of Bombay. Here, hitherto, courses limited to a few weeks only, in cotton seed selection have been given on the Surat Farm. It is now, however, proposed to extend these courses considerably. The use of new implements and machinery; better methods of dairying in Guzarat; methods of dealing with sugarcane and several other courses will shortly be taken up.

The Sub-Committee considers this method is worthy of more extended trial if cultivators can be induced to go to the farms for the purpose.

In Bombay too the sons of ryots are taken for two year courses on some of the farms. This is rendered possible by the provision of the funds by a Bombay gentleman for the purpose. In the United Provinces, an offer is made to teach and train labourers if these are sent to the farms. Wages are paid, but not many usually avail themselves of the opportunity. Demand exists for similar facilities in the Central Provinces, but only from Missionary Schools.

The Sub-Committee feels that with suitable precautions such training may be a method of considerable advantage.

Amongst the general operations of Departments which have been instrumental in popularizing them amongst the cultivators, the well-boring work in the United Provinces requires special mention: 180 new wells have been bored and in 117 existing wells the supply of water has been increased. The success attending these operations has been of the greatest value in inclining the people to rely on the assistance of the Department in agricultural matters generally. Not alone in questions of water supply but in other matters, the advice of the Department is freely accepted in many localities where the well-boring work has brought the people into touch with its officers.

Before proceeding to draw general conclusions on the subject referred to it, the Sub-Committee wishes to draw attention to the financial aspect of the introduction of agricultural improvements by the Indian cultivators. It is impossible to estimate the value of any method to a cultivator unless account be taken of his financial conditions. In the past it doubts whether this has been done sufficiently. Ideas of a ryot's financial condition have often been very vague. It is probable that in many parts of India a cultivator does not have any ready capital. He has to borrow every year for the purpose of meeting the expense of cultivation, and the rates of interest which he has to pay in some Provinces are often from 25 to 75 per cent. per annum. It is therefore not sufficient that an expert in agriculture can prove to himself that a new method will give a return of 10 to 20 per cent. over the old method before the experiment is of "proved value." Account must also be taken of the extra capital involved and the rate of interest which the agriculturist will have to pay for this.

As the cultivator has no capital, he takes no risks. Unless we can show that the new method is a certainty, the cultivator will not take it up. A certainty will mean, as a rule, to a ryot something which will give him a return of over 25 per cent. improvement on the extra capital invested. The Indian cultivator is not nearly so conservative as is often supposed, but is quick to see any advantage, but there must be no risk, and he must be able to pay for the capital from the results of the new method.

The Sub-Committee is anxious to emphasise the connection between agricultural improvement and the extension of cheap credit, and hence the close connection and



collaboration which should exist between the Department and the Co-operative Credit organization. The latter is often in the opinion of the Sub-Committee the best possible introduction to agricultural improvement. Improvement of agriculture by co-operation and Co-operative Credit Societies have gone hand in hand in the principal agricultural countries on the continent of Europe.

*General.*—It remains now to summarise the general conclusions to which the Sub-Committee have come on the questions referred to it. It considers that among all the methods the utility of which it has examined, each is adapted to special conditions. It seems certain that if a really good improvement can be presented to the Indian agriculturist he is ready to take it up. The conservatism of the cultivators is generally exaggerated.

The winning of the confidence of the cultivators is the first condition of success in any of the methods that have been detailed. The cultivators must, in fact, feel that they can turn to the Department for further assistance which will be willingly given to them. With the spread of primary education it will be possible more easily to win their confidence, but success depends much more on the personality of the officers of the Department than on any system.

It must be remembered too, that one great essential is to find by careful local investigation the *actual* needs of the cultivators rather than recommended outside methods which may be improvements, but are not acceptable under the local conditions.

Another point which it seems desirable to emphasise is the necessity of being absolutely sure of the ground before attempting to introduce an improvement, and even in such cases it is inadvisable to try to improve practices in vogue without a carefully considered plan.

Finally, the Sub-Committee desires to urge that work should be concentrated on comparatively small areas at one time and energy not dissipated over a large stretch of country. Once a method is thoroughly established and recognised as an improvement over a small area, a knowledge of it will spread naturally and without effort over similar areas in the surrounding country.

The Sub-Committee feels that its report has reached a much greater length than was anticipated, but in matters of this sort, it feels it essential to go into considerable details, because details which at first sight seem unimportant, very often, in such matters as at present under consideration, have been the determining factor in the success or failure of the work undertaken.

#### THE CULTIVATION IN INDIA OF FIBRE PLANTS.

The report of Sub-Committee (E) was considered. Several members considered that the report is incomplete and referred to a number of important matters that are not included.

68. The Board decides that the report as submitted be referred by the President to each Provincial Director of Agriculture in order that for each province all information available on the subject be gathered, so that the report before publication should be made as complete as possible. The President will then amplify the report and refer it back to the members of Sub-Committee (E) for revision, and will arrange for its publication in pamphlet form.

#### THE SYLLABUS OF STUDIES IN THE PUSA AND IN PROVINCIAL COLLEGES.

The report of the Sub-Committee (G) was considered.

69. Mr. Molony stated that he was not aware that the question of the syllabus of Provincial Agricultural Colleges would be considered and that he had been unable to consult all the officers of his department on this most important question. He thought that it would be advisable to postpone the discussion until next year. This was not adopted.

70. Mr. Sly enquired whether advanced students could be taken at Pusa at once. The President replied in the affirmative.

71. Mr. Sly approved the recommendation of the majority of the Sub-Committee that practical training in the field during the first year should form part of the syllabus in Agriculture in Provincial Colleges. It is, in addition to the advantage gained by practical work from the start, the most useful method of weeding out

unsuitable students early in the course. Messrs. Leather, Howard, Gourlay, Sampson, Evans and Meggitt agreed with this view. Mr. Howlett said that the only difficulty appears to be in arranging the course so that no practical work should be undertaken which required for its proper performance any theoretical knowledge, before such knowledge had been acquired. Mr. Barnes said that he looked on Agriculture as a technical art based on several sciences. In similar cases elsewhere the best opinion holds that specialization should be postponed as far as possible until the full educational value of the sciences concerned has been realised. He regards the sciences of Chemistry, Botany, Zoology and the like as primarily educational and hence they should be taken before their practical application is attempted.

72. Mr. Lefroy suggested that the course of Zoology recommended by the Sub-Committee be omitted from the syllabus. It is, as defined, a pure science course, based on dissections, and of no direct value to agricultural students. Mr. Howlett supported Mr. Lefroy. Dr. Mann said that the students come up absolutely ignorant of even the rudiments of Zoology and scarcely know the difference between bone and muscle. He considered that the course suggested should be retained. Mr. Milne agreed with Dr. Mann. An elementary course is all that is required, but he considered it would be a disgrace to give the diploma in Agriculture proposed, to students entirely ignorant of Zoology.

Mr. Leake desired to point out that the Entomology and Zoology courses recommended in the syllabus are incompatible with the views expressed in the note of dissent appended to the report. He looked on Zoology as a subject for general education. To substitute or even to introduce a considerable element of Entomology is to plunge straight into specialization.

73. The Board adopts the report of Sub-Committee (G) as follows, with the omission of the course in Zoology in the standard curriculum for Provincial Agricultural colleges:—

With regard to item (a) of the terms of reference, the Sub-Committee is of opinion that the class of instruction at Pusa which will be of the most advantage to the Provinces is a post-graduate course for students who have already obtained a degree at a Provincial Agricultural College. The Pusa advanced course might also be open with the special permission of the Director of Pusa, after consultation with the heads of the sections concerned, to students who are not graduates of a Provincial Agricultural College, but who, by reason of their education in science, are likely to derive real advantage from the advanced course.

The Sub-Committee is further of opinion that suitable courses should be provided at Pusa for the following:—

- (i) Students who will afterwards discharge the duties of Assistants to Provincial Experts in Agriculture, Agricultural Chemistry and, in particular, in Economic Botany, Mycology and Entomology.
- (ii) Students sent for special purposes.

It recommends that curricula or schemes of study should be framed for each of the courses of training required in class (i) and should be submitted at the next Meeting of the Board of Agriculture. It does not consider it practicable to frame definite curricula immediately, owing to lack of time, and because it is a matter which requires careful consideration in view of the fact that the Provincial staffs have insufficient experience as yet in the working of the Colleges.

The Sub-Committee is of opinion that the consideration of item (b) of the terms of reference should be deferred until the next Meeting of the Board of Agriculture.

With regard to item (c) of the terms of reference the Sub-Committee, having considered the general principles relating to Agricultural Education recommended by the Board of 1906 (Board's Proceedings, 1906, items 5 to 9), desires to make the following remarks:—

The Sub-Committee re-affirms item 5 of the Board's Proceedings of 1906.

The following changes in item 5-A are recommended:—

The word "might" in the first line to be changed to "should" and the word "assist" in the second line to be omitted.

The words in lines 5 to 7, from "which would fit them" to the end of the sentence to be altered to "which would fit them for managing their own or other private estates, for employment as Managers of Court of

*Wards Estate, and District Associations and for upper subordinate posts in Agricultural Departments.*" The words after "propose" in line 7 to the end of the sentence to be changed to "a course which should admit of a moderate amount either of expansion or reduction to meet local conditions."

In item 6 it is recommended that the words in lines 4 and 5 "private students who may not have in view employment in Government service and who" be altered to "such students as."

Items 7 and 8 are re-affirmed.

The Sub-Committee recommends that the words in item 9 after "course" to the end of the sentence be changed to "and that the only agricultural instruction in the first year should be practical training in the field."

Regarding the standard curriculum for Agricultural Colleges determined upon by the Board of 1906 (Board's Proceedings 1906, item 74\*), the Sub-Committee desires to re-affirm the rough time-table proposed at the head of the curriculum.

It re-affirms the Agricultural Syllabus.

It re-affirms the Syllabus in Physics and Chemistry, with the addition of the following to the note prefixed to the Syllabus:—

"NOTE—It is to be understood that the student is not expected to possess a comprehensive knowledge of every item in the Syllabus. The object of the course is to enable the student (a) to understand what are the chief chemical and physical properties of matter, and (b) to obtain a knowledge of these properties as regards substances with which he is brought into direct contact in agricultural work. In the Organic Chemistry course only a general knowledge of constitution is required."

It recommends the omission of the note on page 21.

With regard to the Botany Syllabus it recommends that the introductory note (page 22) be omitted, that after the heading *Botany* the words in small print be omitted and the words "two alternative Syllabuses are put forward" be added, the two schemes to be simply numbered 1 and 2.

It is recommended that the Syllabus in Entomology and Zoology be amended to read as follows:—

## ENTOMOLOGY.

### FIRST STAGE—CLASS WORK.

(1) The structure of a caterpillar, and of various types of winged insects, including only the following:—head, thorax, abdomen, segments, eyes, antennæ, mouthparts, legs, prolegs, wings, spiracles, ovipositor. These are to be shown in as many large types as possible and no other terms are to be used (pages 3-9)\*.

(2) The stages in the life of a typical butterfly (e.g., *Danais plexippus*, the akh caterpillar) and of a grasshopper or bug. The life of each to be treated in as much detail as in Indian Insect Pests and every stage shown *alive* (pages 15-21).

(3) The distinction between insects with and without a metamorphosis, as shown in different types.

(4) The characters of the seven orders in the winged stage (pages 52-55) and the more prominent immature stages, caterpillar, maggot, grub. The meaning of the terms egg, larva, caterpillar, maggot, nymph, pupa, chrysalis, cocoon, imago (pages 55-57).

(5) The placing in its order of every insect captured and brought to the class by students or lecturer until each order is recognisable at once.

(6) The distinction from insects of allied forms of life, likely to be mistaken, e.g., spiders, mites, ticks, centipedes, millipedes (pages 1 and 2).

(7) A short account in class of every insect found to be injurious on the farm or in the field, of which specimens (alive) are brought into class by students or the lecturer.

(8) Demonstration of the insects maintained alive by the lecturer in the laboratory.

\* References to pages and chapters refer to "Indian Insect Pests."

(9) The food of insects, attention being drawn simply to the fact that insects fall mainly into the following classes:—Plant feeding, scavenging, predaceous, parasitic, insects on warm-blooded animals, household insects and aquatic insects. The recognition of biting and sucking mouthparts (pages 10-14, 6 and 7).

#### FIRST STAGE — PRACTICAL WORK.

Demonstration on the farm or in the field of any available insects; the order they belong to; how they feed, and on what; what stage of life they are in and what they will become or what they have come from. Collection by the students of all available stages of commoner forms which are brought into class. Demonstration of all injurious insects, the student being encouraged to find any stage of the insects previously described by the lecturer in class.

Whenever possible, an hour's field work is followed by an hour's demonstration, in class, of the insects collected and the specimens of damaged plants brought in. Such combined field work and demonstration would alternate with formal lectures or take the whole time during the rainy season or when crops were ripening.

#### SECOND STAGE — CLASS WORK.

- 1 A general account of the features of insect life as given in pages 22 and 23 of *Indian Insect Pests*.
2. An account of the Chapters V-VII of *Indian Insect Pests*.
3. More detailed accounts of injurious insects occurring on the Farm or reported from the Province, *when the stages of each pest can be shown*, with an account of such remedies or preventives as can be used.
4. Useful insects, including bees, lac, silk (Leaflet).
5. Insects destructive to grain and stored produce (Chapter XIX, and Leaflet).
6. Insects injurious to cattle; the part played by insects in disseminating disease (Chapter XX).
7. Beneficial insects (Chapter XXI).
8. Form and colour in insects (Chapter III)

The lecturer should revise the notes taken in lecture and those taken of the pests seen in the field and shown in class. Reports should be written by every student of cases of pests seen in the field and these should be corrected by the lecturer, who should draw attention to the important points. Demonstrations of the methods of packing specimens alive for sending through the post.

#### SECOND STAGE — PRACTICAL WORK.

Demonstration on the farm or in the field of all injurious and common insects, but paying special attention to:—

1. Predaceous insects, insectivorous birds, &c.
2. Parasites.
3. Preventive measures.
4. Remedial measures.
5. Distinguishing important from unimportant insects on a crop, and ascertaining exactly what is the real cause of damage.
6. The meaning of the form, colour and attitudes of insects as seen in the field.

When any remedial measures are adopted in the farm, the students should be present and there should be demonstrations of spraying, with lead arseniate, crude oil emulsion, kerosene emulsion, the last being made on the spot. The use of crude oil emulsion on cattle to destroy ticks, &c., should also be shown.

As before, whenever a pest occurs on the farm, the teacher should have combined field-work and demonstration, following a lecture on that pest.

#### THIRD STAGE — CLASS WORK.

A complete account of the crop pests of the Province treated crop by crop, as in "*Indian Insect Pests*." For this, the information given in leaflets should be used

where available, but no more detail should be given than is in Indian Insect Pests. As many stages as possible must be shown. Latin names are not to be used for plants or insects. The heads of each lecture are:—

1. The pest, how recognised in the field—Vernacular names.
2. Life history.
3. Habits and destructiveness.
4. Distribution in the Province.
5. Seasons at which it is found.
6. Parasites and enemies.
7. Treatment.

With these lectures alternate the field-work and demonstrations, the lecturer also revises the student's notes of each pest, seeing that he completes them from previous notes and that he has a fairly complete account.

A revision of the more important pests, not crop by crop, but order by order, so that the student may have an idea of the relative economic importance of each order and know what pests are closely allied.

#### THIRD STAGE — PRACTICAL WORK.

Demonstration of every injurious insect found on the farm or in the field, and of its enemies and checks. The important points to be noted in reports are drawn attention to and the students taught to see and note the facts they require for the reports they draw up in class afterwards.

#### ZOOLOGY.

The course in Zoology is intended to be introductory to the study of Veterinary Science and Entomology. Students should make themselves practically acquainted with the structure of the following types:—

- (a) A small mammal.
- (b) A frog.
- (c) An invertebrate.

The Sub-Committee re-affirms the Syllabus in Veterinary Science.

In the Syllabus of Agricultural Engineering it recommends the addition of the following words in brackets under the section "*simple dynamics and machines*." "(The training should be practical as far as possible.)"

The Sub-Committee further recommends that the Syllabus as now revised be printed separately for circulation to officers concerned.

#### NOTE OF DISSENT.

The following note of dissent, by certain Members, to the recommendations of the Sub-Committee under item (c) is added to the report.

The undersigned consider that the students who now attend and for some time to come will attend the Provincial Agricultural College are, and will be, deficient in respect of a good general education.

We consider therefore that it should be clearly recognised that the courses given at the Colleges fall into two definite groups:—

- (1) Subjects taught for their educational value.
- (2) Special subjects directly connected with Agriculture.

We regard agriculture to be an art based on the several sciences and not a science of itself and therefore propose as subjects under the first heading the sciences on which the art of agriculture is founded; but these subjects should be taught in such a way that the main object of a sound education may be achieved

These subjects are Chemistry, Physics, Botany, Zoology and Mathematics. We are of opinion that no sound teaching can be given in the second class of subjects until at least a sound basis is laid in the first.

The first year's course should, therefore, consist only of subjects falling into the first class, that is to say, the exact sciences. This will lay the necessary foundation for the second class of subjects.

It will, however, be impossible to do more in the first year than lay the foundation of a sound education and it will be necessary to continue some of these subjects in the second and possibly the third year. In the second year subjects falling into the second class may be commenced.

Taking into consideration the many disadvantages under which the Indian student approaches the study of science in a foreign language, it seems to us unlikely that it will be possible to do more in the three years than carry the educational subjects retained to the point at which specialization may safely begin and as such specialization is only required in the few who remain in the Department, these would, of necessity, have to undergo a post-graduate training in that special subject.

G. CLARKE.

H. M. LEAKE.

J. H. BARNES.

We thoroughly endorse this view having regard particularly to the fact that the necessary breadth will have been given to the student's education by his having mastered thoroughly one language—English—before coming to the College.

A. C. DOBBS.

F. M. HOWLETT.

#### SCHEME OF INSTRUCTION FOR INDIAN AGRICULTURAL STUDENTS IN ENGLAND.

74. The President stated that as the Board has already been informed that higher instruction in the sciences pertaining to agriculture will immediately be provided at Pusa, he wished to omit this subject from the Board's Programme. This was agreed to, and the meeting terminated.

## APPENDIX A.

## PROGRAMME OF THE 4TH MEETING OF THE BOARD OF AGRICULTURE.

SUBJECT I.—*The confirmation of the Proceedings of the last meeting.*

SUBJECT II.—*The programme of work of the Imperial Department of Agriculture.*

A consideration of the programmes of—

- (1) The Director, Agricultural Research Institute, Pusa ;
- (2) The Imperial Agricultural Chemist ;
- (3) The Imperial Mycologist ;
- (4) The Imperial Entomologist ;
- (5) The Second Imperial Entomologist ;
- (6) The Imperial Economic Botanist ;
- (7) The Imperial Agriculturist ;
- (8) The Imperial Bacteriologist.

2. Provincial Directors should examine them to see whether they meet the requirements of their own Provinces ; Imperial Experts should examine them to see whether the programmes of branches, other than their own, meet their requirements.

SUBJECT III.—*The programmes of work of the Provincial Departments of Agriculture.*

A consideration of the programmes submitted by—

- |                            |                                |
|----------------------------|--------------------------------|
| (a) Bengal ;               | (f) The Central Provinces ;    |
| (b) The United Provinces ; | (g) Eastern Bengal and Assam ; |
| (c) The Punjab ;           | (h) Burma ;                    |
| (d) Bombay ;               | (i) Mysore State ;             |
| (e) Madras ;               | (j) Baroda State ;             |
|                            | (k) Kashmere State.            |

2. The Imperial Experts should consider whether the programmes meet their requirements and whether they can suggest improvements. The Provincial Directors should consider whether the programmes of other Provinces can be improved so as to meet any special requirement of their Provinces or to co-ordinate the work.

SUBJECT IV.—*The lines on which the Entomological and Mycological work in the Provinces (for which no European Experts have been sanctioned) should henceforth be conducted ; the expansion of the different sections of the Imperial and Provincial Departments of Agriculture and the adequate rates of pay which should be given in order to attract and retain the best men in the Subordinate Agricultural Service.*

A consideration of the note prepared by the Inspector-General of Agriculture (See Appendix D).

SUBJECT V.—*The best methods of getting into touch with cultivators and the instances in which and the means by which experimental works of proved value have already been successfully brought home to the cultivators.*

A discussion as to the best lines for future work.

SUBJECT VI.—*A study regarding the extension of cultivation in India of fibre plants other than cotton and jute, such as hemps, agaves, etc., and the effect of such extension of cultivation on the material prosperity of the country.*

A discussion as to best lines for future experimental work.

**SUBJECT VII.**—*The scheme regarding the course of instruction which Indian students deputed to England to specialize in Mycology, Botany, Entomology or Chemistry should undergo.*

A consideration of the notes by Mr. C. A. Barber and the Expert Officers of the Imperial Department of Agriculture.

**SUBJECT VIII.**—*Measures to improve the breed of Poultry in India.*

A consideration of a letter received by the Government of India, Revenue and Agriculture Department, from Mr. H. E. Abbott, Editor of the Indian Fowl Fanciers', Gardeners' and Farmers' Gazette.

**SUBJECT IX.**—*The future constitution of the Board of Agriculture in India.*

A consideration of the suggestions contained in the Government of India, Revenue and Agriculture Department, Circular letter No. 23-28-24, dated the 15th August 1907, to all Local Governments and Administrations regarding the constitution of the Board. The matter will be referred to a committee before being discussed by the Board.

**SUBJECT X.**—*The Improvement of the form of the Report of the Proceedings of the Board of Agriculture.*

A consideration of the suggestions contained in paragraph 3 of the Government of India, Department of Revenue and Agriculture, letter No. 208-28-38, dated the 1st February 1908.

J. MOLLISON,

*Inspector General of Agriculture in India and  
President, Board of Agriculture in India.*



## APPENDIX B.

PROGRAMME OF THE IMPERIAL DEPARTMENT OF AGRICULTURE FOR 1908-09.

*Programme of the Agricultural Research Institute, Pusa.*

The scientific work of the Institute for the coming year is indicated in the programmes submitted under the different sections.

Among the investigations mentioned, attention may be drawn to the following more important examples :—

- (a) *Rotation Experiments*, in the programme of the Imperial Agriculturist, in which the fertilizing value of leguminous crops and fallows in rotation with cereals and other crops will be investigated. The action of the organisms of the leguminous crops and the bacteria in the soil will be simultaneously dealt with by the Imperial Bacteriologist, and the Imperial Agricultural Chemist will take up the chemical aspect.
- (b) *Grass Experiments*, by the Imperial Agriculturist and Imperial Economic Botanist, to ascertain the effects of manurial and other treatment on the yield and on the varieties of grasses which were initiated during the past year, will be continued, and matters connected with the chemical section will be dealt with by the Imperial Agricultural Chemist.
- (c) The more precise determination of availability of plant food in Indian soils is being continued by the Imperial Agriculturist.
- (d) Investigations on Indian wheat and experiments on Indian fruits will be continued by the Imperial Economic Botanist.
- (e) The investigations into the biting flies of India, commenced by the Imperial Entomologist, will be specially taken up and continued by the Second Imperial Entomologist, Mr. Howlett.

The above-mentioned investigations indicate only the more important scientific work of the Institute during the coming year, including problems of a far-reaching character of great importance to Indian Agriculture. Besides this, the different sections will perform the work connected with minor investigations. The Entomological and Mycological Sections will continue their work on pests and diseases.

The European Scientific Staff of the Institute will for the first time be complete and will consist as follows :—

- (1) The Imperial Agriculturist, with one Supernumerary Assistant.
- (2) The Imperial Agricultural Chemist, with one Supernumerary Assistant.
- (3) The Imperial Economic Botanist, with one Supernumerary Assistant.
- (4) The Imperial Entomologist, with one Supernumerary Assistant.
- (5) The Second Imperial Entomologist.
- (6) The Imperial Mycologist, with one Supernumerary Assistant.
- (7) The Imperial Bacteriologist.

The Phipps Laboratories will be ready for occupation during the year and the apparatus and records will be transferred to the new building.

Regarding the question of the admission of students, the intention has been that distinguished students of the Provincial Agricultural Colleges should be sent to Pusa for a two years' course in specialising, but as some time must elapse before the arrangement can be given effect to, it is proposed that students should be selected by the Provincial Governments and given a general agricultural education at Pusa.

The publication work will be carried on as before and the stocking and indexing of the Library will continue. A Library Catalogue is in the Press and will be issued very shortly.

B. COVENTRY,

*Director, Agricultural Research Institute, and  
Principal of the Agricultural College, Pusa.*

## I.—AGRICULTURAL CHEMISTRY.

*Available plant food in soils.*—This subject has been referred to in previous programmes. The work during the past year has been on the lines already indicated, but in addition to work at Pusa, field experiments on the value of superphosphate are being conducted at a number of centres in Behar, that is, the laboratory results are being tested in the field. Whilst this work is yielding useful information, it must be fully recognised how empirical are our methods, and the laboratory work at Pusa is now being directed to a more thorough examination of the precise state of the compounds in the soil, the phosphates forming the first main objective. The more exact relationship of the carbonic acid gas in the soil to plant foods forms another part of the same subject.

*Water in soils.*—This subject divides itself under two heads, namely, drainage and evaporation. The four gauges at Pusa are providing interesting data regarding the former, which are supplemented by those at Cawnpore, the Director of Agriculture, United Provinces, being kind enough to allow me to co-operate with his department in this connection. In addition to the gross amount of water passing away, data are being collected regarding the rate of percolation and the nature and amount of dissolved substances which are carried with the drainage water.

The records of evaporation which are being maintained have so far led to two important conclusions, the one being that during dry weather water rises in the soil from a limited depth only, the other that the rate of loss depends (among other things) on the amount of water present. There is some hope, too, that the true relation between physical properties of a soil and its power to retain water may be rendered clearer than it is at the present day. An account of the first year's work is in the press.

A knowledge of the amount of water in a soil is, however, only one factor of a larger subject, for it is equally important to know how much water crops require. Tentative experiments are in progress on this part of the subject. The data which have been published in Europe and America are not only divergent among themselves, but would not, without verification, be applicable to Indian conditions. It is obvious that a more exact knowledge of the movements of water in soils will, at the same time, yield information as to the movements of dissolved substances, whether these are valuable plant foods or deleterious salts; at present this subject is chiefly characterised by its nebulous state.

*The Chemical investigations connected with the permanent field experiments at Pusa.*

*Cyanogenetic glucosides.*—It was explained in my last programme that the work on this subject is restricted at Pusa to the ascertainment of the conditions under which these compounds are formed in large quantity in the plant, and I cannot at present say much more than that the work is in progress. Some positive results were obtained last year with jowar (*Andropogon sorghum*), but it would be premature to publish them at present.

J. WALTER LEATHER, Ph. D.,

*Imperial Agricultural Chemist.*

## II.—ECONOMIC BOTANY.

*Plant breeding and Plant improvement.*—During 1908 the following crops will be studied:—Wheat, tobacco, cotton and barley as well as important *rabi* and *kharif* crops grown in Behar. The determination of the varieties of Indian wheat, tobacco and barley will be continued.

*Fibre plants.*—The collection and investigation of fibre yielding plants will be continued.

*Fruit experiments.*—The permanent experiments on the culture of Indian fruits will be continued on the lines laid down in the first report.

*Minor investigations.*—The study of Cassava as a famine food-stuff (with Dr. Leather). The economic importance of the male plant in Ganja cultivation.

*Publications.*—The monograph on Indian wheat will be completed.

R. J. D. GRAHAM, M.A.,

*Acting Imperial Economic Botanist.*

## III.—MYCOLOGY.

1. *Training*.—The training of probationers for posts of Mycological Assistants in the Provinces will be continued if any are sent up. Three have been accommodated during the past year and their places are now vacant.

2. *Research and experimental work*.—The amount of Pathological work of pressing importance which has arisen during the past year has led to the temporary abandonment of the work on *soil fungi*, referred to in my last programme. The following are the chief diseases at present under investigation :—

- (a) *Diseases of indigo*.—The introduction of the Java-Natal variety of this plant has led to severe outbreaks of disease. Its successful cultivation at the present moment centres on the checking of these diseases. They have not, however, been previously studied, and much investigational work is needed before even their causes can be determined.
- (b) *Wilt diseases of cotton, gram and pigeon pea (rahar)*.—The prolonged investigation of these diseases will be continued, and others taken up if occasion arises. Sesamum wilt will be investigated.
- (c) *Diseases of citrus fruits*.—A number of these have been recently reported and are under study. The results will probably be ready for publication during the year.
- (d) *Palm diseases*.—The biologic study of the parasite of bud rot is practically completed. Assistance will continue to be given in the operations to check this disease in Godavari.
- (e) *Sugarcane diseases*.—Field experiments with red rot and smut will be continued.
- (f) The identification and study of other crop diseases will continue as usual. A commencement has been made in preparing a text-book of Indian crop diseases, and it is hoped to complete this.

3. *Systematic work*.—The identification and recording of the species of *fungi* collected in India will be continued with assistance from abroad. Three of the main groups have been finished up to date from the Pusa collections. The three largest, however, remain.

E. J. BUTLER, M.B.,  
*Imperial Mycologist.*

## IV.—ENTOMOLOGY.

The work of the past year in studying and advising on insects injurious to crops will be continued. Special attention will be paid to insects injurious to indigo, to the problem of controlling Surface Grasshoppers and to pests of rice. Assistance will be given in directing the work of Provincial Assistants and in coping with any outbreaks of pests that may occur; this may form a large part of the work of the year, but the extent to which Provincial Departments of Agriculture will require assistance cannot be estimated until after the meeting of the Board.

No new investigations of an extensive nature can now be proposed. The enquiry into insecticides non-poisonous to cattle will be continued. The experimental cultivation of lac and of eri silk will be continued, and it is proposed to very tentatively take up other wild silks. The transfer of the economic collections to the main laboratory and the arrangement of records, collections, etc., for teaching will occupy some time. Should the teaching of advanced Entomology be taken up, the preparation of the syllabus will also require to be done. Simple leaflets to explain coloured plates illustrating common injurious insects will be prepared primarily for use in the Central Provinces, but this work will be extended to other Provinces, if necessary. To what extent this work will develop cannot now be foreseen, and, if necessary, other work will be dropped to give time for this.

The study of insect-eating birds will be continued by the Supernumerary Entomologist and further inquiry will be made into fumigation methods for treating grain and plants and into methods of checking white ants. A month's course of elementary Entomology will be given at Nagpur by the First Assistant.

No definite arrangements can now be made for further work pending the result of the discussion by the Board of the lines on which Entomological work is to be developed.

H. MAXWELL-LEFROY, M.A.,  
*Imperial Entomologist.*

---

## PART II.

The investigation of the biting flies of India, begun by the Imperial Entomologist, will be continued and extended, the distribution and breeding habits of the various species being especially studied, as being most likely to afford information of value in connection with the spread of disease.

Dipterous pests of crops will be studied as opportunity occurs. The sorting and arrangement of the collection of Diptera will be undertaken, and the species identified, wherever possible, while the care and maintenance of the large general collection will be taken over from the Imperial Entomologist and continued on the same lines as hitherto. The preparation of the text and illustrations of the book on Indian Insects will be continued in collaboration with the Imperial Entomologist.

F. M. HOWLETT, B.A.,  
*Second Imperial Entomologist.*

---

## V.—AGRICULTURAL BACTERIOLOGY.

Some of the following problems will be attacked as opportunity offers and time permits:—

- I.—The chief bacteria characteristic of Indian soils, particularly those taking part in—
  - (a) The fixation of Nitrogen.
  - (b) The rotting of organic material.
  - (c) Nitrification.
- II.—The characteristic organisms growing in association with leguminous crops in India, with particular regard to the inoculation of the soils growing them.
- III.—The bacteria taking part in the rotting of stored organic material under Indian conditions and the bearing of the knowledge gained on the conservation of cattle-manure in India.
- IV.—The fermentation processes accompanying the manufacture of Silage in India.
- V.—The fermentation processes taking place during the manufacture of Tobacco.
- VI.—The fermentation processes taking place during the manufacture of Indigo.
- VII.—Any bacterial diseases of important Indian crops.

C. BERGTHEIL,  
*Imperial Bacteriologist.*

---

## VI.—AGRICULTURE.

- (1) *Permanent manurial experiments.*—These are described in detail in series I below.
- (2) *Permanent Rotation experiments.*—These are described in detail in series II below.
- (3) *Permanent Wheat and Maize Manurial experiments.*—These are described in detail in series III below.
- (4) *Permanent Pasture Experiments.*—These will be continued according to the revised scheme appended. These experiments are not considered of the first order.

(5) *Sugarcane*.—Work on sugarcane will include (1) methods of planting, (2) methods of manuring, (3) selection by sports or otherwise. This work is not considered of the first order.

(6) *Flax and other Fibre Crops*.—The possibility of establishing a flax industry in this country will, in collaboration with Mr. Finlow, be further investigated. Experiments on the cultivation and preparation of flax will be conducted on a larger scale than hitherto. The flax will be grown in rotation with Indigo but these crops will not occupy the same land oftener than once in four years. The work will include plant selection in flax and in Indigo. Sann-hemp (*Crotolaria juncea*), *Sida rhombifolia*, *Hibiscus cannabinus*, *Hibiscus panduriformis* and *Malachra capitata* will be tested on a field scale. This work is not considered of the first order.

(7) *Tobacco*.—A fairly large area of selected indigenous and exotic varieties will be grown and experimental work in curing will be done in the curing house.

(8) *Varieties*.—Varieties tested will include those of wheat, rice, maize, opium and castor. Plant to plant selection will be carried out wherever possible.

(9) *Thrashing Trials*.—These will be continued on the same lines as last year with special reference to wheat.

(10) *Breeding*.—The breeding of bulls for the province of Bengal will be continued. A Dumbha ram has been purchased and he will be crossed with selected ewes. Poultry breeding will be carried on with selected imported and indigenous breeds. In connection with the cross-breeding of sheep and poultry Mendel's Laws will come under study.

(9) The general improvement of the estate will be continued.

*Note on the permanent experiments at Pusa.*

The problem of agriculture is to secure from the soil the maximum production possible under the existing conditions and with the resources at the command of the cultivator. Next to climate the most important factor in production is the degree of fertility of the soil. Soil fertility is conditioned by circumstances which are still far from being properly understood. While in a large measure a quality inherent in the soil, it may be profoundly modified by agricultural practice with respect to cultivation, manuring and rotation of crops. The proposed permanent experiment detailed below have been arranged with a view to study the conditions which determine soil fertility in a subtropical climate, and in particular the manner in which soil fertility is affected by the application of the important manures, including green manure, by rotation of crops (with special reference to the part played by legumes in a rotation), by cultivation and by fallows.

SERIES I.

*Permanent Manurial Experiments.*

The object of this series is to determine the specific effect on soil fertility of the more important organic and chemical manures applied alone and in various combinations to a two years' four course rotation.

<i>Kharif.</i>	<i>Rabi.</i>	<i>Kharif.</i>	<i>Rabi.</i>	Manures applied per acre.
1 Maize	Rahar	Maize	Oats	No manure
2 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 10 lbs Nitrogen
3 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 20 lbs. Nitrogen
4 Maize	Rahar	Maize	Oats	Farm-yard Manure to supply 30 lbs. Nitrogen.
5 Maize	Rahar	Maize	Oats	Rape cake to supply 20 lbs Nitrogen.
6 Maize	Rahar	Maize	Oats	Sulphate of Ammonia to supply 20 lbs Nitrogen.
7 Maize	Rahar	Maize	Oats	Sulphate of Potash to supply Potash as in Farm-yard Manure No. 3
8 Maize	Rahar	Maize	Oats	Superphosphate to supply Phosphoric acid as in Farm-yard Manure No 3
9 Maize	Rahar	Maize	Oats	Sulphate of Potash to supply Potash as in Farm-yard Manure No 3.
				Superphosphate to supply Phosphoric acid as in Farm-yard Manure No 3.
10 Maize	Rahar	Maize	Oats	Sulphate of Ammonia to supply Nitrogen as in Farm-yard Manure No 3.
				Sulphate of Potash to supply Potash as in Farm-yard Manure No 3.
				Superphosphate to supply Phosphoric acid as in Farm-yard Manure No. 3.

Plots to be  $\frac{1}{2}$  acre duplicated and all the crops of each rotation to be grown in the same year. Manures to go on every year on the maize.

## SERIES II.

*Permanent Rotation Experiments.*

This series is designed to determine how far soil fertility is affected by growing in a rotation leguminous crops (1) removed from the land, (2) returned to the land in the shape of green manures. It is complementary to series I, inasmuch as the results obtained will give an indication of how far legumes can replace manures in a rotation.

	Kharif.	Rabi.	Kharif.	Rabi.	REMARKS.
1	Maize	Barley	Maize	Oats	No manure.
2	Maize	Barley	San Hemp	Oats	Green manure on cereal rotation.
3	Maize	Rahar	Maize	Oats	Residual value of deep rooted pulse.
4	Maize	Rahar	Maize	Oats & Peas	Residual values of two legumes one deep and one shallow rooted.
5	Maize	Rahar	San Hemp	Oats	Residual value of a pulse crop plus a green manure.

Plots to be  $\frac{1}{2}$  acre duplicated and all the crops of each rotation to be grown in the same year.

## SERIES III.

*Permanent wheat and maize Manurial Experiments.*

This series has been prepared on the plan of the Rothamsted permanent manurial wheat plots but has been modified to suit Indian conditions. It was necessary to introduce maize as an alternate crop with wheat (1) because the land on which the plots will be grown normally carries two crops a year, and (2) because of the difficulty of keeping a bare fallow clean during the monsoon season.

*Permanent wheat and maize Manurial Series.*

No.	Kharif.	Rabi.	Manure applied per acre.
1	Maize	Wheat	No Manure.
2	Maize	Wheat	Farm-yard Manure=20 lbs. Nitrogen.
3	Maize	Wheat	Rape cake=20 lbs Nitrogen.
4	Maize	Wheat	Sulphate of Ammonia=20lbs. Nitrogen.
5	Maize	Wheat	Sulphate of Potash to supply potash as in Farm-yard Manure.
6	Maize	Wheat	Superphosphate to supply $P_2 O_5$ = that in Farm-yard Manure.
7	Maize	Wheat	Sulphate of potash to supply potash } as in Farm-yard Manure. Superphosphate to supply $P_2 O_5$ }
8	Maize	Wheat	Sulphate of Ammonia to supply Nitrogen } as in Farm-yard Manure. Sulphate of Potash to supply Potash } Superphosphate to supply $P_2 O_5$ }

Plots to be  $\frac{1}{2}$  acre duplicated and all the crops of each rotation to be grown in the same year. The question of fallows will not be taken up this year.

*Permanent Pasture Experiments.**Manurial Scheme for Pasture Experiments.*

No.	Details.	REMARKS.
1.	No manure	To be applied once; thereafter at the end of 3 years or other date to be subsequently fixed to be followed by 10 tons farm-yard manure repeated every fifth year.
2.	Superphosphate = 150 lbs Phosphoric acid per acre.	
3.	Basic slag = 150 lbs. Phosphoric acid per acre	
4.	Superphosphate = 100 lbs Phosphoric acid per acre.	
5.	Superphosphate = 100 lbs Phosphoric acid per acre	
6.	Sulphate of Potash = 50 lbs. Potash per acre	
7.	Rape Cake = 100lbs. Nitrogen per acre. Castor Cake = 100lbs. Nitrogen per acre.	

*Manurial Scheme for Pasture Experiments—contd.*

No.	Details	REMARKS.
8.	Ammonium Sulphate = 20 lbs. Nitrogen per acre	} To be apphed every year.
9.	Nitrate of Soda = 20 lbs. Nitrogen per acre	
10.	Superphosphate = 25 lbs. Phosphoric acid per acre	
11.	Superphosphate = 25 lbs. Phosphoric acid per acre	
11.	Sulphate of Potash = 20 lbs. of Potash per acre	
12.	Superphosphate = 25 lbs. of Phosphoric acid per acre	
12.	Ammonium Sulphate = 20 lbs of Nitrogen per acre	
13.	Superphosphate = 25 lbs. of Phosphoric acid per acre	
13.	Ammonium Sulphate = 20 lbs Nitrogen per acre	
14.	Sulphate of Potash = 20 lbs. Potash per acre	
14.	Farm-yard Manure = 3 tons per acre	

The extent of even land available in the pasture land at Pusa is limited and the proposed experimental plots are, therefore, smaller than is desirable. The area in one block will be divided into 14 plots each of one-half acre. One-fourth of each plot will be fenced off and cut annually as hay, the remaining three-fourths will be grazed by cattle and simply kept under observation.

A detailed botanical examination of the character of the herbage of each plot will be undertaken.

E. SHEARER, M. A.,  
*Impersal Agriculturist.*

## APPENDIX C.

PROGRAMMES OF PROVINCIAL AND NATIVE STATES DEPARTMENTS  
OF AGRICULTURE FOR 1908-09.

## BENGAL.

1. There are at present five Agricultural Stations in this Province, *viz.*, Burdwan, Bankipore, Dumraon (Shahabad), Sabour (Bhagalpur), and Cuttack.

Particulars regarding their physical and climatic conditions are given in the statement below:—

Serial No.	Name of station	SITUATION		Tract represented	Area in acres	Types of soil.	D <sup>o</sup> when estab- lished	Height above sea- level.	Average rainfall in inches.	TEMPERA- TURE	
		North Lati- tude	East Longi- tude.							Maxi- mum.	Mini- mum.
1	Burdwan	23° 70'	88° 00'		31		1885	99	57 54	80°	70°
2	Dumraon (Shaha- bad).	26° 30'	84° 00'		30		1895	239	41 13	88°	68°
3	Bankypur	25° 27'	85° 14'		210		1906	183	44 54	89°	69°
4	Sabour (Bhagalpur)	25° 12'	87° 1'		324		1906	180	49 35	97°	68°
5	Cuttack	20° 29'	85° 54'		60		1904	80	60 35	91°	73°

In addition to the above, an area of about 210 acres has been acquired at Chinsurah in the district of Hooghly for an Agricultural Station which will be representative of the Deltaic tracts of this Province and enquiries are being made with a view to obtaining suitable sites for stations which will be representative of the laterite tracts of the Province and Chota Nagpur. The following farms are also maintained:—

- (a) The Purnea and Berhampur Jute Seed Farms.
- (b) The Chakradharpur Cotton Farm.
- (c) The Chaibassa Tasar Farm.

II. The programme of work for 1908-09 in the stations is as follows:—

(1) *Burdwan*.—The experiments now being carried on will be continued, *viz.*:—  
Jute experiments:—

1. Manure.
2. Cutting at different stages.
3. Variety.
4. Spacing.
5. Drill *versus* Broadcast sowing.
6. Rotation experiment with paddy.
7. Rotation experiment with potatoes.

Paddy Experiments:—

A. Manure.

1. First series—Quantitative.
2. Second series—Qualitative.
3. Third series—Green manuring.

B. Variety.

C. Cultivation.

1. Thick and thin sowing (broadcast).
2. Spacing in transplanting.
3. Number of seedlings per hole in transplanting.

Potatoes:—

1. Manure experiments.
2. Variety experiment.

Selected varieties of Sugarcane, Jute and Paddy will be grown for seed distribution. Cassava will be tried.



- (2) *Bankipore*.—The laying out will be completed and the farm will be worked to get uniformity of conditions before commencing experiments. Sugarcane, paddy, gram, *juar* and vegetables will be grown for seed distribution.
- (3) *Dumraon* (Shahabad).—The sugarcane and mustard experiments will be continued, viz:—

Sugarcane :—

1. Manure experiment.
2. Variety experiment.
3. Planting experiment.
4. Rotation experiment.

Mustard :—1. Variety experiment. Selected varieties of Sugarcane, mustard and *arhar* will be grown for seed distribution.

- (4) *Sabour*. (Bhagalpur).—The College buildings will be pushed on. Laying out of the farm will be continued. Maize, *arhar* and *juar* will be grown for seed distribution.
- (5) *Cuttack*.—The experiments now being carried on will be continued, viz:—

Jute experiments :—

1. Manurial.
2. Cutting at different stages.
3. Variety.
4. Rotation with Aman paddy.
5. Rotation with Potatoes.

Paddy experiments :—

1. Manurial.
2. Varietal.
3. Methods of cultivation.
  - (a) Number of seedlings per hole in transplantation—1, 2, 4 and 8.
  - (b) Quantity of seed per acre in broadcasting—25, 30 and 40 seers (medium sized grain) per acre.
  - (c) Different ploughs—Cuttack, Burdwan, Sibpur, Meston and Hindustan.
4. Irrigation.
  - (a) General.
  - (b) Application of different quantities of water (3" and 6") every 15 days.

Potatoes :—

1. Manure.
2. Variety.

Groundnuts :—

1. Manure.
2. Variety.
3. Rotation experiment.

Sugarcane :—Variety.

Turmeric.

Selected varieties of jute, paddy, sugarcane, groundnut, turmeric and papayas will be grown for seed distribution.

*Chinsurah*.—The laying out of the farm will be commenced.

*Purnea and Berhampore Jute Seed Farms*.—These two seed farms will be continued.

*Chakradharpur Cotton Farm*.—Plant to plant selection of seed of the Buri variety of cotton for distribution purposes will be continued. A manure experiment will be commenced.

*Chaubassa Tasar Silk Farm*.—Distribution of one year acclimatised cocoons for seed purposes will be continued.

### III.—GENERAL.

Well boring experiments will be undertaken. Cattle breeding at Sripur will be continued. Proposals for the improvement of sericulture have been submitted and it is hoped that work under this head will be undertaken.

## UNITED PROVINCES OF AGRA AND OUDH.

*I.—Section under the Deputy Director of Agriculture, including the agricultural stations at Cawnpore, Oras and Aligarh.*

*Cawnpore.*—Only changes in detail have been made in the programme presented at last year's meeting of the Board. The investigations deal mainly with fundamental problems such as the effects of the continuous growth of crops on the same land with and without manure, the quantity and composition of drainage water, some of the chief existing rotations, the quantity of water required for various crops, and the loss of water in transit to the field. The remaining work is mainly selection applied to maize, poppy and cotton. The new investigations taken up include the trial of cotton-refuse as manure, methods of preserving potatoes and fruits, and the renewal of the seed-stock of potatoes in the hills.

At the Juhi outstation for the reclamation of non-alkaline barren land, practically the only experimental work in progress is the endeavour to reduce the cost of tree-planting by the use of an auger for drilling holes through the barren layer.

*Oras.*—The main objects of this farm are to study the question of tillage in Bundelkhand, both generally and in relation to the growth of *kans*, to make some use of the inferior soils, and to attempt to increase the diversification of crops.

*Aligarh.*—This station is intended mainly for the study of cotton. Indigenous and acclimatized varieties are grown, and it is the chief centre for the distribution of the latter kind among cultivators.

No new work has been undertaken at the alkali sub-station at Gursikran.

*II.—Section under the Assistant Director of Agriculture, including the agricultural station at Partabgarh and the investigations in sugar-manufacture.*

The Assistant Director is on special duty for the greater part of the year in connection with the organisation of sugar-factories following his methods of manufacture. The field work at Partabgarh is preliminary; areas that appear suitable for experiments have been cropped uniformly and the yield is being tested by harvesting in small compartments. Meanwhile, only a few preliminary experiments with sugar-cane are in progress. The station is the centre of seed distribution on credit. A small alkali outstation has been formed for trial of gypsum, and another for the prevention of ravining.

*III.—Section under the Economic Botanist.*

The Economic Botanist is engaged mainly in organising the biological side of the Agricultural College. His experiments with cotton have advanced and a preliminary note of the scientific results is in course of publication. Information concerning the agaves of the province is being collected.

*IV.—Section under the Agricultural Chemist.*

The Agricultural Chemist is engaged mainly in organising the chemical side of the Agricultural College. He is taking up preliminary experiments with a view to the study of the losses in sugar manufacture recommended by the Board at its last meeting.

*V.—Well-section, under the Director.*

This section is engaged in placing out borers where they are wanted; in investigating the form of percolation-wells in sand, and the improvement in rock-wells; and in classifying the various areas of the province according to the nature of their resources and their needs.

## PUNJAB.

## PROGRAMME OF WORK FOR THE CURRENT YEAR OF THE DEPUTY DIRECTOR OF AGRICULTURE, PUNJAB.

1. Investigation of the Reh question in collaboration with the Agricultural Chemist.

2. The introduction of harvesting machinery to the notice of cultivators.
3. Demonstrations of improved sugar-making methods.
4. Distribution of American cotton in the Jhelum and Chenab Colonies.
5. District trials of cottons (Egyptian cotton in South-West Punjab, American and Egyptian at Hissar).
6. Seed distribution generally.

#### PROPOSED NEW WORK.

7. Establishment of a second Experimental Farm.

Preliminary investigations with reference to :—

- (i) Diseases of gram in collaboration with the Economic Botanist, Punjab.
- (ii) The question of fodder scarcity particularly in the south and east of the Province, and the possibility of increasing the yield of crops by manures or otherwise on irrigated tracts in, and adjoining, famine areas.
- (iii) Improvement of tillage in backward districts.
- (iv) Study of crop rotations in special districts.

---

#### PROGRAMME OF WORK OF THE PRINCIPAL, PUNJAB AGRICULTURAL COLLEGE, FOR 1908-09.

1. Little progress having been made with the equipment of the Lyallpur College and the framing of the curriculum and prospectus, the bulk of this work will fall in the present year.

2. The laying out and equipment of the Agricultural Station for experimental seed-growing and recreational purposes will claim a good deal of attention.

3. At the Lyallpur Agricultural Station constant observations will be made on, and attention given to, the experiments already in progress. These have been somewhat modified during the last year.

- (a) The most noticeable advance has been the laying out, for comparative experiments, of the area tested last year. This area having been found, as was to be expected, uneven in quality, 12 acres were laid out, in the light of the information obtained by the testing, in plots which are expected to give consistent results. The experiments on this area include the comparison of :—

- (1) Varieties—principally of wheat and cotton.
- (2) "Cinereal" manuring.
- (3) Nitrogenous manuring—including the growth, removal and ploughing in, of leguminous crops.

- (b) In addition to these strictly comparative experiments, the area directly cultivated for seed-growing purposes will be used for testing one or two promising varieties, methods of cultivation, or manures on a relatively very large scale.

- (c) Preliminary observations on the effect of light and heavy waterings and surface cultivation on different crops and soils will be made, with a view to re-starting the irrigation experiment.

- (d) Other experiments include the trial of machinery—chiefly harvesting machinery, of new crops such as jute, of the effect of leguminous weeds in the wheat crop, and on the inoculation of land newly sown with leguminous crops.

- (e) The work of segregating varieties of crops, especially of cotton, by growing seed from single plants separately—as has been done by Mr. Howard with the Punjab wheats, was begun last year and has now been taken up by the Economic Botanist.

- (f) Various kinds of common fruit trees will be grown under observation.

PROPOSED WORK OF THE AGRICULTURAL CHEMIST, PUNJAB, FOR THE YEAR 1908-09.

The work can be divided into two branches—

1. Educational.
2. Chemical.

1. After the completion of the laboratories of the Punjab Agricultural College, a large portion of the Agricultural Chemist's time will be given to the preparation of the courses of study which he will have to supervise and this will include the training of educational assistants.

2. Chemical work.

This includes the various problems awaiting investigation and which have, as far as possible, been placed in order of importance :—

- (a) An investigation into the composition of the alkali lands of the Province with the object of effecting a cure.
- (b) In connection with the above problem, an investigation of the type and quantity of salts absorbed by plants.
- (c) An examination of the salt wells of the Southern Punjab.
- (d) An examination of the *sajji* industry (the manufacture of crude carbonate of soda from salt bushes).
- (e) Analysis of the river and canal silts of the Punjab.
- (f) The improvement of sugar manufacture.
- (g) An examination of special soils in connection with the disease hæmorrhagic septicæmia.
- (h) The most suitable conditions for retting the various fibres which can be grown in the Punjab.
- (i) An investigation into the reported deficiency of nitrogenous manure in the Hoshiarpur District.
- (j) General analytical work in connection with the experimental station.

In the meantime, before the laboratories are complete, it is proposed that the Agricultural Chemist should tour as much as possible in order to gain personal experience of the natural conditions of agriculture in the Province and of its problems in particular.

A certain amount of work is still to be done in connection with the equipment of the Chemical Department, and this will require the personal attention of the Chemist.

PROGRAMME OF WORK OF THE ECONOMIC BOTANIST, PUNJAB, FOR THE YEAR 1908.

1. Organisation of office.
2. Fitting out of Laboratories and Libraries, etc., for the Economic Botanist and students.
3. Collecting and getting knowledge of the Botanical literature of the Punjab.
4. Carrying on and extending the work of improvement of varieties of cotton and wheat already started at the Lyallpur Farm.
5. Making a survey of the indigenous cottons of the Punjab and North-West Frontier Province with a view to improving these crops by selection and hybridization.
6. Touring the Province to collect Herbarium Specimens of plants, to be familiar with the Flora and to become acquainted with the special agricultural conditions that obtain in the Punjab.
7. While touring, an attempt will be made to solve the problems put forward by the agriculturists of the districts.
8. Necessary attention will be paid to the Mycological and Entomological work of the Department if placed under the care of the Economic Botanist.

## BOMBAY.

## I.—AGRICULTURAL STATIONS IN CHARGE OF THE DEPUTY DIRECTOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION.		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maxi- mum.	Min- imum.
1	Surat . . .	21° 12'	72° 52'	South Gujarat.	172	Black Cotton.	1896	About sea-level.	39	106°	51°
2	Nadiad . . .	22° 44'	73° 0'	North Gujarat.	44	Alluvial Loam.	1903	Do.	35	114°	43°
3	Dhárwār . . .	15° 27'	75° 6'	Karnatak.	136	Black Clay and Laterite	1904	2580	32	100°	50°
4	Dhulia . . .	21° 10'	75° 20'	North Deccan.	28	Medium black.	1905	844	22½	114°	36°
5	Muváha . . .	22° 50'	70° 18'	Panch Mahála	58	Part red part black.	1906	..	30	108°	44°

In addition, land has been acquired (66 acres) for a farm to be irrigated from the Gokák Canal (Belgaum District), but it is not yet started owing to want of men and funds.

2. *Continuous investigations* are being conducted on the manurial and cultural practices of the cultivators in the several districts of which the conditions on the above stations are typical. New methods and artificial manures are being tried in comparison.

3. *Selection of the following crops* is a part of the work of all stations on which they are grown, viz.:—Cotton, Jowár, Báji, Wheat, Tur, Til, Ground-nut.

4. *Foreign varieties* of these crops are being tried.

5. *Cotton breeding* is being extended.

6. *A Cotton survey* of the presidency is being continued and, where mixtures are grown, these are analysed.

7. *A survey of the cottons of the world* will shortly be published by the late Deputy Director (Mr. Fletcher).

8. *A wheat survey* has been initiated.

9. *Cotton wilt* is being investigated.

10. *Disease proof potatoes* are being sought for (Dhárwār).

11. *Tobacco cultivation and curing* are being investigated (Nadiad).

12. *The Spice gardens* of Kanara are being experimented on with regard to the question of leaf mould.

13. *Land Reclamation* is being attempted at Dumas near Surat.

14. *Irrigation* on several of the stations is a subject of experiment both as regards quantity of water to be applied and method of raising it.

15. *Insect Pests* are being investigated.

16. *European ploughs* are being largely distributed to cultivators at cost price.

17. *Cotton and Ground-nut seeds* are being distributed.

18. An experiment in the *manuring of pasture land* on similar lines to that about to be carried out at Pusa is being initiated.

II -- AGRICULTURAL STATIONS IN CHARGE OF THE SECOND DEPUTY DIRECTOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres.	Types of soil	Date when established.	Height over sea-level	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maxi- mum.	Mini- mum.
1	Mirpurkhas .	25° 32'	69° 2'	Sind.	54	Light coloured clay.	1904	Feet. 50	7	116°	42°
2	Daulatpur .	25° 27'	69° 1'	Do.	400	Alluvial sandy loam to clay loam.	1907	50	7	116°	42°

MIRPURKHAS STATION.

1. This station is a representative of perennially irrigated lands of Sind.
2. The objects of this station are:—

- (1) Head-quarters of Agricultural Department in Sind.
- (2) Centre for seed distribution, chiefly Egyptian Cotton seed and Berseem or Egyptian Clover for the Jamrao Canal colonists.
- (3) A centre for demonstration plots carried out in various districts in Sind on Zamindars' own fields.

On the Farm itself the main work consists of comparative tests of Egyptian and American cottons, varietal tests of wheat, bajri, jowar, pulses, etc.

An important endeavour is being made to introduce into Sind one of the common Egyptian rotations with its improved cultivation and implements. As ordinary Sind cultivation is still in such a backward state all work is as far as possible of a simple and practical nature.

DAULATPUR STATION.

This station is a representative of the worst classes of alkali or *kalar* lands in Sind.

2. The object of this station is to prove that these *kalar* lands can be profitably reclaimed and after reclamation cultivated at a good profit. The land will be given out to Sindhi *haris* on cultivation and the work done by these on a basis of share of crop. The whole station is to be run on strictly commercial lines and similar to the work being carried on by Land Reclamation Companies in Egypt. It is expected to be useful not only as a reclamation station but also as a means of prominently bringing to the notice of Zamindars the benefit of more careful and intensive cultivation. The land is favourably situated with regard to water-supply. The analysis shows some portions of the land to contain over 3 per cent. of total alkali and is said by neighbouring cultivators to be quite unfit for cultivation under ordinary methods.

## III.—AGRICULTURAL STATIONS IN CHARGE OF THE PROFESSOR OF AGRICULTURE.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres.	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE.	
		North Latitude.	East Longitude.							Maximum.	Minimum.
1	Månjri (near Poona).	18° 32'	74° 2'	South Deccan.	62	Medium black and light murum	1894	1,850	16	106°	46°
2	Poona Agricultural College.	18° 30'	73° 50'	Do.	130	Light and Medium black.	1905	1,850	32	106°	41°
3	Poona (Kirkee) Dairy and Dairy Farm.	18° 30'	73° 50'	Do.	66	Medium black and light murum	1879	1,850	32	108°	42°
4	Lonávale . .	18° 45'	73° 27'	West Deccan	30	Light.	1904	2,030	186	.	..
5	Báramata . .	18° 8'	74° 37'	Do.	11	Light and heavy black.	1906	1,774	22	..	..

## MÀNJRI STATION.

Månjri station is a Sugarcane Farm. A comprehensive series of experiments has been drawn up by a Committee composed of the officers of the Department.

Experiments to determine number of waterings, interval between them and the total quantity of water required for sugarcane continued; rotations suitable for the block system of irrigation, manural tests, including application of farm-yard manure and safflower cake, in varying proportions and at different stages of growth; farm-yard manure, safflower cake and sulphate of potash, farm-yard manure, safflower cake and ammonium sulphate, farm-yard manure, safflower cake and calcium nitrate and farm-yard manure, safflower cake and crude nitre.

In all cases, the quantity of manure is to be measured by bulk as well as in terms of its chemical constituents instead of solely in such terms as in previous experiments. The results of sugarcane tests will be recorded as recommended by the Board of Agriculture of 1907.

Cotton and jute under irrigation are to be tried.

Tests with wheat varieties to be continued.

Gram and Jowar fodders will be grown in rotation with sugarcane.

Light shallow soil area is utilized for growing cottons of the American type, pulses, oats and barley.

## POONA AGRICULTURAL COLLEGE STATION.

College Farm is devoted for demonstration to agricultural students and for students' plots.

Experiments in dry farming will be arranged.

## POONA DAIRY STATION.

It is proposed to convert the Poona Station into a Dairy Farm.

Dr. Butler has a series of experiments with ground-nut Tikka disease, and one with Tur wilt. These will be continued. The rest of the area will grow fodder for the Dairy.

Breeding experiments will be continued.

## LONAVLA STATION.

Lonavla rice experiments are to be continued. A new area has been taken up. The principal line of work is to investigate the principles upon which the efficiency of *rab* depends, and to find a suitable substitute.

Some work in making a survey of the rice varieties has been begun.

## BARAMATI STATION

At this station the results of experiments with sugarcane and irrigated cotton obtained at Mānjri will be demonstrated.

*Rabi* crops will be grown on lands flooded in the *kharij* season

## IV.—AGRICULTURAL STATIONS IN CHARGE OF THE ECONOMIC BOTANIST.

Serial No.	Name of station.	SITUATION		Tract represented.	Area in acres	Types of soil.	Date when established.	Height over sea-level.	Average rainfall in inches.	TEMPERATURE	
		North Latitude	East Longitude.							Maximum.	Minimum
1	Ganeshkhind gardens.	18° 30'	73° 50'	South Deccan.	80	Medium black and reddish alluvial deep loam.	1904	Feet. 1850	32	109°	45°
2	Bassein gardens	19° 20'	72° 51'	North Konkan	90	Sandy alluvial loam.	1906	About sea level	83	96°	64°

## GANESHKHIND GARDENS.

1. A systematic collection of indigenous trees and shrubs to determine (among others) the following facts:—

- (i) The most satisfactory methods of reproduction, transplanting and treatment during growth.
- (ii) The periodical increment of growth.
- (iii) Periods of leafing, flowering, fruiting and ripening of seed.
- (iv) Age at maturity.
- (v) Special investigations regarding the quality of timber, yield of the other economic products, etc.

2. Experimental introduction of rubber, fibre, medicinal plants, etc.

3. Experimental tests on exotic plants on the same lines as (1) and (2).

4. Endeavours to increase and to improve the yield of fruit trees, indigenous and also exotic, if found suitable for the Deccan.

5. Botanical research, in special natural orders, the first three to be undertaken being Malvaceæ, Leguminosæ and Cucurbitaceæ.

6. To continue the cultivation of cottons for purposes of botanical classification, also of wheat, rice, millets and pulses.

7. To attempt the improvement of a selected number of our finest wild flowering plants so that they can be used as garden plants.

## BASSEIN GARDENS.

Programme of work as in the Ganeshkhind Botanical Gardens with special reference to conditions in the Konkan. While the ground within the Fort is being cleaned, advantage is being taken to study the best local methods of agriculture.



## MADRAS.

On the Government Agricultural Stations the following are the chief lines of work :-

(1) *Paddy* experiments in spacing are being carried out on the Samalkota and Palur Stations and on the Central Farm at Coimbatore. The object is to find out the best number of seedlings to plant, and the best distance apart, in different soils and conditions. In most parts of the Presidency five or more, up to twenty seedlings are planted in one bunch. Experiments are also being made as to the best time to lift seedlings from the seed-bed, and the seed-rate for seed-beds. Experiments will also be made in transferring superior varieties to districts where they are not known. *Green manuring* experiments will be continued on the Central Farm, Coimbatore, and on the Palur and Hagari Agricultural Stations.

(2) *Sugarcane*.—The testing of new varieties will be continued at Samalkota, and the best varieties will be distributed as before from the Samalkota and Palur Agricultural Stations. Mauritius sugarcanes have also been successfully grown on a small experimental plot at Taliparamba, in Malabar, where the cultivation of sugarcane is almost unknown. Manual experiments on sugarcane will be continued at Samalkota and Palur.

(3) *Fibres*.—Experiments with jute will be continued at Samalkota, Palur, Taliparamba and Coimbatore, and it is hoped to get some more experimental plots of jute grown in Tanjore and Malabar through the local Agricultural Associations. Mr. Finlow inspected these plots last year and reported that the defects noticed in the crops were mainly due to want of experience. A specimen of *Corchorus capsularis* having been found growing in a wild state in South Canara, it seems probable that jute could be successfully cultivated on the West Coast. Experiments on *Hibiscus cannabinus* will also be continued. The subject of Sunn-hemp for fibre and green-manuring is being specially investigated by the Acting Government Botanist and a bulletin will be published in the course of the year.

The Hindupur Agave Plantation will be continued and experiments will be carried out with the co-operation of the Indian Fibre Company.

(4) *Cotton*.—The extension of the area under pure Karunganni by the distribution of pure seed on a large scale and the introduction of the drill and bullock-hoe of the Ceded Districts will be the main lines of work in the Tinnevely District. On the Koilpatti, Bellary, Hagari and Nandyal farms the most promising plants of the indigenous cottons will be selected and the seed sown next season for observation. The hybrid cottons at Bellary and Koilpatti will be treated in the same way. At Hagari various methods of planting and spacing will be tried, and irrigation experiments continued on local and Egyptian cottons. The work at Nandyal chiefly consists of rotation experiments. The various types which at present are found in a very mixed condition in the District are being grown separately for comparison.

(5) *Groundnut* at the Palur Station. Cultivation, varietal, manurial and rotation experiments will be continued. Special attention will continue to be paid to the "surul" caterpillar pest. This crop has also been tried at Coimbatore, Attur, Koilpatti, Taliparamba, Hagari and Samalkota. It appears that groundnut can be successfully grown throughout a wider range of climates and soils than was hitherto supposed.

(6) *Indigo* is being tried as a rotation for cotton at Nandyal, and the Java Natal variety is being grown on a small scale at Palur.

(7) *General*.—Cultivation experiments are being tried on several crops with a view to improving the methods of the preparation of the land, the methods of sowing or planting crops, and their after-cultivation. The measures for the eradication of the palmyra fungus disease which are being carried out under the direction of the Imperial Mycologist, will be continued.

(8) *Botany*.—The Anamalai forests will be explored for economic products, and the Nilgiris will be surveyed for plants of systematic and economic importance. Similar work will be done in the hill tracts of the Kurnool District. Fodder plants are being collected from the chief grazing districts of the Presidency, and attempts made to render available for commerce the fibres of the *nendrom* plantain of Malabar, the hill plantain of Madura, the Amritapani and Chakkarakali plantains of

the Gódvári and Vizagapatam Districts, the pine-apples of the Simhachalam hills and the West Coast, and the *Agave vivipara* of South Canara.

Efforts will be made to introduce from the West Coast into Ganjam and Vizagapatam several varieties of edible tubers.

The process of extracting edible oil from the safflower which has already been demonstrated, will be again brought to the notice of the people in the Madura and Tinnevely Districts.

The cultivation of Sunn-hemp for fibre is being investigated in all parts of the presidency where it is grown.

(9) *Chemistry*.—The laboratories will be fitted up and prepared for the use of the students, and for carrying on the analytical work of the province. It is hoped that the following general investigations may be taken up later on:—

- (1) A systematic investigation of the tank and river silts of this presidency.
- (2) Experiments dealing with the ripening of sugarcane and the changes occurring in the juice during the period of growth.
- (3) The food requirements of plants cultivated in Southern India.

#### CENTRAL PROVINCES AND BERAR.

There are four Agricultural stations in these Provinces—Nagpur, Raipur, Hoshangabad and Akola. These serve a double purpose (1) as experimental stations, and (2) as central depôts from which selected seed, good bulls and improved agricultural machinery can be obtained. The Raipur station is situated in the rice tract, Akola in the cotton tract, and Hoshangabad in the wheat tract. The experiments at these stations are devised to solve problems relating to the staple crop or crops grown in the tracts in which they are situated and to introduce new ones. The crops experimented with at the Nagpur station are of a more varied type, as are also the crops of the surrounding country. This station, moreover, serves as a college farm on which the students of the Agricultural College get a practical knowledge of all the important crops grown in the provinces. At all the stations the programmes of experimental work have been revised in the light of past experience, so as to simplify the issues and improve the standard of work.

The experimental work on which the department will be engaged during the year will fall under the following heads.

2. The chief experiments with cotton are in progress at Akola under the supervision of Mr. Clouston, Deputy Director of the Southern Circle. The four

Cotton.

different varieties of cotton commonly grown under the name of *jari* or *kativlayti* will be grown separately, and the values of the outturns compared *inter se* and with other indigenous and exotic varieties suited to the conditions that obtain in the cotton tract. The rigid system of plant to plant selection already being followed with the view of improving the indigenous varieties and the exotics under trial gives promise of success, and will be continued. Other experiments deal with the spacing distances most suitable for cotton plants, the most profitable rotations with cotton, the advantages or otherwise of topping young plants to produce increased branching, of deep *versus* shallow ploughing for cotton, and the use of artificial and natural manures. The tests of nitrate of soda and sulphate of ammonia will be continued, and the former will be applied at different times so as to find the most economical method of application. These artificials will be tried with and without cattle dung. Many exotic cottons, previously under trial, have been abandoned because they proved quite unsuitable to the local conditions, but the acclimatized American cotton received from Bengal under the name of *buri* is very promising, and will be tested on a field scale. The results from hybridization have generally been disappointing, but a few selected hybrids will be tested on a larger scale. Other hybrids will be produced, and crosses made between plants of the same variety in order to endeavour to improve the vigour of growth.

3. A collection of all the wheats grown in the provinces has been made, together with information about the tracts in which they are grown and their local reputation. The varieties have been grown pure to type, and a preliminary

classification is now in progress. The main work of the Hoshangabad station, under the direction of Mr. Evans, Deputy Director of the Northern Circle, will be the production of a variety immune to rust and at the same time of good milling quality. The pure varieties and crosses now available will be tested still further for rust resistance. Questions relating to depth of tillage, suitable rotations, manuring and the like will also be investigated at the Hoshangabad station. A special study will also be made of the varieties of pigeon-pea (*Cajanus indicus*).

4. Experiments in rice cultivation are confined to the Raipur station under the supervision of Mr. Clouston. The four different methods of cultivation are compared, *viz.*, transplanting, broadcasting with and without subsequent cross-ploughing, *lehi* (sowing artificially germinated seed). Work will be started in the improvement of varieties by plant to plant selection of seed. As double cropping is likely to become important in rice land under regular irrigation, experiments will be designed with the view of extending the practice by introducing new after-crops and improving on the present method of cultivating the land for this crop. Experiments are also being conducted to ascertain what is the most economical quantity of water for rice in different classes of soil, and whether light waterings at frequent intervals are more economical for the less retentive soils than heavy waterings at longer intervals.

Rice.

5. The rotation experiments with *kharif* and *rabi* crops will be continued at all the stations. A study of the sorghums of the province will be started at the Nagpur station by Mr. Allen, and the improvement of the most desirable varieties by seed selection will be continued at Akola. Different varieties of sugarcane and groundnut will be tested on the Raipur farm in order to ascertain which varieties can be grown most profitably. Groundnut (*Arachis hypogaea*) promises to be a useful introduction into Chhattisgarh as a rotation crop. The experiments with jute have given promise of success both at Raipur and Nagpur, when it is sown under irrigation in April-May, and will now be tested on a field scale. The tests of Russian flax at Hoshangabad, which have hitherto given no definite results, will be continued. A beginning will be made in testing the best fodder grasses at Akola station.

Miscellaneous crop.

6. The various series of continuous experiments with locally obtainable manures and imported fertilizers, including the experiments started with calcium cyanamide and calcium nitrate, with and without irrigation, will be continued. Leguminous crops and weeds will be tried as a green manure for wheat on a larger scale than heretofore and in the cotton tract trials will be made to grow gram as well as some of the leguminous weeds found locally as a second crop after cotton; the second crop will be sown between the rows of cotton after the last weeding of that crop.

Manurial experiment.

7. The advantages of deep *versus* shallow cultivation for wheat and cotton will be compared. The use of Ransome's Turn Wrest plough for the eradication of *kans* (*Saccharum spontaneum*) will be demonstrated on one of the demonstration farms. New implements will be purchased and tried from time to time.

Tillage experiment.

8. The study of the wilt disease in tur and rust in wheat will be continued. The value of *bhendi* as a catch crop for cotton boll-worm will be tested. The Entomological Assistant will be free to devote all his attention to outdoor work in future, as another Assistant is being appointed to lecture in Entomology at the College. The Mycological Assistant will be mainly employed in the collection of material relating to the principal plant diseases in the province.

Plant diseases and insect pests.

9. The Agricultural College will continue its educational work under the supervision of the Principal, Mr. R. G. Allen. The curriculum has been revised on the lines of the standard syllabus framed by the Board of Agriculture. Now that the prospects in the Agricultural Department have been settled by the introduction of a graded service a larger and better class of students is attracted. The Principal has been placed in charge of the Nagpur Agricultural station, so that there is ample field for practical work by the students.

Agricultural education

The value of *bhendi* as a catch crop for cotton boll-worm will be tested. The Entomological Assistant will be free to devote all his attention to outdoor work in future, as another Assistant is being appointed to lecture in Entomology at the College. The Mycological Assistant will be mainly employed in the collection of material relating to the principal plant diseases in the province.

10. The Agricultural Chemist will mainly be employed in teaching at the College and in the general analytical work of the laboratory. He will take up the investigation of the composition of the wheats of the province, which will be done in conjunction with Mr. Evans' investigations on wheats. He will also continue his study of the soils of the Nagpur tract.

11. The demonstration work of the Department will fall under the following heads :—

*Irrigated rice farms.*—Several small farms will be worked by the Department in the more backward agricultural tracts of Chhattisgarh, recently provided with irrigation from Government reservoirs. The two main objects of these farms will be to introduce the system of transplanting rice and growing irrigated *rabi* staples, both as a single and double crop, so as to induce the cultivators to utilize to the best advantage the water now at their disposal. The opportunity will be taken to demonstrate better methods of cultivation, and to introduce new crops and manures that have proved successful on the Raipur Farm. The new crops to be grown on these demonstration farms are sugarcane, jute and ground-nuts; and the manures to be tried are urine, earth, nitrate of soda, sulphate of ammonia and saltpetre.

12. *Cotton seed farms.*—The existing farms having proved a success, four new seed farms will be started this year. They will be supplied with selected seed from the experiment station, the cultivation will be carried out on special lines for seed production, and the produce will be available for seed distribution.

13. *Manures.*—In addition to the tests of manures at the irrigated rice farms mentioned above, practical demonstration will be given of the Meagher system of sewage disposal at selected towns. Co-operative experiments with nitrate of soda and sulphate of ammonia as fertilizers for cotton will be carried out by members of the Agricultural Association in the cotton tract. Some have also agreed to adopt the method recommended by the Department for conserving cattle urine and to test it as a manure for *kharif* or irrigated *rabi* crops.

14. *Prevention of smut in juar.*—The method of treating juar seed with sulphate of copper to prevent smut will be demonstrated to cultivators at fixed centres in some of the sorghum-growing districts, where the method is not yet practised. These demonstrations will also be carried out at fairs. In some tracts, this method of seed treatment has become an established agricultural practice.

15. *Improved implements.*—The use of suitable new implements, such as the winnower, fodder-cutter, corn-sheller, Cawnpore pump and light iron sugarcane mill will be demonstrated at fairs. An Agricultural Assistant will be sent to the United Provinces to learn the Hadi process of sugar-making.

16. *Publications.*—The *Agricultural Gazette* published monthly gives the results of experimental work and such other information as is likely to be of some practical utility to its readers. Bulletins and leaflets will also be published as their want is felt.

17. *Agricultural Association.*—The meetings of the Agricultural Association are recognized means of disseminating useful knowledge and advice among the leading cultivators of these provinces. These meetings will be attended by one of the officers of the Department.

## BURMA.

The Department now consists of a Director, two expert Agriculturists, an Agricultural Chemist and an Assistant Entomologist. The sanction of Government has been solicited to the entertainment of an Assistant Botanist.

2. The further organisation of the Subordinate Staff and the construction of the College and Farm buildings will continue during the year. Work will be in full swing on the Mandalay and Hmawbi Agricultural Stations. Proposals for the acquisition of a site for a dry zone farm at Meiktila have been submitted; but, for want of a trained staff, work will not begin there till the rains of 1909.

3. The details of work under the Principal of the College and the Deputy Director of Agriculture are given below. Amongst more general work the

Agricultural Survey will, it is hoped, be commenced by the Expert Staff. The Director proposes to devote a portion of next rains to a detailed study of one or more of the dry zone districts which are peculiarly liable to scarcity with a view to considering the possibility of introducing drought resisting crops or supplying local irrigation by means of wells. The development of the principles of co-operation in the purchase of seed and implements will also be considered. The Director also proposes to visit the Southern Shan States some time during the year.

4. *Agricultural Chemistry*.—A laboratory for the Agricultural Chemist is nearing completion. Mr. Warth will be engaged in training Junior Assistants and in the detailed work set forth below.

5. *Entomology*.—The Assistant Entomologist will continue his studies and collections of insects of economic value under the orders of the Principal of the College.

6. *Agricultural Education*.—It is hoped that it may be possible to complete the curriculum of the College during the year under report, as also to formulate courses for the training of Normal School Teachers, Inspectors of Land Records and Revenue Surveyors, Survey School Teachers and sons of cultivators. The training of men already appointed to the Department will be continued. It is hoped that it may be possible to start the full Diploma Course by next rains, temporary accommodation being found in a part of the Director's new office and in the Chemical Laboratory.

7. *Publications*.—The issue of cultivator's leaflets and of Bulletins will be continued as the necessity for them occurs.

## II.—UNDER THE PRINCIPAL, COLLEGE OF AGRICULTURE.

### MANDALAY AGRICULTURAL STATION.

1. *Cotton*.—A number of new varieties have been introduced and are being tested. The indigenous varieties will be selected, and endeavours to improve them by crossing with other varieties will be made. Other new varieties will, if possible, be introduced and experiments in cultivation and rotation will be commenced. Very little care is taken at present by the Burman cultivator in the growing of cotton.

2. *Paddy*.—Classification of varieties, already begun, to be continued. At present more than 250 varieties are being grown for this purpose. Experiments on watering, suggested by the Irrigation Department, will be commenced, and, if possible, rotation experiments with jute.

3. *Groundnut*.—Distribution of tested varieties and introduction of new ones. A test of all varieties grown in Burma.

4. *Jute*.—An attempt will be made to grow jute in rotation with paddy; and experiments on cultivation and the best time to sow will be made.

5. *Wheat and Barley*.—Classification of existing local varieties and introduction of new ones. Wheat-breeding may be initiated.

6. *Sugarcane*.—Trials of new varieties and methods of cultivation on the Mandalay Farm. Introduction of better methods of crushing and gur-making into the chief sugarcane districts.

7. *Jowari and Maize*.—Trials of new varieties, and selection of the indigenous varieties.

8. *Grasses*.—A continuation of the grass experiments now in progress, and the trials of other kinds, particularly the best known indigenous varieties. A continuation of the grass survey at present in progress.

9. *Rotations and Manures*.—Several rotation and manural experiments will be commenced. Green manuring and the value of bones and bat guano, now so largely exported, will be demonstrated, if possible.

10. *Implements*.—Suitable European and other implements are being introduced. Other simple and inexpensive implements are being made locally under the direction of the Principal of the College. Three of these have already been tried and proved satisfactory. This work will be continued.

11. A complete Agricultural Survey of the Province is about to be commenced, and will continue, whenever possible, throughout the year.

## III—UNDER THE DEPUTY DIRECTOR OF AGRICULTURE.

## (a) HMAWBI FARM.

The work on this farm will consist of—

1. *Laying-out operations.*—The experimental area will be divided by bunds into half acre fields, and these, if it be found possible or expedient, may be again subdivided for purposes of experiment. The whole farm is under water during the rains, hence bunds are a necessity, especially in manurial experiments. Such land as is not required for experiment will be sub-let to cultivators. Farm buildings will, it is hoped, be erected during the year.

2. *Experiments with paddy*—

(i) *Varietal Experiments.*—To compare botanically and for yield the varieties grown in the Pegu, Hanthawaddy, Tharrawaddy and Prome Districts.

(ii) *Cultivation Experiments.*—To ascertain the best method of transplanting, whether in ones, twos, threes, etc., also to discover the best time for transplanting and to compare and to contrast transplanting and broadcasting.

(iii) *Manurial Experiments.*—Experiment with different plants as green manures, sunn-hemp, cow-pea, etc., will be tried. The best time of application of farm-yard manure will be the subject of an experiment, and it is also proposed to try the effects of the ordinary artificial phosphates, potash, etc., on paddy soils. The manurial value of paddy husk will be investigated.

(iv) *Native Implements*—will be tested alongside of introduced ones and their relative merits ascertained.

3. *Experiments with Jute.*—These will have for their object to test the possibility of growing jute successfully on typical paddy soil and also to discover the proper times of sowing and cutting. A few Indian varieties will be experimented with.

4. *Experiment with sugarcane.*—This crop is grown on high lands of the delta only. The experiment will be to test the possibility of growing it on banks or on ordinary flat paddy land. Local varieties will be tried first.

5. *Grass Experiment.*—A portion of the farm will be laid under permanent pasture. This will be subsequently subjected to manurial treatment with a view to improvement. An attempt to grow English grasses may be tried on a small area.

## (b) OTHER WORK.

1. *Agricultural Surveys.*—It is proposed to make a complete agricultural survey of the whole country so as to ascertain accurately the methods, conditions, resources and requirements of each district. A start will be made with the Hanthawaddy District in 1908.

2. *Demonstration of Implements.*—When the buildings are erected at Hmawbi, demonstration will be given of the use and advantage of hand thrashing machines, winnowers, choppers, etc.

This will also be done during the agricultural surveys mentioned above and cultivators, who desire such machines, will have them supplied at cost price.

3. *Winter cultivation experiments*—may be continued on areas which are so flooded in the rains that even paddy cannot be grown.

Such experiments are being tried this year at Yandoon and Hmawbi where a variety of crops have been tried.

4. *Insect and fungoid diseases*—will be noted and specimens collected and forwarded for examination and identification.

## IV.—AGRICULTURAL CHEMISTRY.

1. *Examination of the Experimental Farm soils*—

(a) Determination of chemical composition of the soils.

(b) Determination of physical state of the soils.

(c) Examination of some properties of the soils.

2. *Examination of the saline matters present in some soils—*
  - (a) Determination of the composition of such saline matters.
  - (b) Determination of the relative quantities present at different times of year.
  - (c) Study of some site where alkali is accumulating.
3. *Examination of Agricultural products—*
  - (a) Sesamum and ground nut oils.
  - (b) Toddy palm juice.
4. *Investigations in connection with the utilisation of silt on the lines of Sir Edward Buck's Report will be intrusted by the Agricultural Chemist in conjunction with the Agricultural Experts.*

#### EASTERN BENGAL AND ASSAM.

1. The programme of work for the ensuing year falls under the following heads:—

- I. Organisation of the Department.
- II. Experimental work at the Agricultural Stations.
- III. Promotion of sericulture.
- IV. Experimental work outside the Agricultural Stations.
- V. Demonstration of agricultural improvements and dissemination of agricultural information.
- VI. Special work of the Expert staff.
- VII. Organisation and work of the Provincial Veterinary Department.

#### I—ORGANISATION OF THE AGRICULTURAL DEPARTMENT.

2. The superior expert staff consists at present of an Assistant Director, a Fibre Expert and an Agricultural Chemist. An Economic Botanist is expected to join the Department a few months hence. A Bengali Sibpur graduate, who has recently returned to India after a course of agricultural study at Cornell University in America, has been appointed an Agricultural Supervisor. It is proposed to appoint two more Agricultural Supervisors as soon as men suitable for the posts become available. Three students were sent a year ago by the Local Government for special courses in agriculture at Poona and Pusa and more will follow during the current year. It is expected that some of them will ultimately qualify themselves for appointments in the Department.

3. The expert staff will be located at the Dacca Central Farm. A most pressing work is the construction of laboratories and buildings for the accommodation of these officers and their subordinate staff. The farmsteading has been completed and quarters for one expert and some of the subordinate staff are nearly ready. It is expected that by the end of the year all the residences of the superior staff and the greater part of the work on the laboratory building will have been completed.

#### II—EXPERIMENTAL WORK AT THE AGRICULTURAL STATIONS.

4. There are seven Experimental stations now in the Province, *viz.*—

- (i) The Dacca Central Farm.
- (ii) The Rajshahi Farm.
- (iii) The Rangpur Farm.
- (iv) The Burirhat Farm.
- (v) The Jorhat Farm.
- (vi) The Upper Shillong Farm and the Shillong Fruit Garden which are worked as a single concern.
- (vii) The Wahjain Tropical Plantation.

The Dacca Central Farm and the newly opened station at Burirhat are being laid out in suitable plots for experimental purposes; the work is expected to be completed in a few months, but some of the land will not be fit for experimental work for some two or three years.

Several of the farms remain to be provided with buildings which are being pushed on as fast as local resources permit.

The programmes of work of the several stations are briefly noted below.

5. *The Dacca Central Farm.*—No programme of work has yet been prepared for this farm. It is proposed to settle a programme after consulting the Imperial and Provincial Experts at Pusa. As a basis of discussion, the Assistant Director proposes the following experiments for inclusion in the programme :—

- (i) *Winter rice.*
  - (a) To grow varieties to study characters.
  - (b) To test, or rather to demonstrate the effect of green manuring with dhaincha (*Sesbana aculeata*) and sunn-hemp (*Crotolaria juncea*).
  - (c) To test the effect of bone meal with and without the addition of saltpetre.
- (ii) *New Crops* :—Ground-nut, flax and 3 varieties of cotton (*Buri*, Dharwar American and Spence's tree cotton).
- (iii) Fertilising an upland field by continuous green manuring for two or more years on the following plan :—
 

1st year—	<i>Bhador</i> —	Jute	ploughed in.
	—	<i>Rabi</i> —	Sunn-hemp, ditto.
2nd year	— <i>Bhador</i> — <i>Dhaincha</i> ( <i>Sesbania aculeata</i> ) ploughed in.		
	— <i>Rabi</i> —Oats fed off on the land.		

Two acres of land may be taken, of which one may be treated as above and the other cropped in the ordinary way.

Experiments in breeding rice, maize and cotton may be initiated after the Economic Botanist has joined the Department.

6. *The Rajshahi Farm.*—The programme of work will remain nearly the same as for the current year. The new crops tried will be potato, *malancha* (*Malachra capitata*) and groundnut. There will be trials of varieties of autumn and winter rice, sugarcane and wheat and manure experiments in winter rice, sugarcane and mulberry. The scheme of manuring for winter rice is to be as follows :—

- (i) To test bone meal—6 mds. per acre *versus* no manure.
- (ii) To test green manuring with *dhaincha* instead of cow-pea (which has been hitherto used, but found not to grow well on the clay soil) *versus* no manure.

For sugarcane the manure experiments will be—

- (i) Cowdung—150 mds. per acre *plus* castor cake 24 mds. per acre, to see if the use of the additional manure is profitable.
- (ii) Super—6 mds., *plus* saltpetre 2 mds. per acre *versus* castor cake 24 mds. per acre, to see if the use of oil cake can be profitably superseded by that of mineral manures.

It is proposed to decide the scheme for experiment in mulberry cultivation after discussion at Pusa.

It is proposed to abandon the seed selection experiment with winter rice at Rajshahi and to concentrate all selection and breeding experiments at the Dacca Farm under the control of the Economic Botanist.

A demonstration of sugar making with Mr. Hadi's apparatus has been made this year at Rajshahi and Bogra. It will probably be repeated next year at some other places in East Bengal.

Experiments in jute, sida and malancha will be under Mr. Finlow's direction. To meet the need of steeping water the existing tank is being considerably enlarged.

7. *The Rangpur Farm.*—A new station for tobacco research having been opened at Burrhat, a place 5 miles from the Rangpur civil station, it is proposed to make over the Rangpur station to the local Agricultural Association, to whom the land belongs, with effect from the 1st July 1908. The Association have not been able to decide on what lines the farm will be worked.

8. *The Burihat Farm.*—This station is to be mainly devoted to tobacco. As hitherto, the main object will be to produce tobacco suitable for the manufacture



of cigars and cigarettes. A large number of exotic and indigenous varieties of tobacco are being cultivated—the treatment of the crop as regards manuring, spacing, topping and suckering, as well as the subsequent operations of curing and spacing, being varied according as the leaf is intended to be used as cigar wrapper or filler or for the manufacture of cigarettes. A small area of Sumatra tobacco is grown under shade, following the practice which has largely come into vogue in the United States.

Besides these attempts at producing tobacco suited for expensive cigars and cigarettes, it is also intended to give special attention to the production of tobacco suitable for cheap cigarettes.

Besides tobacco there will be experiments with different varieties of ginger and potato, both being important crops in the Rangpur district.

Groundnut will be tried as a new crop.

9. *The Jorhat Farm.*—This farm is to be devoted mainly to the sugarcane crop. A programme of sugarcane experiments for the current year was decided in consultation with Dr. H. Mann in April 1907. It is proposed to follow the same programme with some slight modifications in the ensuing year. The programme includes—

- (i) An experiment to test the merits of a number of varieties of sugarcane. There will be some fourteen varieties under trial in the coming year, four among these being seedling varieties imported last year from Barbadoes. The experiment includes a continuous detailed study of the field characters of each variety during the growing season.
- (ii) An experiment to ascertain the most profitable amount of cattle manure and oil cake to apply; the manures tried being as follows:—
  - (a) 300 mds. of cowdung plus 20 mds. of rape cake per acre.
  - (b) 150 mds. of cowdung plus 10 mds. of rape cake per acre.
  - (c) 75 mds. of cowdung plus 5 mds. of rape cake per acre.
  - (d) 300 mds. of cowdung and no oil cake per acre.
  - (e) 150 mds. of cowdung and no oil cake per acre.

To these it is intended to add experiments with fish manure, green manure, cotton seed cake and whole cotton seed.

- (iii) An experiment in ratooning on the two plots planted with varieties in the current year. Most of the plots ratooned this year will also be maintained for a third year.
- (iv) A selection experiment consisting in selecting the 20 best cuttings of each variety picked out from the healthiest clumps of cane in the variety plots.

The attempt to free from disease certain varieties of cane which are extremely susceptible to red rot by carefully excluding every set that may show the least trace of reddening at the cut ends will be continued.

The programme of the farm will include the cultivation of groundnut as a new crop, of potatoes and of several exotic varieties of pineapple and of plantain, orange, lime, litchi and mango trees. It will also include demonstrations intended to bring home to the local raiyats the advantages of the 3-roller iron sugar mill and the shallow evaporating pan over the wooden mill and deep pans used by them.

*The Upper Shillong Farm and the Shillong Fruit-Garden.*—The programme will be as follows:—

- (i) *Potatoes.*—
  - (a) Trial of varieties.
  - (b) Experiments to test the merits of
    - (i) boxed against unboxed seed
    - (ii) whole against cut sets
    - (iii) large against medium sets.
  - (c) Trial of Bordeaux mixture as a fungicide. This may be said to have passed the experimental stage. Arrangements are being made to demonstrate the value of Bordeaux mixture in a number of raiyats' fields in the ensuing season.

## (d) Manure Experiments :—

(i) Green manure with pulse crop *versus* no manure.

(ii) Rape cake—20 mds. per acre

*versus*

Super—6 mds.

Sulphate of Potash 3 mds.

} per acre,

both fields receiving 150 mds. of cow dung in addition.

(ii) *Introduction of European fruits and fruits of the semi-temperate climate.* These include apple, pear, cherry, plum, apricot, peach, grape, strawberry, gooseberry, raspberry, currant, fig, walnut, almond, loquat, tree tomato, cherimoyer and mountain papaya.

(iii) *Distribution of trees and seeds* of such new fruits and vegetables as have proved successful. These include pear, strawberry, fig, Spanish chestnut, rhubarb, asparagus, mulberry, varieties of potato, and a large fruited variety of squash.

(iv) *Trial of new crops.*—Three varieties of American sweet potatoes, Jerusalem artichoke, mangel wurzel and groundnut.

(v) *Breeding of manze.*—By cross-fertilising local with superior American varieties.

(vi) *Preservation of fodder in soils.*—As an object lesson to Khasia cultivators.

(vii) *Cattle-breeding.*—Efforts are being made to introduce a good milking strain of cattle and to improve the local Khasi breed by crossing it with a half English Patna bull. The farm will continue to distribute young bulls of its own breeding to cattle breeders in the District. The Superintendent of the Veterinary Department will constantly inspect and advise on the breeding operations.

(viii) *Sericulture.*—The cultivation of mulberry will be continued, as well as the experiment in the rearing of the univoltine silkworm, both from fresh imported seed and from seed locally produced. It has been proved that European silkworms can pass at least one year in Shillong without deterioration or increase of disease. It is now intended to ascertain whether the seed of the same worms gives equally good results in the third year. To introduce sericulture in the Khasi Hills, one Khasi boy has been sent with a Government stipend to the sericultural school at Rajshahi. He has bound himself to commence rearing silkworms on his return after completing the normal course of training at the school. Next year it is expected that two more Khasi boys will be sent for training.

11. *The Wahjain Tropical Plantation.*—The plantation will continue to be used as the trial ground for various species of tropical spices, drugs and fruits. These are as follows :—

A. *Spices*—

Cinnamon,  
Lesser Cardamom,  
Greater do.  
Nutmeg,  
Clove.

B. *Drugs*—

Coffee,  
Cocoa,  
Camphor.

C. *Fruits*—

Oranges and other citrus fruits,  
Pineapple,  
Papaya,  
Grafted mango,  
" litchi,  
Sapota,  
Banana,  
Bread fruit,  
Rambutan,  
Soursop,  
Cherimoyer.

*D. Essential oils—*

Lemon grass,  
Tezpat (leaf of a species of Cinnamon).

The plantation is situated on the southern slopes of the Khasi Hills which are the home of the Sylhet orange. A very serious blight has appeared in the orange groves, which has already killed a vast number of trees, and is spreading fast. Dr. Butler was good enough to send one of his assistants, Mr. S. K. Basu, in May last to investigate the pest. His report has not yet been received, and no remedial measures have as yet been suggested. The blight is believed to be the work of a fungus which spreads underground from tree to tree. It has been observed that several species of citrus, though growing in close association with diseased orange trees are free from the blight. Experiment is being made to confirm this observation by planting a large number of citrus trees of different species in a badly diseased orange garden. If any of these species prove immune to the attack of the fungus, it will be possible to combat the blight by using them as stocks for grafting the orange on. Previous attempts at grafting orange on such stocks have however failed, and information is desired as to whether skilled grafters can be obtained from the Central Provinces or elsewhere to conduct further experiments.

### III.—PROMOTION OF SERICULTURE

12. It has been decided that this province, while working in concert with Bengal in measures for the revival of the silk industry should have a separate staff for the purpose. This department is therefore taking over from the Bengal Silk Committee the charge of all sericultural operations in the districts of Eastern Bengal, including the two small pure-seed stations in Rajshahi. These it is intended to supplement shortly by two large rearing stations, one in Rajshahi and the other in Bogra, each controlled by a responsible officer of the grade of Sericultural Superintendent. One such officer after passing through a course in sericulture in Tokio University is now receiving special training in Indian methods under Mr. A. K. Ghose, Sericultural Superintendent of Bengal.

The sericultural school at Rajshahi will be continued on the lines already established last year. Twelve apprentices are received who must be sons of silk-rearers. After a year's training each apprentice who proves himself thoroughly competent is awarded a microscope together with a sum of Rs. 250 with which to build a model rearing house. It is expected that the number of students will be increased to twenty from January 1909, when probably six students will be received from Bengal, and two from the Khasi Hills.

### IV.—EXPERIMENTAL WORK OUTSIDE THE AGRICULTURAL STATIONS.

13. The programme of work outside the Agricultural Stations will include helping Government Officers in making experiments in Government and wards' estates with advice as well as with seeds, manure, etc., and rendering similar assistance to private individuals wishing to try new crops, manures or implements. There are several private experimental farms in the Province which are being worked in co-operation with the department and will continue to receive its assistance.

14. An important branch of work, not directly connected with any Agricultural Station is the investigation of insect pests and the application of remedies wherever possible. The Department has in its employ an Entomological Collector who received his training under Mr. Lefroy at Pusa. It is proposed to issue a small handbook in the chief vernaculars of the province, of more important insect pests locally known for which practicable remedies can be recommended.

15. In some parts of the province the rearing of poultry and ducks and the sale of eggs are important industries. It is intended to make some experiments on the rearing of improved breeds and in the introduction of improved methods of preserving eggs. Some of these experiments will be made by officers of the department, others will be made by private persons and officers of other Departments with our advice and help. In all cases the experiments will be on a modest and tentative scale, until experience has shewn the lines on which larger operations can be undertaken with full expectation of ultimate benefit to the country.

16. The supervision of measures for the improvement of the hand-loom industry has received a large share of the attention of the officers of the department during the past year and it is probable that during the ensuing year this work will be largely developed.

17. During 1907 the department was charged with the duty of arranging for the planting of avenues in the new civil station of Dacca. It is probable that shortly the department will be directed to supervise the roadside arboricultural operations of the whole province.

#### V.—DEMONSTRATION OF AGRICULTURAL IMPROVEMENTS AND DISSEMINATION OF AGRICULTURAL INFORMATION.

18. The Department hopes to receive considerable assistance from its Honorary associates and correspondents in disseminating useful agricultural knowledge and in obtaining timely information of pests, blights and other calamities affecting crops, with a view to taking such steps as may be possible towards devising remedies. Some associates and correspondents have already been appointed, and it is proposed to extend the number as gentlemen qualified to do the work expected of them become available. An Honorary correspondent is expected to send regularly to the Department reports on all matters affecting crops and, in return, he is supplied with all information likely to be useful to the agriculturists of his neighbourhood. An Honorary Associate in addition to the duties of an Honorary correspondent is expected to make a comparative demonstration of an agricultural improvement which has been already proved by experiment.

19. The demonstrations to be taken up at present have been described in a bulletin (No. 16) issued by the Department. Materials for a bulletin on the cultivation of the potato, another on the cultivation of coffee in the Khasi Hills and a third on the use of Bordeaux mixture as a fungicide, particularly with reference to the potato disease, are being collected by the Assistant Director, and will be soon ready for publication.

20. Agricultural exhibitions which are an important means of spreading a knowledge of new crops and new agricultural practices will continue to receive assistance from the Department.

21. The compilation of agricultural statistics and the improvement of the present system of collecting figures for crop forecasts will require and receive considerable attention from the officers of the Department.

#### VI—SPECIAL WORK OF THE EXPERT STAFF.

22. Mr. Finlow will continue, in collaboration with the Reporter on Economic Products, the chemical and agricultural study of the various races of jute, having regard to quality as well as yield of fibre. The selection experiments with jute will be continued and, if possible, some cross fertilisation experiments will be made. Mr. Finlow will also be required to advise on measures for the extension of jute cultivation to parts of this province where, though the land is suitable, the crop is not at present grown. Mainly to assist in these measures he will maintain and distribute a sufficient supply of first class seed. He will also continue to visit other provinces where his services are required in connection with jute experiments.

23. During 1907 Mr. Finlow, in collaboration with Messrs. Cross and Bevan of London, commenced an investigation regarding the deterioration of damp baled jute. This will be continued and possibly completed during the year.

24. Further experiments will be made with flax cultivation and retting. The study of various fibre yielding plants indigenous to this province will be developed. It is hoped that a bulletin on the latter subject will be published during the year.

25. One of Mr. Meggitt's important duties will be to see that the construction and fitting up of the Central Laboratory at Dacca are brought to a speedy and satisfactory conclusion. Meantime from June next he expects to have the use of the old Dacca College laboratory.

26. The Local Government have asked that an enquiry should be taken up in regard to the value of the silt deposits on land annually inundated by rivers. One branch of this enquiry relates to the effect of embankments in depriving the fields of further supplies of silt. The details of the enquiry have not yet been settled. It is intended that this should be done after consultation with the Imperial Experts and officers of other provinces at Pusa. The enquiry when taken up will be in Mr. Meggitt's charge.

27. The Agricultural Chemist will also be required to continue the analytical work commenced this year in connection with sugarcane experiments. Many other analyses of soils, manures and plants will also have to be made.

#### VII—ORGANISATION AND WORK OF THE VETERINARY DEPARTMENT.

28. The Secretary of State having now sanctioned the formation of a Veterinary Department in this province, it is expected that great progress will be made during the year in veterinary work. At present there are under the Superintendent, one Inspector and 28 assistants. Within 4 or 5 months it is hoped that these numbers will be increased to 2 Inspectors and 48 assistants. The inspection and instruction of the new assistants will occupy most of Mr. Harris' time. He is also required by Government order to inspect and test all glanders and surra cases before any animal is destroyed under the Act.

29. An excellent site has been obtained for the Veterinary headquarters and laboratory between the new and old civil stations of Dacca. The construction of buildings will, it is hoped, be well in hand by the end of the year.

30. The special staff of inoculators under a qualified European Veterinary Surgeon will be maintained for a further period of one year in the Surma Valley where great progress has already been made in driving out the epidemic of rinderpest which had been working untold havoc among the cattle.

#### BARODA.

1. There are now four Farms—one Experimental and three Demonstration Farms in the State. The crops experimented with at the Baroda Model Farm are of a more varied type, as are also the crops of the surrounding country. This Farm, moreover, serves as a school farm on which the students of the Agricultural school get a general knowledge of all the important crops grown in the State. The three small Demonstration Farms are worked by the Department in the more backward Agricultural districts with the object of demonstrating better methods of cultivating certain crops, or of introducing new ones. The experimental work on which the Department will be engaged during the year 1908-09 will fall under the following heads :—

2. Manure experiments on Tobacco and Sugarcane were started last year with the intention of ascertaining whether any artificial manures can be economically successful so as to replace manures locally obtainable. For this, complete manure formulæ were made up for equal cost. This being the first year of the experiment, no results were deduced. The experiment will be continued.

3. Sowing of white Egyptian cotton at various dates was tried. That started in March gave 600 lbs per acre, while that sown in June gave only 240 lbs. The experiment will be continued.

Special experiment with brown Egyptian cotton without irrigation was tried in people's fields in various kinds of soil. The results show (1) that the best black soil of Gujrat is suitable for this crop; (2) that the heat of October—November forces this cotton to early maturity and the bolls thus formed attract boll-worms; and (3) that by removing tops and October flowers as they are found, good crops may be hoped for.

The trial will be continued now on a small scale under direct control of the Department in the best black cotton soil.

4. The seed of big Japanese groundnut which gave the best yield as an unirrigated crop has been given to the best cultivators and Travelling Instructors with printed leaflets of instructions. Efforts will be made to make this crop popular

- Cheese. 5. The Cheese-house which was under construction last year is now complete for making cheese and for utilizing Skim Milk.
- Cross breeding. 6. Cross breeding between English and Indian cattle will be tried.
- Seed Depôts. 7. The number of Seed Depôts for the selection and distribution of seeds of ordinary crops will be increased.
8. The insect diseases of tobacco, rapeseed, sesamum, gram, cotton, sugarcane were studied. Useful particulars about the cotton bollworms and Katra have been printed in Gujrati leaflets.
- Entomology.
9. The Mulberry plantation was extended at the Songhad Sericultural Farm to meet the growing demands of people for propagation. Six crops of silk worms were taken last year and forty students have received instruction in rearing and reeling. It is hoped that these students will take up the new industry, as special concessions are given.
- Sericulture
10. Revised course of studies in the School of Agriculture will be introduced from this year.
- Agricultural Education
11. Three more Experimental Farms will be opened before the end of this year for special experiments of cotton, poppy and sugarcane at Dabhoi, Sidhpur and Navsari, respectively.
- Experimental Farms
12. To induce the cultivators to make use of English implements, Turn Wrest Ploughs B.T. 2 are given on loan with skilled labour of the farm to well-to-do farmers. They tried these ploughs on their own lands and have promised to buy some ploughs.
- Introduction of English Ploughs
13. This year to economise water on irrigational crops, side-irrigation is tried on sugarcane, wheat, tobacco, English vegetables, potatoes, etc. The whole is still in experimental stage, but the present outlook of all the crops is very healthy, and it is expected to give a better yield.
- Side-irrigation.
14. It is proposed this year to inoculate the farm yard manure with Nitrogen-bacilli and to compare this manure with other artificial Nitrogen manures; if possible, the inoculated manure will be distributed to well-to-do farmers for trial.
- Inoculation of manures.

### KASHMIR.

1. Experimental work at the Pratap Model Farm to be continued on the following points :—

1. Variety experiments with—

- (a) Wheat.
- (b) Oats.
- (c) Gram.
- (d) Peas.
- (e) Mustard.
- (f) Shali.
- (g) Cotton.
- (h) Maize and jvar in alternate plots.
- (i) Tobacco.
- (j) Potatoes.

The object of the variety experiments being to discover varieties suitable to the Kashmir Valley and superior to those commonly grown.

2. Russian Inseed (Riga) for fibre. Experiments were made with Riga to see if it could successfully be grown for fibre in Kashmir. The seed was obtained from the Department of Agriculture, Eastern Bengal. The sowing was delayed

over a fortnight owing to severe rains. The cultivation too was unsatisfactory owing to want of the proper implements. A sample of fibre, as grown, was sent to Messrs. Oglvy, Gillanders and Company, London, for favour of opinion, which is given as below :—

“Codilla, rough, strawy, mixed strength, value £13 to £14 per ton; owing to the irregularity of the sample, it is valued lower than it would be, if stored.

If the product was carefully stored, a varying proportion of ‘Line’ (which means fine quality) would be obtained, which at present is valued £20 to £30 per ton and ‘Codilla’ at a proportionate price.”

### 3. Manual experiments with—

- (a) Wheat.
- (b) Mustard.
- (c) Peas.
- (d) Paddy.
- (e) Oats.

The manures to be tried in each case are those which are easily procurable by the cultivators of the Valley. They are as follows :—

Horse dung; cattle dung; farm-yard manure; Dal soil; ashes of chinar leaves.

The Electric Department of Jammu and Kashmir State expects to produce nitrate of lime at a very cheap cost.

### 4. Green manuring *versus* Farm-yard manure.

- (a) Two plots. Wheat after urd-fodder ploughed in.
- (b) „ Wheat after moong-fodder ploughed in.
- (c) „ Wheat after hemp ploughed in.
- (d) „ Wheat after beans ploughed in.
- (e) „ Wheat after application of 100 maunds farm-yard manure.
- (f) „ Wheat without any manure.

The object is to see whether green manuring could quite as well and economically serve the purpose of farm-yard manure, which is very difficult to get sometimes at any price.

### 5. Norfolk rotation of Four Course System.

*First year.*—Wheat.

*Second year.*—Potatoes.

*Third year.*—Oats.

*Fourth year.*—Lucerne.

*Fifth year.*—Same as first year, and so on.

### 6. Two-year rotations :—

- (a) Two plots. Wheat and beans in alternate years
- (b) „ Wheat and juar do.
- (c) „ Wheat and peas do.
- (d) „ Wheat and urd do.
- (e) „ Wheat every year.
- (f) One plot. Wheat-mustard every year.
- (g) „ Wheat-gram every year.

### 7. Dofash rotations :—

- (a) Two plots. Wheat after urd-fodder removed.
- (b) „ Wheat after moong removed.
- (c) „ Wheat after hemp removed.
- (d) „ Wheat after beans removed.
- (e) „ Oats after urd removed.
- (f) „ Peas after juar removed.

Further work proposed to be done by the Agricultural Department of Kashmir State is —

- II. Organization of the Department.
- III. Trial of the following new crops :—Groundnut, juar, bajri, [finer paddy and lucerne.
- IV. Seed selection and distribution of ordinary crops.
- V. Trial of the Watt's and Meston ploughs and other agricultural implements likely to be more serviceable to the cultivators of the Kashmir Valley.
- VI. Cattle-breeding. Efforts will be made to improve local breeds of cattle by the distribution of stock from the farm.
- VII. Arrangements are being made for a seed farm.
- VIII. A Live Stock and Agricultural Show was held in Shrinagar on 18th and 19th October 1907 for the first time. It was fairly successful, and it is arranged that one should be held every year to encourage the cultivators and the zamindars of the Valley.
- IX. Introduction of European fruits and vegetables in the State gardens.



## APPENDIX D.

## PROPOSALS FOR THE EXPANSION OF THE DIFFERENT SECTIONS OF THE PROVINCIAL DEPARTMENTS OF AGRICULTURE.

The rates of pay fixed for the higher posts for Indian assistants at Pusa are not sufficient to attract and retain the best available men. It is equally certain that better rates of pay would attract better Indian assistants to the Agricultural Department of each Province, and would prevent them, after passing through the course in Agriculture, from eagerly seeking employment in other Departments as at present.

2. Until the best Indian assistants are employed for laboratory, class room and field work, it is uncertain that reliable original agricultural work will be done by them and probably ordinary routine work will also suffer.

3. Field and other practical experiments must always be largely supervised by Indian assistants. If this supervision is inadequate, the recorded results must be worse than useless.

4. The men we want should have been brought up on the land and should have obtained a good general education as also a technical education in some branch of the Department. The rates of pay for Indian assistants in the Agricultural Departments should be graded to rise as high as those in the Revenue Department.

5. I submit below a scheme to provide a sufficient native agricultural establishment for each Province. I hope it will be accepted by each Local Government without material alteration as the basis to which each Province can work up gradually. If Local Governments generally accept my proposals, we will have a strong case to put before the Secretary of State. The rates of pay and prospects should as far as possible be fairly uniform for all sections of the Department in each Province.

6. The work in each Province should be approximately as follows:—

- (a) Research and tuition in the College and in the field of the College Farm and to some extent in the districts.
- (b) The practical application in the field of research and experimental discoveries of proved value, the extension of improved varieties of crops, of improved methods of cultivation or other improvements from the experimental plots through demonstration areas to the cultivator's fields, the study of the variable and fixed natural conditions and their influence on agricultural possibilities and the collection of general agricultural facts.

7. For the work classed under (a) the following European staff was proposed by the Government of India to the Secretary of State:—(1) an all-round Agriculturist to be Principal of the College; (2) an Agricultural Chemist; (3) an Economic Botanist; (4) a Mycologist; (5) an Entomologist. The Principal of a Provincial College need not necessarily be an expert Agriculturist. Another expert on the staff might be a better man for the post. The Principal should reside at the College, but the other members of the staff will be able to tour to a considerable extent and all should be in continuous communication with the Deputy Directors of Agriculture, so that research work can be, as far as possible, based on practical information gathered in the field.

8. The Provincial posts of Mycologists and Entomologists have not been sanctioned by the Secretary of State. It is therefore necessary to get these sections of work done in each Province by the best Indian agency which is procurable.

9. Each European Expert, who at a Provincial College is a Professor of a particular subject, should have an Indian assistant thoroughly capable of teaching and also of guiding the laboratory work of the students.

10. In every Provincial College provision should be made for the teaching of Physics, Geology, Agricultural Mechanics, Surveying, Plan Drawing, Book-keeping and to some extent Veterinary Science in addition to the main subjects, *viz.*, Agriculture, Chemistry, Botany and Mycology.

11. I summarize below the Indian establishment required at each Provincial College and Research Station :—

*Principal and Agriculturist's Section.*

1 Assistant Professor of Agriculture . . . . .	250-10-500	
1 Farm Manager . . . . .	200-5-250.	
1 Teacher of Physics, Agricultural Mechanics and, if necessary, Mensuration and Mathematics. . . . .	150-5-250.	
1 Teacher of Surveying, Plan Drawing and Farm Book-keeping. . . . .	100-5-150.	
1 Veterinary Assistant for teaching and also in charge of the District Dispensary. . . . .	100-5-150.	
2 Field Assistants . . . . .	75-5-125.	each.

*Agricultural Chemist's Section.*

1 Assistant Professor of Chemistry and Geology . . . . .	250-10-500.	
1 Laboratory Assistant and Demonstrator . . . . .	150-5-250.	
2 Laboratory Assistants. . . . .	100-5-150.	each.
2 Ditto . . . . .	75-5-125.	"

*Economic Botanist's Section.*

1 Assistant Professor of Botany . . . . .	250-10-500.	
1 Laboratory Assistant and Demonstrator . . . . .	150-5-250.	
2 Field Assistants . . . . .	75-5-125.	each.

12. Since the Secretary of State has not sanctioned the appointment of European Mycologist and Entomologist for Provincial service, Dr. Butler and Mr. Lefroy have made proposals which provide the following Indian staff in each Province. Full explanations are given in Appendices to this note :—

*Mycology.*

1 Assistant Mycologist and Teacher (when necessary) . . . . .	250-10-500.	
1 Laboratory Assistant and Demonstrator . . . . .	150-5-250.	
2 Field Assistants . . . . .	75-5-125.	each.
1 Fieldman . . . . .	30-4-50.	
1 Collector and Mounter . . . . .	10-2-30.	

*Entomology.*

1 Assistant Entomologist and Teacher (when necessary). . . . .	250-10-500.	
1 Laboratory Assistant and Teacher . . . . .	150-5-250.	
3 Field Assistants . . . . .	100-5-150.	each.
4 Ditto . . . . .	75-5-125	"
2 Setters . . . . .	30-4-50.	"
7 Fieldmen . . . . .	10-2-30.	"
1 Laboratory keeper . . . . .	10-2-20.	

13. The work of the Provincial Mycological and Entomological Assistants should be supervised by the Economic Botanist. Therefore efforts will be made to appoint to each Province an Economic Botanist of proved experience in original and practical work.

14. It should be recognized that it will take years to work up to an effective staff of Indian assistants, but definite rates of pay should be fixed at once to attract the right men. I consider that agricultural improvement in India depends largely upon the proper training of Indian assistants.

15. I strongly believe that the senior assistant of each European Expert of each Provincial College should be trained partly in England until Pusa can undertake this training. Each should be a graduate in Agriculture of an Indian College and be deputed to the Cambridge University for two years on a pay of Rs. 200 to take his degree in Agriculture and afterwards to specialize in his own particular subject. Experience has shown that selected students, who have graduated in Agriculture in India, have no difficulty in taking the Cambridge degree in Agriculture in a year and are then free to specialize in Economic Botany, Agricultural Chemistry or any other Agricultural subject in the other year. Each student should then have one year's further training at the Pusa Research Institute. The training

at Pusa will, by the time men are ready, be as good as that at Cambridge and directly suited to Indian workers. The other posts of my list down to those on pay Rs. 75-5-125 should be filled by graduates in Agriculture of an Indian College who should also in special subjects get a further special training at Pusa (for instance in Mycology or Entomology).

16. In (b) section of Provincial Agricultural work referred to in paragraph 7 of this note, the Deputy Director of Agriculture requires a sufficient number of Assistants as Farm Superintendents, Overseers and Fieldmen. The number should increase as work develops. I propose the following rates of pay :-

Superintendents of Experimental Stations and Seed Farms	200-5-250.
Overseers of Demonstration Areas	100-5-150.
Fieldmen	75-5-125.

In all cases these men should be chosen from the Agricultural graduates of Indian Colleges. A Fieldman may of course be gradually promoted to be a Superintendent.

17. It is unnecessary for me to discuss the range of work of Deputy Directors of Agriculture and of European Experts attached to Provincial Colleges and Research Stations. The work will be largely influenced by the originality and individuality of each man, but will be guided of course very materially in each Province by the consultation between the Experts and the Directors of Agriculture.

18. At Pusa full arrangements have been made for the illustration work of each section. Coloured and other illustrations can now be clearly reproduced in India and arrangements are being made so that coloured plates representing the life history of destructive insects will be supplied for leaflets or other publications to be issued by Provincial Agricultural Departments or by vernacular papers or otherwise at Rs. 30 per thousand and similar arrangements can be made in any other section.

J. MOLLISON,

*Inspector General of Agriculture in India.*

#### APPENDIX I.

*A summary of some information obtained from the Imperial Mycologist regarding the expansion of his work in different Provinces.*

The Secretary of State has not sanctioned a European Mycologist for each Province; therefore highly-trained Indians must do the work.

2. The need for Mycological enquiry regarding Indian crops is great. Rust causes immense loss to cereals and to linseed almost every year. Smut is also very prevalent in cereal crops and grasses. The palm disease in Madras has already caused loss amounting to 20 lakhs of rupees or more. The Betel Palm plague in Eastern Bengal is still more disastrous. Many other plant diseases affect the prosperity of agriculture in India. The cost of Dr. Butler's section would be met for many years by checking one of the major diseases which affect our agricultural crops.

3. He draws a distinction between the immediate results of the work of his section and of some other branches of agricultural science in India, because before his time there were no previous workers in India in Agricultural Mycology except Dr. Barclay and Dr. Cunningham; and because Mycology in relation to agricultural plant diseases is yet only a new science particularly in the tropics.

4. There is not a general treatise which deals with the fungus diseases of the tropical agricultural plants. Dr. Butler is preparing one and it is almost ready for the press. He has issued many clearly illustrated articles which deal with particulars of his work. Complex plant diseases are not necessarily the most difficult feature of Dr. Butler's work. He says there is often a stage in the life history of a plant parasite in which destructive measures are possible, and with full knowledge once gained a decision can easily be made upon the beneficial lines of work.

5. The first requirement for Mycological work in India is full provision for research. This, for the present, must be arranged for at Pusa. It is a very big undertaking, considering the agricultural area and the number of crop diseases which have to be dealt with. For research and general work at Pusa and throughout

India 3 European Mycologists and a full staff of Indian assistants will probably soon be employed.

6. The present Indian staff of the Mycological section at Pusa, excluding clerical and menial establishment, consists of—

	Rs.	
1 First Assistant	200-250	
2 Assistants	75-125,	each.
1 Fieldman	50-75	
2 Fieldmen	30-50,	each
1 Assistant (for Supernumerary Mycologist)	75-125,	
2 Assistants (trained for and employed by Provincial Departments).	100,	each.

7. Experience has proved that better rates of pay are required to attract and keep first class Indian assistants. Proposals have been made for such improved pay.

These proposals are—

	Rs.	
1 First Assistant and Teacher	300-600	
1 Second Assistant	250-300	
1 Third Assistant	200-250	
3 Assistants	100-150,	each.
1 First Fieldman	50-75	
2 Fieldmen	30-50,	each
1 Assistant to Supernumerary Mycologist	75-125	

8. The Indian staff above referred to is required for field and laboratory work connected with research and also for teaching students sent from Provinces.

9. The establishment at Pusa of a central reference collection and library in Mycology is receiving particular attention, as it is of the first importance that the Mycological workers in India should get fungus pests identified at or through Pusa and get other assistance there. The demand for information is keen from officers in the Forest and other Civil Departments and also from men in the Provincial Agricultural Departments.

10. The work of the Pusa staff will chiefly for some years refer to—

- (a) Scientific research in plant diseases and their remedies and other problems such as the action of the fungi in the soil. It is from such enquiries that practical measures of treatment are chiefly expected.
- (b) The study of the fungus flora of India and arrangements for a central reference collection which will aid Provincial Departments in the determination of their pests and in the study of life histories and in teaching students.
- (c) The publication—
  - (i) of the results of research work in specific diseases,
  - (ii) of descriptions with illustration of Indian fungus affecting agricultural crops,
  - (iii) of the results of remedial measures,
  - (iv) of popular articles in the Agricultural Journal of India or in leaflet form, the object of these being to indicate to educated landowners and agriculturists how the work of the section can be applied to practice in the field.
- (d) The training of men for Provincial work.
- (e) The co-ordination of work in the Provinces.
- (f) The conduct of campaigns too large for the Provinces to deal with unaided.

11. The staff required in each Province should for the present be as follows :—

	Rs.	
1 Assistant Mycologist and Teacher (when necessary)	250-500	
1 Laboratory Assistant and Demonstrator	150-250	
2 Field Assistants	75-125,	each.
1 Fieldman	30-50.	
1 Moulder	10-30.	

12. The Senior Assistant in each Province should be a selected student of an Indian Agricultural College who is of the landholder class and who should be, if possible, a science graduate of an English University. The most satisfactory training possible would perhaps be that required for the Agricultural Diploma of Cambridge University, provided that the student devotes special attention to Mycology during the course.

13. The laboratory assistant required is the class of men who have been sent to Pusa by several Provinces for training, in the past two years. These men are graduates of Indian Universities who go through a course of about 18 months training at Pusa. When the Provincial Colleges are equipped, picked students from them with a considerable further training at Pusa will be available and should prove satisfactory. Men whose upbringing has been on the land should be sought.

14. The two field posts should be filled from the Agricultural Colleges in India, with some further training at Pusa.

15. The whole of this part of the proposals relating to the pay, selection and training of Provincial Assistants must be dependent, to some extent, on the special conditions and preferences of the Provinces concerned. It is impossible to lay down any hard-and-fast rules.

16. The duties of the Provincial Assistants should chiefly be connected with practical matters and should not particularly refer to original research. These Assistants should make enquiries in the field regarding any crop diseases, their seasonal prevalence, amount of the damage done, methods of checking adopted by cultivators, practicability of introducing other remedial measures and should adopt such measures on recognized lines, as far as possible, on the Government Farm and in cultivators' fields. They should collect specimens of the fungi of the Province which are harmful to agriculture and form teaching collections for the Provincial Agricultural College. Duplicate specimens should be supplied to Pusa to be identified.

17. In each Province the Assistant Mycologist and his Assistants should work under the Economic Botanist who alone will have sufficient knowledge to properly direct the work.

18. Since, for a part of the year, the presence of the two first assistants will not be essential at head-quarters, they should keep in close touch with field-work and carry out detailed enquiries into such serious diseases as are reported by the Field Assistants or otherwise. It is impossible to separate the field and laboratory branches of Mycological work. The two must be brought together by the frequent touring of the Assistant Mycologist and Laboratory Assistant. When large field work has to be taken up, as in a campaign against a specific disease, the field staff must be strengthened from the laboratory, and microscopic work in the field should form a prominent feature of such work when the full characters and life history of the disease are not thoroughly understood. All arrangements for the supply of spraying and steeping materials and the like should be made by the Assistant Mycologist.

19. The Field Assistants should be occupied in disseminating information, making enquiries, visiting villages to inculcate simple practices for checking or avoiding disease and such other purely field work. They must keep in constant communication with the laboratory for the identification of specimens and for other useful information. The fieldmen should chiefly carry out practical remedies requiring no special scientific knowledge.

20. The broad lines of work in each Province should be arranged in consultation between the Imperial Mycologist and the Provincial Botanist. Pusa should be kept in advisory touch with the Provincial Assistants so as to co-ordinate work and prevent overlapping. Monthly reports should be submitted by the Assistants, a copy being forwarded to the Imperial Mycologist for information and remarks.

21. As a specific instance of how this scheme of departmental organization should be applied in practice, Dr. Butler's description of the work at present being carried out by the Madras Department of Agriculture under the advice of the Imperial Department is given as Appendix II.

## APPENDIX II.

*The field campaign against the Palm Disease of the Godavari Delta.*

The Godavari Palm Disease was first noticed by the people of the Delta about ten years ago. It was then confined to a few villages, but has extended steadily since, and in August 1905, when I visited the Delta to investigate, it occupied an area of about 900 square miles.

In the early years palmyra palms alone were attacked. Subsequently it spread to coconut and probably also to areca palms. These palms formed the chief feature of the Deltaic landscape, and in those localities where the disease has existed for several years, the sight of thousands of dead naked poles is extraordinarily impressive in indicating the severity of the disease.

The capital loss to the cultivators and landowners of the Delta is already somewhere between ten and twenty lakhs. This takes no account of the loss of excise revenue to Government amounting to Rs. 1-8-0 per dead tapped tree per annum. If once the disease reaches the large coconut-growing districts to the south, the loss will run into crores, unless the effective methods of checking are thoroughly carried out. In the Godavari Delta, palms form the most valuable economic asset of the people, furnishing them with an extraordinary number of every-day appliances, food, fuel, and the essential parts of their dwellings. In some villages 70 per cent. of the palms have been killed, and this loss will change the whole economic conditions of the Delta if not checked.

My investigations showed the disease to be due to a new form of fungus, belonging to an obscure group. I had fortunately been engaged in an extended study of this group for several years, and it was this fact that enabled me rapidly to work out some of the main features of its life history and to suggest practical measures for checking it. The information already available has been published in the *Agricultural Journal* for October 1906 and in *Memoir No. 5, Botanical Series*, of the Department. Further detailed study on the spot is necessary to elucidate all the conditions of attack, but should extend over six months or more to yield full information and it is impossible for me to leave my laboratory for so long a period.

The suggestions for treatment were adopted experimentally by the Madras Government and operations commenced in December 1906 at an estimated cost of Rs. 5,000. The perfect feasibility of these operations having been proved by three months' trial, their extension to the whole area has been recently jointly recommended by the Collector of Godavari, the Director of Agriculture, Madras, and myself and I understand that full measures for stamping out the disease are now assured. If these are thoroughly carried out I am confident that they will meet with entire success.

The parasite gains entrance to the leaf sheaths surrounding the apical bud of the palm. It penetrates these one after another, until the bud is reached and the tree dies. Two sorts of spore have been found, which germinate only under certain conditions. These convey the disease from tree to tree, but how is not certain. Infective material is only produced at certain stages. The activity of the parasite reaches its height about December. The facts ascertained would ordinarily have taken months of enquiry to work out, but for previous knowledge of all allied forms, gained chiefly by laboratory work, and this case indicates strikingly the value of research. Further useful knowledge of the specific action of the parasite on palm trees, the method of infection, the particular functions of the two spore forms, the conditions governing their production and germination, and the relations between host and parasite, await the strengthening of the Mycological staff sufficiently to depute a trained Mycologist for prolonged local investigation. It is a good example of the sudden appearance of a new disease, of which the coffee leaf disease in Ceylon, the potato disease and the vine mildew in Europe are well known cases,—requiring the application of knowledge gained by long continued research in checking.

The treatment was based on the facts that infection passes from tree to tree by the wind, birds or some unknown agency, but can only carry a short distance; that infective material is only produced in the inner layers of the bud and not very early

in the attack; that infection takes place through the outer leaf sheaths, and requires moisture and other seasonal conditions for its success; and that heating destroys the parasite in its entirety and Bordeaux mixture prevents the germination of the spores.

No local trained assistance was available. Three working parties were formed, each in charge of a Revenue Inspector. Village returns were obtained through the village officials. Each village in a certain area, reporting the existence of the disease was visited in turn. A local staff of palm climbers (toddy drawers) was recruited, the trees were marked and all diseased trees climbed and the tops cut. Neighbouring healthy trees were climbed for Bordeaux mixture treatment. One man could cut 15 trees or treat 35 in a day and the cost worked out at about 2 annas and 1 pie, per tree, respectively. An assistant from the Madras Government Botanist's staff was in supervising charge, but had no Mycological training and no field experience. No better provision was available.

The new proposals provide for the treatment of the whole affected area, taluq by taluq. The total cost is estimated at Rs. 30,000. Two Indian assistants will be lent from my establishment and two provided by the Government Botanist, Madras. Application has been made for a junior officer of the Civil Service (an Assistant Collector) to take charge of the operations, and this recommendation, strongly supported by the Collector and the Director of Agriculture, emphasises the need of sufficient European staff to deal with large campaigns of this nature, for the want of scientific training will seriously reduce the efficiency of the control. I shall have to give frequent visits to the scene of operations instead of being able to depute a trained European Mycologist to take charge of the work. Superior control has been found necessary, even though effected by a non-scientific officer, in order to check fraud for which there are many openings.

In the scheme proposed for extending Mycological sections in India the original investigation would have been entrusted to one of the superior staff at Pusa, who could have remained for as long as was necessary to work out the disease fully. He would be assisted by the local staff in field enquiries and could direct their work to elucidating many of the field conditions which it is of importance to note. We would have submitted our results to the Director of Agriculture, Madras, and planned the campaign in consultation with him. The field operations would have been carried out by the Provincial staff, strengthened if necessary, by one or two Assistants from Pusa and controlled in a large measure from Pusa. One of the European staff from Pusa would probably have to spend six or eight months in the Delta during the field operations or could visit it frequently, but this could be provided for out of the staff suggested, for it is but rarely that more than one large campaign of this nature will occur in any one year.

I think this case furnishes a strong argument in favour of the proposals for strengthening the central staff now submitted and shows, in its most favourable light, the particular directions in which trained Indian assistance and local knowledge will prove useful.

E. J. BUTLER,

*Imperial Mycologist.*

### APPENDIX III.

#### WORK IN ENTOMOLOGY.

The assistance which Provincial Agricultural Departments can obtain from the Entomological Section at Pusa, can, to some extent, be estimated by the following information. The present Pusa trained staff for Entomology consists of:—

<i>European.</i>	<i>Rs.</i>
The Imperial Entomologist . . . . .	750-50-1,000,
Second do (expected to join soon) . . . . .	500-50-1,000
Supernumerary Entomologist . . . . .	{ 400-30-450.
	{ 500-50-1,000

<i>Indian.</i>	Rs.	
1 Special Assistant . . . . .	200- 5-250.	
1 Sericulture Assistant . . . . .	100- 5-150.	
4 Assistants . . . . .	75-10-125,	each.
1 Fieldman . . . . .	50- 5-75.	
6 Fieldmen . . . . .	30- 4-50,	each.
3 Setters . . . . .	30- 4-50,	"
2 Laboratory keepers . . . . .	10- 2-20,	"

2. In order to undertake original research and help the Provinces as far as possible in practical enquiries and work, the following Indian staff will probably soon be appointed :—

	Rs.	
1 Assistant . . . . .	250-400.	
1 Do. . . . .	150-300.	
1 Do. . . . .	150-250.	
1 Assistant for Sericulture and Bees . . . . .	150-400.	
6 Assistants . . . . .	100-150,	each.
9 Fieldmen . . . . .	30-75,	"
6 Setters . . . . .	20-40,	"
2 Laboratory keepers . . . . .	10-20,	"

3. Mr. Lefroy considers that at Pusa, where the work of each Assistant will be closely watched by himself and two other European Entomologists, he does not require men of exceptional educational qualifications. The Secretary of State has not sanctioned a European Entomologist for each Province. Therefore Mr. Lefroy would prefer to post to the Provinces men who have been partly trained in England. Such men may show special individuality or originality in their work and are, therefore, more suitable for the Provinces than for Pusa.

4. The investigation at Pusa should form a basis for the extensive work in each Province. Questions, such as the utilization of beneficial insects, the means of spreading parasites, the value of fungoid diseases of insects and the part played by birds in destroying insects, should be investigated at Pusa or by investigators from Pusa.

5. In the Pusa Insectory the life histories of injurious insects will be worked out in the greatest detail. All stages will be painted by trained artists. Insects destructive to crops and other insects will be collected, identified and preserved. In time a complete collection of the insects of the agricultural areas of India will thus be formed.

6. In collaboration with other experts on the Imperial staff insecticides and other methods of checking insects will continue to be investigated in the laboratories and in the fields of Pusa.

7. Pusa will provide instruction in Entomology, a long course for the Provincial Assistants and a short course for fieldmen.

8. When serious damage is being done by insects over wide areas, the Imperial Department must be in a position to give prompt assistance to the Provincial Departments or combine the work of two or more departments so as to secure the most efficient work. This has been found necessary recently as regards the migratory locust and boll-worm outbreaks.

9. Mr. Lefroy describes the entomological work which should be done in each Province as follows :—

- (a) Enquiry into the prevalence, behaviour and seasonal occurrence of injurious insects in the various tracts of the Province; into the injury caused to crops; the attitude of the cultivator towards these pests, the measures he adopts to check them and his willingness to adopt other remedial measures.
- (b) The examination in the field, as they occur, of all injurious and other insects.
- (c) The collection of specimens of injurious insects and the forwarding of those when necessary, for proper identification to Pusa.
- (d) Testing remedies on Farms and modifying these to suit local conditions.
- (e) Urging on the cultivators such simple remedies as have been found suitable, whenever losses in crops are noticeable.



- (f) Systematically spreading among the agricultural classes accurate information about insect life which injuriously or beneficially affects agriculture. This information should include the exhibition of collections by lantern slides in school rooms, fairs, etc., the publication of vernacular leaflets and village to village tours to demonstrate simple facts.

10. In reference to the Provincial establishment proposed under paragraph 12 of his general proposals, Mr. Lefroy advises that the work of the Assistant Entomologist should be executive, practical and chiefly in the field. He should not attempt systematic work that can be done at Pusa. He should direct and, as far as possible, control the work of the fieldmen. He should collect specimens of injurious and beneficial insects for Pusa and form at the Provincial College (a) the students' economic collection, (b) a reference collection of all economic insects of the Province, (c) a general collection of all insects of the Province.

11. The Laboratory Assistants' work should consist of—

- (a) Teaching entomology to students.
- (b) Care of the Collections.
- (c) Experimental and practical work on the College Farms and in the vicinity.

12. A field Assistant and a fieldman will be required for each Government farm and well-defined agricultural tract. The work of the field assistants will be to watch for the occurrence of a pest, to study it on the spot, to at once communicate the occurrence to the Assistant Entomologist and demonstrate practical remedies. In a serious outbreak all the fieldmen of the Province should be gathered in the affected areas. Ordinarily each field assistant should tour, talk to the people, instruct them, collect specimens of injurious insects, maintain on the Government Farm a small exhibit collection for demonstration and keep at hand such insecticides as may be ordinarily useful.

13. Mr. Lefroy explains that during the last two years Provincial Assistants have met in Conference at Pusa. This annual meeting is very useful and should be a definite feature in the year's work.

## APPENDIX E.

## POULTRY-FARMING IN INDIA

My Dear Sir,

May I call your kind attention to the following article which appeared in the *Indian Planters' Gazette* and beg your kind assistance in promoting the industry. I am sure the matter will commend itself to you, and thanking you in anticipation.

I am, dear Sir,

Yours faithfully,

H. E. ABBOTT.

## POULTRY-FARMING IN INDIA.

It has been a great disappointment to us, and also an extreme regret, that in all the schemes for the agricultural regeneration of India, which have been mooted and considered since Lord Curzon established the Agricultural Bureau, the valuable adjunct of poultry-farming finds no place. Two annual meetings of delegates from all parts of the country have already been held at the Research Institute at Pusa, and in the first number of the *Agricultural Journal for India*, officially published the other day, Mr. F. G. Sly, the Officiating Inspector-General of Agriculture, has in a very interesting manner sketched the outlines of the general scheme for the expansion of the Imperial and Provincial Departments of Agriculture, which has become possible with increased expenditure justified by the stability of exchange and the prosperity of the finances of the country. He very rightly claims that the Department of Agriculture in India should occupy the first position in the administration of a country where the land revenue is such an important source of income, and where famine makes such appalling inroads on the national prosperity. But neither at the conclaves at Pusa nor in Mr. Sly's exposition has there been said a single word of the value of poultry-culture, which in one form or another has become a really valuable industry in Europe, America, and Australia, one in which much capital is invested, and the returns from which form a considerable item in national food and wealth. The neglect of so potential a source of revenue in India is to us little short of amazing, especially as the authorities cannot plead in excuse that their attention has not been drawn to the enormous field the country presents for the profitable pursuit of this essentially modern cult in economics. In the fall of 1900, the first year of the new century, Mr. H. E. Abbott, one of the oldest and most optimistic fowl fanciers in India, started the *Indian Fowl Fanciers' and Farmers' Journal* with the avowed intention of encouraging the breeding of poultry among the poorer classes of Europeans, Eurasians, and Native Christians to raise them from a slough of poverty and despondence into which they had been plunged by the tradition, we might almost say the fetish, of shiftless and improvident living. The journal was an immediate success and has since been steadily growing in popularity and influence. The enthusiastic Editor has kept pounding away on the value of poultry-farming to solve a large part of the problem of the Domiciled, a problem that has baffled the most astute of our legislators. He has supported his opinions by practical demonstration on his farm at Jaintpore. He is constantly importing from England the best breeds of utility poultry and loses no opportunity to prove the profitableness of such investment. Month after month the journal records the enormous advances made in the industry in Europe, America, and the Colonies, and with sturdy independence rebukes the Government for failing in a duty which is as plain as it should be compelling. We are told of successful individual effort in every part of the country, and then asked to say what we think of the supineness of an administration which allows such a certain and lucrative means of revenue to slip. We must repeat that the official indifference is simply amazing, and it makes one inclined to concede to Dr. Emil Reich, author of "Success Among Nations," the justice of his allegation that the English official is singularly inelastic and must be driven by a goad to meet new exigencies. Mr. Abbott's clever little paper has done very much during the past five years to educate its readers in poultry-keeping; it is a welcome guest in:

library of more than one Secretary to Government; and it proclaims the fiscal value of the hen with the clarion note of a chanticleer. Yet both Pusa and the Agricultural Bureau are deaf to the call, and would probably fall down in a scientific fit, if asked to contribute a portion of the annual grant of twenty lakhs of rupees to the promotion of poultry-farming in India on a large scale. Before going further it may be useful to draw the attention of Mr. Sly to the attitude of the English Board of Agriculture and Fisheries towards the industry. Last year it issued some very valuable hints to farmers on the feeding of Poultry which were prefaced by the following significant remarks:—"There is a widespread belief that poultry keeping can never be made a great industry in the United Kingdom, by reason of the large amount of labour entailed and the great cost of upkeep in the way of food. No idea can be more incorrect, though there is at present an unfortunate tendency in many quarters to look upon poultry-keeping as a sort of hobby, and moreover, there is a serious wastage in the matter of food and labour. So far as cost of keep is concerned, co-operation in buying will work wonders, while, as to the saving of labour, experience is all that is necessary." We would hardly put the case for India more trenchantly.

Poultry-farming has reached its highest development in the United States of America, owing to an inexhaustible market. The Americans consume much less butcher's meat than we English do, and poultry and eggs are rapidly replacing it as the national food. It would be well if the Anglo-Indian followed this excellent example. It would reconcile him to the fact that *moorghis* is ever a most important item in the dāk bungalow bill of fare, and, what is of more consequence, the demand thus created would result in the rearing of a better class of fowl for the table. From an excellent article on the subject of poultry-farming contributed by Lewis Wright, the author of "The New Book of Poultry", to the latest edition of the *Encyclopaedia Britannica*, we learn that the poultry industry in the United States is the most gigantic in the world, and probably the greatest pecuniary interest the country possesses. By the census of 1900, which tabulates returns from 5,096,252 out of the 5,739,657 farms in the States, the number of fowls over three months old on 1st June 1900 was returned as 233,598,085, with 6,599,367 turkeys, 5,676,863 geese, and 4,807,358 ducks, or 250,681,673 birds in all, valued at 85,794,966 dollars. This, however, would include very few of the chickens raised that year which would not have reached the age stated, and mainly represents breeding and laying stock, which thus average about 49 birds to every holding; it also of necessity omits many of the smaller city-lot raisers. The value of the poultry raised during the whole year 1899 is given as 136,891,877 dollars and of the eggs produced (1,293,819,186 dozen) at 144,286,186 dollars; a total year's product of over £56,000,000. Adding only a very moderate amount for city-lot and other small producers not making returns, it will be seen that the poultry industry in America exceeds in value either the wheat crop, or swine crop, or cotton crop, which probably comes next in value. Is not this enough to spur our Government to strenuous endeavour, especially when we find that both in Australia and Canada the authorities, stimulated by the example of the United States, make considerable efforts to encourage poultry? Were it not that we would greatly exceed the limits of a leading article, we would quote the Continental statistics to show the rapid advance and the increasing importance of the industry in France, Holland, Belgium, Germany, and even Russia, during the last decade of the nineteenth century.

Having written so much of the value of poultry-farming as a national asset, we may turn our attention to the immediate requirements of India. Anybody who has taken an interest in the subject and watched the signs of the times must be convinced that something will have to be done, and at once, if the *moorghis* is not to disappear entirely from our tables. The drain on indigenous poultry, always raised by the natives in the very haphazard sort of way, is enormous and the supply is slowly but surely giving out. Considering the extent of the country, the number of natives that go in for it is microscopic, and it is our experience that the denizens of the *paras* are becoming more and more discouraged. The necessity to save the industry from extinction is an imperative duty of the State, and we think of no better way than for the Government of India to issue to the local Governments a circular enjoining on them the duty of employing a portion of the provincial grant to assist native professional poultry-keepers, Poor Whites, and Christian Missions to obtain from England and elsewhere the best breeds of

utility poultry and thus start an industry the future of which is secure. Most of the railways in India are owned by the State and the operations of the few companies that remain are controlled by the Government. Nothing would, therefore, be easier than to send a recommendation, which would have force of an order, to the railway directorates to encourage and assist their poorer employes to rear poultry and thereby make a much-needed addition to their scanty wages. Safe and cheap transport by special poultry coop wagons on all Indian lines would be an important item in the general scheme, and it would present no difficulty to a sympathetic and determined Member for Commerce like the Honourable Mr. Hewett. Knowing what we do of the great shipping companies that draw much of their wealth from India, we entertain no apprehension that they would refuse to assist the great industrial experiment we are advocating, by carrying fowls from England at low freight and providing proper coops to ensure their being landed strong and healthy. In Mr. Sly's article in the *Agricultural Journal for India*, to which we have already referred, he says that it is contemplated to have an experimental farm for each important distinct agricultural tract in India. We contend that the equipment of every such farm will be incomplete unless provision is made for a poultry department. It is unnecessary to labour the argument, for, beside the value of eggs and fowls, there is the exceptional advantage of the best manure that can be procured. Having accepted the poultry adjuncts to experimental farms, the next step of the Government will be the appointment of an expert controller and inspector with a position and independence of action similar to that enjoyed by the Veterinary Inspector-General. But by far the most important action we expect from Government is the holding of shows at important centres. The development of poultry culture in England owes nearly everything to the great number of poultry exhibitions during the last ten years of the nineteenth century. It is difficult for us in India to realise that in the height of the season the *Field* had criticised as many as twenty shows in one week in Great Britain. We cannot hope to attain to any such enthusiasm in India for several generations to come; but it is useful to record the fact to show how incumbent it is on Government officials, in the mofussil especially, to organise frequent poultry exhibitions and encourage native rajahs and zamindars to help such of their ryots as are not prohibited by caste prejudices to take up poultry-breeding as an essential of their existence. If Government would provide such men and the Poor Whites, to whom we have so often referred, with eggs and young stock from the Government depôts, either gratis or at very nominal prices, the first great obstacle would be overcome and the industry would be launched on the fair way to success. Government aid in the way above indicated is imperative and it is also legitimate. We have in Lord Minto a Viceroy who is a great landlord at home and has done everything in his power to assist the prosperity of his tenants. He has come to us direct from Canada, where during his Viceroyalty the Government established several stations for official experiments in poultry culture. To him we can, therefore, appeal with a confidence we did not possess before he came among us to inculcate the lessons of his experience in the heads of the local Governments on whose initiative and support the success of any scheme of poultry-farming must necessarily depend. The planting districts of Behar, Assam, and the Wynnaad, the mission fields of Chota Nagpur and Southern India, the military garrison stations where the Eurasian descendants of British soldiers congregate and the innumerable railway towns scattered over the length and breadth of the country, are all ready to join at once and *con amore* in the Government experiment we advocate, and Lord Minto will confer a lasting benefit on the country if he will lead this host of willing workers into so rich a pasture, which for the present is unfortunately *incultum ac derelictum solum*.