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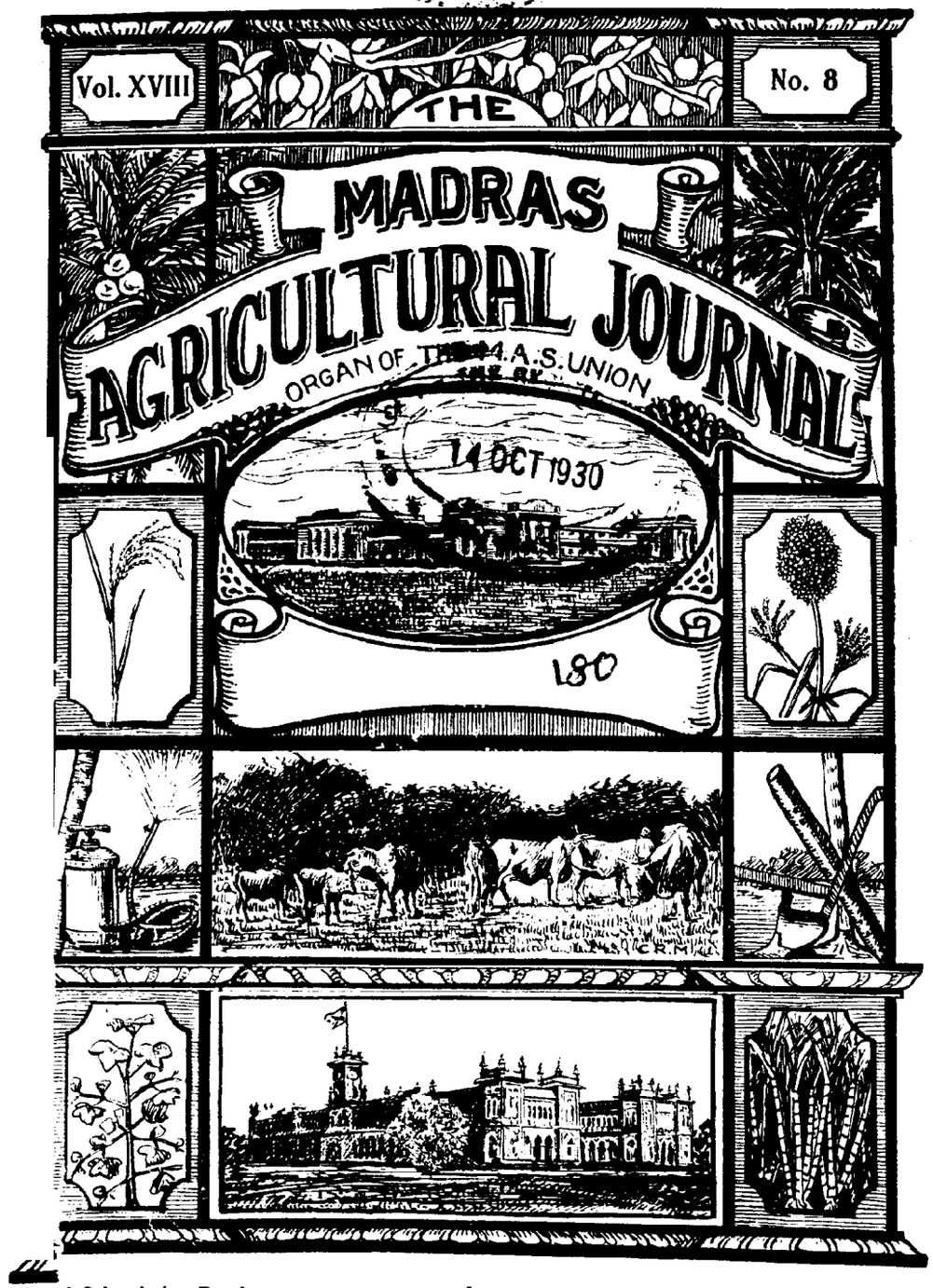

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The Late Mr. M. Ramiah Shetty

We learn with very great regret of the sad and sudden demise under most tragic circumstances, on the 28th of July last, of Mr. Ramiah Shetty, B. Sc., (Ag.), Assistant to the Cotton Specialist at the Madras General Hospital after an operation for appendicitis. The late Mr. Shetty had been ailing for some time past and left for Madras only ten days ago for treatment; but none of his friends at the College were prepared for the shockingly sudden news.

The late Mr. Shetty passed out of the College only in April 1929 winning the Dewan Bahadur Raghunatha Rao Prize for the best work done in Practical Agriculture during the course. Later as Assistant to the Cotton Specialist he displayed the same sincerity of purpose and application to work that had characterised him earlier as a student. Of a retiring disposition and an unassuming and unostentatious nature he never cared to be in the limelight. But those who had intimate contact with him—both superiors and colleagues—knew he was a man of great energy, indomitable will, sound grit and sterling character. Cut off 'when yet life was in bud and blade'—he was hardly twenty-four at the time of his death—his sudden death has left the Cotton Section and the Agricultural Department the poorer by an officer of great promise and possibilities.

We offer our heart-felt condolences to the members of the bereaved family.

Farming will never be a success unless the farmer had more voice in the disposal of his produce—P. Morrel.

The Madras Agricultural Journal

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THE H—M GUNTAKA

By G. R. HILSON, B.Sc.

Director of Agriculture, Madras

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This implement is an improvement upon and is intended to replace that most admirable indigenous implement known in one form as a 'guntaka' and in another as a 'danti.'

Admirable models of simplicity as these indigenous implements are, they yet possess certain features which allow of room for improvement.

In the first place, the arms which carry the blade and the shaft-pole or poles are fixed in the beam and the position of the one in relation to the other cannot be altered at will. The methods of adjusting the depth to which the blade will work are therefore limited to altering the distance between the beam and the point at which the shaft-pole is attached to the yoke-pole, placing the shaft-pole on top of or underneath the yoke-pole, and placing a weight on the beam e.g. by the driver standing on it.

In the case of the guntaka the chief defect of this limited range of adjustability, is that when it is desired to set the implement to do shallow work, the beam must be brought close to the heels of the bullocks and therefore to avoid damage to the animals by the blade they have to be yoked wide apart. Wide yoking has two disadvantages, one is that there is more scope for movement of the yoke on the neck of the bullock and the other is that one animal must always walk on the land that has been worked and therefore leaves hoof marks which are not obliterated at the next turn of the implement. When seed is being covered this is a distinct disadvantage as these uncovered hoof marks lead to blanks in the crop, either because the compacted earth becomes hardened by the sun or because it enables the hoof mark to act as a cup in which rain water collects and remains for some time.

In the case of the *danti*, it is difficult when five or six implements are attached to one yoke-pole to arrange for the coolies to work without interfering with one another and at the same time have all the implements working at the same depth. This may not be a serious defect, but it is a defect, for if one implement is set to work at the correct depth the one next to it must be set to work either deeper or shallower and it is left to the agency behind the implement to apply the necessary amount of correction.

Secondly, the length of the arms is such that when working the implement to remove stubble, the beam is so close to the ground that it collects the stubble in front of it which eventually causes the implement to choke. It is therefore necessary to make frequent stoppages to clear the obstruction.

Thirdly, the blade is fastened to the arms by turning back the ends of the blade and fixing them to the arms. It is therefore not possible to vary the length of the blade used without altering the position of the arms. If therefore different lengths of blade are required for different purposes a separate implement has to be made for each such purpose.

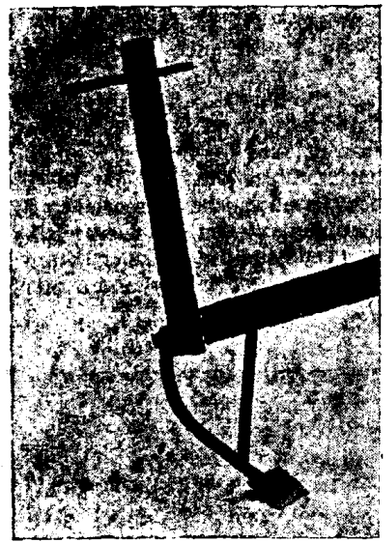
Fourthly, the arms, generally, the beam, the handle and the shaft-pole always, are made of wood, not always well seasoned. The arms, the handle, and the shaft-pole are all attached to the beam by passing them through the beam and fixing a pin in the part projecting. Breakages are common, particularly if heavy work is done. Much time is therefore wasted in repairing the implement, usually at a time when the need for the implement is greatest.

Fifthly, two poles are frequently used for the shaft. In this case a long rope about 20 feet long is required to attach the implement to the yoke-pole. With a long rope time is wasted in getting the implement set properly to begin with, and as the rope stretches under the strain frequent adjustment is necessary.

Sixthly, the initial cost of the implement is moderate, but the need for one implement for each different type of work, the continual meeting of charges for repairs and the waste of time when time is important make it an expensive implement in the end.

The H–M guntaka has been designed to avoid these defects and in addition to do work which the indigenous implement does not do. It is made in three forms, which have been numbered respectively No. O, No. 1 and No. 2.

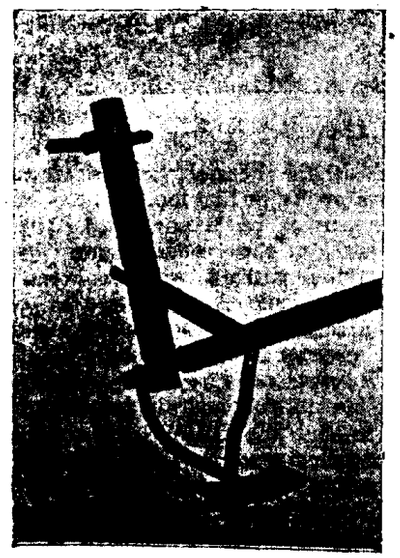
Model No. O. This is the lightest of the three models and is intended to take the place of the danti for intercultivation work. It consists of a curved arm to one end of which the frame is permanently attached. The frame is formed of two pieces of flat iron placed one on each side of the arm and between which the handle and the rear end of the shaft-pole are fixed. The free end of the arm carries the blade, which can be any length up to a foot and is readily removable. Near the blade, on the arm, an adjusting link is permanently attached. The free end of this link is suitably bored and can be attached to the frame. By means of this arrangement the position of the arm relative to the frame can be altered and the depth of working of the blade varied. Between the arm and the bottom of the handle and between the handle and the end of the pole a space is left. The angle between the handle and the frame can therefore be altered and by putting a wooden wedge between the handle and the end of the pole the desired position can be maintained.



No. O

Like the *danti*, 4 to 6 of these implements can be attached to one yoke-pole and worked at one time, but with this implement owing to the adjustability of the handle and of the arm it is possible to arrange for all the implements to work to the same depth without the workers interfering with one another.

As the blade is easily detachable, it is not necessary to have an entirely new implement for each differently spaced crop. All that is necessary is to change the blade.



No. 1

Model No. 1. This model is very similar to the No. O model but is more sturdily built. The main differences apart from strength are that the adjustability of the handle is greater and is achieved by two adjusting links lying between the frame and the handle and that the cross piece of the handle is removable and can be fitted as desired for use with one hand only or with two hands. This model can be used for intercultivation and also for ordinary cultivation work, removing stubbles etc. Owing to the greater strength of this model the length of blade used can be increased to 18 inches. Moreover with a curved blade this implement can be used for harvesting groundnuts, uprooting strong growing weeds and the stalks of cotton plants after the crop has been harvested. The draft is not heavy and a small pair of bullocks can do the work perfectly well.

No 2.

Model No. 2. This is the heaviest and strongest model of all. It differs from the other two models in that the frame is wider and stronger, it has two arms which are carried on the outside of the frame at a distance of 18 inches apart and in the arrangement for the handle which consists of an iron frame with a wooden cross bar. The arms as before are adjustable. The blade is supported at two points and if a straight blade is used, the length may vary from 22 inches to 4 feet. Except that this model cannot be used for intercultivating crops sown in lines spaced closer than 2 feet apart, it can be used for the same kind of work as the No. 1 model. As however the blades are longer a greater area can be covered in the same time.

For shallow work, covering seed or working the soil to a depth of 1 to 2½ inches, this implement can be drawn by a poor pair of bullocks. For the former work, a 4 foot blade can be used and in order that there should be no projections on the side of the blade next to the soil the blade can be turned upside down.

For deeper work, harvesting groundnuts in light soil and working the soil to a depth of 3 to 4 inches, this model can be drawn by a medium pair of bullocks. It is however intended also to be used for heavier work, stirring hard soil to a depth of 5 to 6 inches and at the same time uprooting cotton stubble. For this kind of work a pair of good bullocks is necessary, and the implement should be fitted with a curved blade. A curved blade should also be used when harvesting groundnuts.

This model has the added advantage that the back bar of the frame acts as a clod crusher when the implement is worked in a field in which the soil has been turned up in clods.

Each of these models is fitted with a single shaft-pole only. They are therefore very quickly set and a short length of rope or chain is all that is needed to attach the shaft-pole to the yoke. Except for the pole, which in the No. O model may be a bamboo, and the handles, these implements are made of iron or steel. They therefore stand up to their work and are not in continual need of repair. In actual weight they are no heavier than the indigenous implements, the heaviest can easily be carried by one man. Their strong construction, durability, adaptability to different uses, the efficiency of their work and their freedom from the need for frequent repair mark these implements out as being a distinct advance on the indigenous implement.

A word of warning is necessary in regard to the use made of the adjusting arrangements. When the soil conditions are unfavourable, there is for example a lack of moisture, the soil is hard and it is difficult to get the blade to penetrate the soil, the adjustment should not be altered but instead, pressure should be applied or the implement should be weighted by means of a stone or some other readily removable weight. If the adjustment is altered and the angle between the pole and the arm is increased, the implement will either not run smoothly or it will tend to penetrate the soil to a greater depth than is desired and cause unnecessary trouble to the bullocks pulling the implement.

The prices of these implements are No. O, Rs. 7–12, with handle but no pole, No. 1, Rs. 11–8, with handle but no pole, No. 2, Rs. 18–8, without either handle or pole. These prices are for cases of 10, 10 and 5 respectively and are all f.o.r. nearest railway station.

THE INFLUENCE OF RAINFALL ON THE COTTON CROP AT KOILPATTI*

By S. N. VENKATARAMANAN, B.A., B.SC., Ag.,

Assistant in Cotton.

Introductory. The subject of the weather and the crop is receiving considerable attention in these days, and many aspects relating to this problem were discussed more or less fully at the last Conference of Empire Meteorologists in London. While expressing the desirability of accumulating more data on the subject, it was resolved to examine all present records by Dr. R. A. Fisher's [1] method as a first step in the statistical investigation of the problem. The following is an analysis of the rainfall and the yields of the cotton crop at Koilpatti by that method, from data kindly supplied to me by Mr. V. Ramanatha Ayyar, Cotton Specialist, Coimbatore.

Material. This comprises the yields of the past 21 years on the black soil at the Agricultural Research Station, Koilpatti, of Karunganni cotton after fodder cholam and after fodder cumbu. The yields are the averages of the weighed figures of about 20 acres for the several years at that farm, where the rainfall was also recorded. It may not be out of the place to mention at the outset, that from fundamental considerations relating to the theory of random errors in the value of the multiple correlation co-efficient emphasised by Fisher, even 20 years are not enough to gauge completely, the influences of the weather elements and the crop. It has been therefore decided to postpone for the present, the discussion on the true nature of the basic changes in the weather, as also of the crop, until more years of data are accumulated. The relationships of the rainfall to the yield only are presented in this paper, in so far as they are statistically significant from the twenty-one years of data available.

'Trend' influence on yield. Besides the local influences of whether meteorological or otherwise of each particular year, the yields of crops are subject to a long time or 'trend' influence, and exhibit a certain periodicity in their movements, which are to some extent determined by the position of the year in the time, series. These slow changes are the result of a number of unknown causes, independent of the weather elements of each year, but their course is best expressed as shown by Fisher,[2] by a smooth polynomial curve of time. Such a curve of the 5th degree for the cotton crop at Koilpatti is presented in Fig. I., where, reckoning (t) from the middle of the series of years examined, the course of the yield (y) in pounds per acre, can be expressed by the following equations:

$$Y \text{ (after cumbu)} = 377\cdot599 - 15\cdot872t + 1\cdot635t^2 + 1\cdot146t^3 - 0\cdot0264t^4 - 0\cdot01175t^5.$$

$$Y \text{ (after nathu)} = 332\cdot517 - 5\cdot154t + 0\cdot0484t^2 + 0\cdot5377t^4 - 0\cdot0107t, - 0\cdot00625t^5.$$

* Paper read at the Meeting of Economic Biologists, Lawley Road on the 20th June 1930.

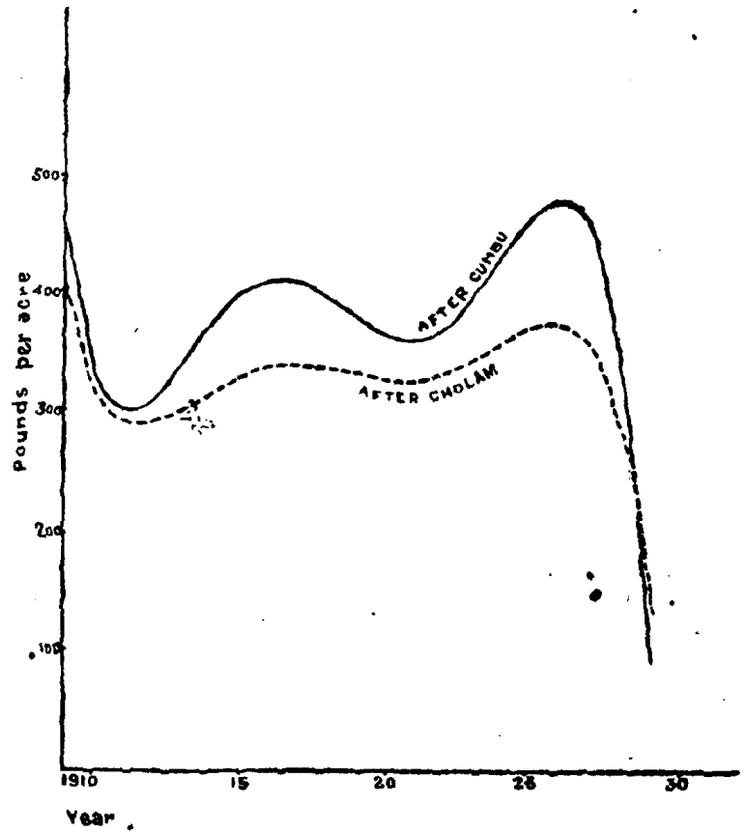


FIG. I

POLYNOMIALS OF YIELDS OF COTTON KOILPATTI SHOWING TREND INFLUENCE

It will be seen that the yield exhibits periods of high crest in the years 1916–19 and again in the years 1925–26, while one before 1908 is also indicated. The course of the yield is more or less similar in time for cotton after cumbu and after cholam, but in the former case the yields are slightly higher; a fact in keeping with agricultural experience. The actual yields represent the excess or defect of the annual effects over these polynomial figures. Much of the variance in yield, can be traced to this 'trend' influence (Table I), but, the effect is exaggerated due to the limited years of data, and require some more study for complete statistical estimation. It is however worthy of note, that the cotton crop at Koilpatti is passing through a period of depression in yield, in the past few years, from which it will take some time to recover.

In judging the effect of rainfall on the yield, we have to eliminate from it the effect of these slow changes, which take place independently of the weather elements. This is mathematically done by fitting the yields biorthogonally to a polynomial of time and correlating the deviations of the actual values from the polynomial fitted.

The distribution of rainfall in relation to yield

In correlating the yield with the rainfall, it is essential to present the effect not only of the quantity of rainfall, but also of its distribution. It is a well known fact that the rainfall at different periods of the year, have different effects on the crop, and also that the same quantity of rainfall precipitating itself on a single day, will have an effect different from that which it will have, when it is distributed over a number of days. In judging therefore, the effect of rainfall, what is most important to consider, is the distribution of rain. To give effective representation to this, the rainfall of each year is fitted to a curve, and the values corresponding to the moments of these curves (given in Table I) are correlated with the yield.

The regression integral. For the above purpose the year is divided into several periods of rainfall. The yield (y) can then be expressed by the ordinary regression method by an equation of the form.

$$Y = a + b_1 r_1 + b_2 r_2 \quad \ldots \quad \ldots \quad + b_n r_n \quad \ldots \quad (1)$$

where $r_1, r_2, \ldots r_n$ are the rainfall in inches of the 'n' subdivisions of the year and $b_1, b_2 \ldots b_n$ are the effects, positive or negative, of each inch of rainfall in pounds per acre on the yield. These latter values are the partial regression coefficients. As 'n' is increased the labour involved in their computation becomes insurmountable. To overcome this difficulty, Fisher has introduced the conception of a regression integral which has the advantage in addition, of fully expressing a fundamental point in the nature of the rainfall influence given below.

The continuity of rainfall effect. An all important factor to consider in the rainfall influence, is that it is a continuous process which takes place throughout the year. Part of the changes are induced in the soil long before the crop is sown, and the total of these slowly varying influences is expressed progressively through different channels on the final yield. It is essential, therefore, that the influences of neighbouring periods are alike. For this purpose the year is divided into small periods. Equation I then takes the regression integral form $\bar{Y} = a + \int_o^t brdt$; where rdt is the rainfall, falling in the element of time dt.

If the rate of rainfall at any epoch is also expressed in the form $r = P_0 T_0 + P_1 T_1 + P_2 T_2 \ldots$

where $T_0, T_1 \ldots T_n$ are chosen biorthogonally and $P_n = \int_o^t rT_n\, dt$, the regression of rainfall on the yield can be expressed by the form

$$a = L_0 T_0 + \ldots L_t T_t \quad \ldots \quad \ldots \quad + L_n T_n,$$

where $L_n = \int_o^t bT_n dt$.

By this method of Fisher, the number of independent variables Y is reduced to the degree of the polynomial to which the rainfall has been fitted, while the actual distribution of rainfall is more effectively represented. It is possible from this, to express the effect of every additional inch of rainfall in pounds

Table I

Rainfall distribution values—Koilpatti (April to March)							Deviation from polynominal of yield	
Year	a′	b′	c′	d′	e′	f′	After Cumbu	After Cholam
1908–9	1·07958	—0·14639	—0·12297	—0·08769	0·08433	·01503	24	25
10	1·10375	—0·13262	—0·15240	—0·15697	0·17149	—0·07774	—36	—17
11	1·17333	—0·16064	—0·20478	—0·13154	0·16656	·00062	—21	—31
12	1·28167	—0·13256	—0·22118	—0·11346	0·06488	·11216	22	—43
13	1·29625	—0·17565	—0·42355	—0·30795	0·00961	·02119	7	25
14	1·17667	0·04710	—0·21454	—0·20860	0·11502	·10898	74	99
15	1·53792	0·04155	—0·26033	—0·25350	0·17711	·06801	—56	—47
16	1·59458	—0·07809	—0·24557	—0·25164	0·10436	·17475	18	120
17	·70542	0·00038	—0·06116	—0·01992	—0·00712	—0·11862	—7	108
18	1·44750	0·15647	—0·21363	—0·15858	—0·04640	—0·26661	—126	—79
19	·99958	0·16541	—0·15697	—0·13494	0·08104	·13749	93	7
20	1·21958	·15621	—0·19793	—0·13504	—0·01614	·06341	—34	—15
21	1·47292	—0·02065	—0·15559	—0·28940	0·10348	·10627	58	81
22	1·58642	0·01369	—0·31687	—0·27971	0·22647	·05065	58	13
23	2·06625	0·21395	—0·51339	—0·32865	0·24921	·19869	—98	—104
24	·98500	0·19403	—0·16445	—0·16792	0·05808	·12223	128	111
25	1·53333	0·14430	—0·21428	+0·01140	0·11612	—0·01824	—127	—9
26	1·34792	0·20085	—0·35167	—0·24175	0·05993	·14807	—82	—37
27	1·02667	0·14927	+0·02283	+0·04312	0·07092	—0·03245	143	—20
28	1·53708	—0·29252	+0·09052	—0·23342	0·07036	·07810	—24	11
1928–29	1·21542	0·09225	—0·19875	—0·17920	0·08328	·08085	—14	6
						Variance ...	114302	81172 $S(Y-Yp)^2$
					Total	Variance ...	249285	138520 $S(y)^2$

per acre on the cotton crop at the different periods of the year, as a continuous curve. (Fig. II).

The regressions of rainfall on yield. The actual values of the rainfall distributions corresponding to the moments of the several powers of 't' are given below.

The deviations from the polynomials of yield (given in columns 7 and 8 of table I) are correlated with the rainfall distribution values, giving the sums of products $a'y$, $b'y$, ... $f'y$. These sums of products are multiplied by the corresponding row or column of a matrix of multipliers formed from a determinant of the values a' . . f', and given below (Table H) to give regressions of the yield on the time variate considered.

TABLE II

Rainfall matrix

	a′	b′	c′	d′	e′	f′
a′.	1·55817	−0·00736	−1·38525	2·92315	−2·53466	0·20116
b′.	−0·00736	1·29059	−0·09359	0·15307	−0·47653	−0·13989
c′.	−1·38525	−0·09357	3·77445	−4·62783	3·53674	−0·52625
d′.	2·92315	0·15307	−4·62783	10·14972	−2·43233	1·72667
e′.	−2·53466	−0·47653	3·53674	−2·43233	13·52150	−1·94559
f′.	0·20116	−0·13989	−0·52625	1·72667	−1·94559	5·59604

The regressions of the rainfall on yield for the several powers of T are given below.

TABLE III

Regressions of rainfall on the yield of cotton

	a′	b′	c′	d′	e′	f′
After cholam	−113·938	−45·425	119·742	−236·772	42·916	275·576
After cumbu	−457·446	−35·584	635·437	−896·108	965·457	167·509

From these, the effect of every additional inch of rainfall in pounds per acre on the cotton crop for the several fortnights of the year is presented in the form of a smooth polynomial curve in Figure II, the co-efficient of the term relating to $t^{s'}$ being obtained by multiplying the corresponding regression by factors of the form, $\frac{(2s)!}{(S!)^2\, n.(n+1)\ldots.(n+s)}$ where 'n' is the number of subdivisions of the year.

The effect of rainfall. From an examination of Figure II, it will be seen that the effect of every additional inch of rainfall over the polynomial normal is negative almost throughout the year. This negative influence is most pronounced in July to August before sowing, and least in the months of January and February during the growth of the crop. In fact, it is most in the less rainy months. In regard to the calendar year, the effect in direction is more or less similar whether after cotton or cumbu, but after cumbu it is very much greater.

The significance of the rainfall effect. The extent to which the rainfall as judged by its distribution in the several fortnights of the year influences the yield, can be understood by the values of the multiple correlation 'R' given below, with the probability 'P' of such a value occurring due to chance alone.

Cotton		Value of R.	P	Percentage effect of rainfall
After cumbu	...	·829	0·006	55
After cholam	...	·440	·6	not significant

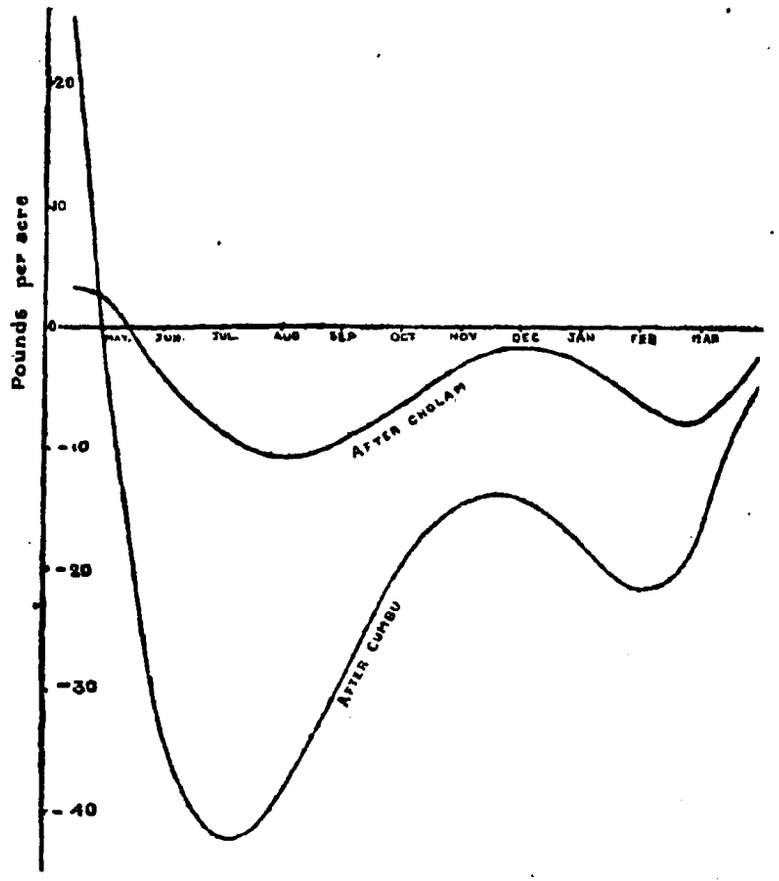


FIG. II

AVERAGE EFFECT IN POUNDS PER ACRE OF EVERY ADDITIONAL INCH OF RAIN ON THE COTTON CROP AT KOILPATTI AT DIFFERENT PERIODS OF THE YEAR

The effect on cotton after cumbu is clearly siginificant, although the percentage of variance attributable to it (55 per cent) is probably exaggerated due to the limited number of years of data. The effect after the cholam is not significant. It can therefore, be inferred that extra rainfall exercises a depressing influence on yield after cumbu in the direction indicated by Figure II, at the different periods of the year. The result is in agreement with the experience at Koilpatti that cotton after cholam withstands the adverse effect of rain better than after cumbu. It is not possible at the

present stage to offer any explanation to the above effects noted, although in England, a similar influence on the wheat crop has been associated definitely with washing away of nitrates. Hindrance to the development and aeration of roots is also another possible cause. Before concluding it may not be out of place to mention the importance of another factor affecting the yield.

Effect of the time of sowing. By Fisher's method the influence of rainfall has been computed in relation to the calendar year. In the case of the cotton crop, this relationship is to some extent interfered with by the changes in the date of sowing, brought about by the chance circumstance of the rainfall incidence. An estimate of the rainfall effect in relation to the age of the crop has been made by Mr. V. Ramanatha Ayyar,[3] who has studied the effect of every inch of rain at the different fortnights after sowing. The regression equation for yield in terms of the rainfall for cotton after cholam at Koilpatti is as follows :

$$y : 297{\cdot}6 - 4{\cdot}15x_1 + 6{\cdot}405x_2 - 8{\cdot}824x_3 + 23{\cdot}356x_4 + 6{\cdot}685x_5 + 3{\cdot}373x_6 - 25{\cdot}574x_7 + 18{\cdot}902x_8 + 1{\cdot}145x_9 + 32{\cdot}326x_{10}$$

The effects of the 4th, 8th and 10th fortnights after sowing are very pronouncedly positive, while the 7th fortnight shows a negative effect. Due to the limited degrees of freedom of the data, the multiple correlation (0·74) is not significant (p : 0·3), but the form of the equation suggests the importance of the factor. It might also be mentioned that in experiments conducted at the Cotton Breeding Station early sowing has a most pronounced increased effect on the yield of irrigated cotton, and it has sometimes been observed that in dry cotton also late sown plants fare poorly. Efforts are therefore being made to treat the date of sowing as a dimensional factor affecting the yield in the manner indicated by Fisher.

Summary. The effect of every inch of additional rainfall in pounds per acre on the cotton crop at Koilpatti has been presented for the several fortnights of the year in the form of a smooth curve by the method of Dr. R. A. Fisher. It is found that extra rain has a negative influence on the yield almost throughout the year. This effect is more pronounced in cotton after cumbu, than after cholam. The greatest effect is seen in the dry months of July and August before sowing, and the least in the months of January and February when the crop is on. In the former case, every additional inch depresses the yield by as much as 30 to 40 lbs. per acre, in the case of cotton after cumbu ; after cholam the effect is not significant.

Acknowledgment. I am indebted to M. R. Ry. V. Ramanatha Ayyar Avl. for guidance and facilities.

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BETEL-VINE

(Concluded from previous issue)

By M. R. BALAKRISHNAN

We are now in a position to sum up the results of the experiments in Plot 5 and of the control Plots 3 and 4, and to draw inferences.

1. The raised rows of Plots 5 all put together, have, every month, for 13 harvests, given an increased yield over the local rows all put together, the percentage increase being about 27 for the consolidated total yield.

2. The northern half as a whole, and the southern half as a whole, of Plot 5, have similarly shown that the raised rows have given a 27 % increase of yield over the local rows.

3. When we consider the 5 series of experiments separately, the 1st, 2nd and 4th series have given emphatically positive results in favour of the 'raised rows'; the 3rd and 5th series have given apparently negative results, but when allowance is made for the advantage of position and for the behaviour of contiguous series in the adjoining plots 3 and 4, they also bear out that the 'raised rows' have given a definite increase over the local rows.

4. While the tendency of the soil is for the yield to diminish as we go from south to north, raising the rows has counteracted this tendency.

5. All these, indirectly go to show that defective drainage is the chief factor responsible for the poor yield of the crop; for, raising improves drainage conditions and has given higher yields. Correlating the two, we have the inference, that improving the drainage will increase the yield. In our experiment, raising the beds, was one of the methods, by which drainage was sought to be improved.

Leaving these figures and the clear inferences they lead to, we have now to look to the lay out of the experiment in plot 5, and find out any defects before we can say that the increased yields which have been obtained and proved to be significant, are really due to the raising of the beds—and therefore to defective drainage.

The experiment in fact, was far from perfect, and the following defects could be noted :

1. The raising of the three alternate beds was done when the betel vine had grown to some height, and unequal conditions (number of plants, healthy and diseased specimens, etc.) prevailed in the several rows.

2. Originally, soil from Plot I was intended to be used, but, as this was found impracticable, tank silt was used to raise the rows, and it might be argued that the increased yield was due to the manurial capacity of tank silt and not to the raising itself.

3. The betel vine itself is peculiar, in that it has adventitious roots, and raising the beds after the crop is planted would have stimulated these roots to strike into the top soil applied fresh, the bottom roots stopping to function. In other words, the crop on the raised rows, can be likened to a new crop, and on the face of it, it is an error to compare it with the 'local' crop.

We are thus led to confess that unless these defects are obviated, we cannot lay too much value on these results, and at best, the experiment in Plot 5, should be regarded as a preliminary to further work and confirmation. The results however, are valuable, as an indication of the direction wherein lies the defect of the soil, if not as a positive confirmation of such indication.

The defects of Plot 5 were therefore eliminated, in Plot I, where the same experiment was repeated. Herein, the raising was done to a height of 1½ feet by tank silt. The local rows were dug out to the same depth and filled in with tank silt. Thus the local and the raised rows have the same soil. The planting was done after the raised beds had been formed and an equal number of plants put in each row. Thus all possible conditions equalised, any difference in yield can be attributed only to the 'raising', and figures obtained go to show, that what was indicated in Plot 5, with all its defects, of lay out, is amply borne out. Below is given a statement showing the yields of the raised and the local rows in Plot I month after month, and it will be seen that the Raised rows again show a 27 % increase over the 'Locals'.

Month of harvest	Raiseds Lbs.	Locals Lbs.	Percentage increase of raised over locals
1. July 1927 ...	36·4	31·5	15·5
2. September ,, ...	93·8	65·6	43·0
3. October ,, ...	109·4	85·6	27·7
4. November ,, ...	207·0	163·9	26·3
,, ,, ...	144·0	94·6	51·0
5. January 1928 ...	149·5	117·1	27·6
6. February ,, ...	175·6	134·6	30·5
7. March ,, ...	139·2	109·7	27·5
8. April ,, ...	261·4	255·3	2·43
9. May ,, ...	213·2	193·8	10·0
10. June ,, ...	216·8	179·4	20·9
11. July ,, ...	233·6	193·1	21·0
12. August ,, ...	206·8	152·3	35·8
13. September ,, ...	276·7	236·9	16·8
14. October ,, ...	244·5	192·4	27·1
15. November ,, ...	321·3	235·3	36·6
16. December ,, ...	265·7	191·9	38·5
17. January 1929 ...	247·3	164·8	50·1
18. February ,, ...	260·6	195·8	33·1
19. March ,, ...	204·3	140·4	45·5
Total ...	4007·7	3134·0	27·9

Manurial Experiment. This experiment was conducted in Plot 2 which is divided into two halves, one being unlimed and the other limed at 1000 lbs. per acre. Within each half, there are thirty rows again, as in Plots I, III, IV and V, and every three rows were manured alternately with organic manure and mineral manures. The object of the experiment was mainly to

test the tenacious belief held by ryots that earthworms are the cause of damage to the betel vine crop. By growing betel vine on rows manured with mineral manures like Potassium Nitrate and Super, the assumption is that we are minimising the chances of earthworm-breeding, for, earthworms require a lot of organic matter. If, therefore, the 'mineral manure' rows yield more than the 'organic manure' rows and, if it could also be shown that they contain less earthworms there is something to be said for the ryots' opinion. But, if the contrary is found to be the case, the earthworm theory will have to be exploded. The Entomologist, in fact, has been making a statistical survey of the earthworm population month by month, and his figures correlated with the harvest yields should be able to throw light on the question and clear the charges laid at the door of the earthworms. The lay out and the monthly figures connected with this experiment are sufficiently voluminous to deserve attention in a separate paper which can be done at a later date. So far, the following inferences can be made from the harvest records:

(1) The limed half is better than the unlimed half.

(2) Both in the limed and in the unlimed halves the organic manure rows have been giving slightly higher yields than the mineral manures and a higher percentage of good quality leaves.

Analyses. Besides mere record of harvest yields and linear measurements of leaf samples drawn at random, an attempt was also made to see if analyses of samples of leaves from the healthy, the diseased, the raised, and the local portions of the various plots could throw any light on the mineral matter content, and the physiological metabolism within the leaves. For this purpose, samples were collected from the September, October, and November yields of 1927 and these were analysed for their mineral and other constituents.

Results of analyses of Betel Leaves

HEALTHY AND DISEASED

	September leaves		October leaves				November leaves			
	Samples taken from all plots		Samples from plot 3		Samples from plot 4		Samples from plot 3		Samples from plot 4	
	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased
Original moisture ...	84·04	76·64	79·26	76·60	83·52	76·21	81·33	79·17	85·60	72·50
Organic matter ...	84·25	85·55	86·54	85·32	83·24	85·80	85·41	85·78	83·78	84·21
Insoluble mineral matter.	4·15	3·81	3·34	4·13	3·45	3·91	3·72	3·42	3·93	3·12
Soluble mineral matter...	11·60	10·64	10·12	10·55	13·31	10·29	10·87	10·80	12·29	11·67
Iron and alumina ...	0·66	0·44	0·55	0·44	0·60	0·68	0·63	0·67	0·67	0·72
Lime ...	1·82	2·02	1·28	1·54	1·49	2·30	1·32	1·79	1·36	1·92
Magnesia ...	1·32	1·79	1·82	0·83	1·40	1·16	1·91	1·38	1·51	1·41
Potash ...	5·13	3·83	4·17	3·87	4·24	3·00	4·22	3·71	3·98	3·41
Phosphoric acid ...	0·66	0·55	0·70	0·50	0·86	0·62	0·63	0·69	0·92	0·85
Nitrogen ...	3·04	1·75	2·64	2·32	2·74	2·49	2·53	2·38	2·78	2·63

Note. The results tabulated are the averages of duplicate analysis, except in the case of the November leaves. The analyses of the September and the October leaves showed close agreement in duplicate and hence the November samples were not done in duplicate.

Results of Analyses of samples of leaves drawn the Raised and Local portions, October 1927

Heads of analyses	Plot 5		Plot 1	
	Raised	Local	Raised	Local
Moisture ...	76·00	81·50	83·00	82·00
Organic matter ..	87·92	91·29	83·46	84·42
Insolubles ...	1·72	1·56	2·49	2·51
Solubles ...	10·36	7·15	14·05	13·07
Iron and alumina ..	1·10	·68	·95	·42
Lime ...	·79	·55	·95	·61
Magnesia ...	1·07	·74	1·28	·95
Potash ...	4·23	2·70	5·83	4·18
Phosphoric acid ...	·77	·42	·65	·81
Nitrogen ...	2·74	2·81	2·76	2·64

In addition to analysing the leaves, an attempt was also made to determine roughly the pH values of leaves by the colorimetric method. This had necessarily to be done under certain limitations and with certain handicaps. As the examination had to be carried out immediately after harvest, the necessary apparatus, chemicals and indicators had to be carried to the Vellalore Betel Vine Station, and even then, one could not command the facilities of an equipped laboratory, fitted with filter pumps, shaking machines etc.

Statement showing pH values of diseased and healthy betel leaves with different concentrations

Concentration	Kallias Variety		Karpurakodi Variety	
	Diseased	Healthy	Diseased	Healthy
150 gms. of leaves and 100 cc. of water ...	5·3	5·4	5·6	over 5·95
Do ...	4·8	5·2	5·6	over 5·95
Do ...	4·8	5·2	5·6	over 5·95
25 gms. of leaves and 100 cc. of water ...	5·6	5·95	...	...
Do ...	5·6	over 5·95	...	...
Do ...	5·6	over 5·95	...	...

The pH value figures show :

(1) that the diseased are more acid than the healthy leaves.
(2) the dilution increases the pH value.
(3) and that the pH value varies with the variety.

Interesting as these figures may be, we cannot say that they, as well as the results of the Chemical analyses will take us any further in arriving at the exact cause of the disease. The higher content of potash in healthy leaves will, however, seem to indicate that a potassic manure might do advantage to the crop. Potash, as an agent whereby disease resisting powers are developed, has been used in the case of other crops, and a useful line of attack will be to study the effect of potash as a fertilizer, on the incidence of disease on the betel vine.

Conclusion. The fact however remains, proved by the results of the drainage experiments, that defective soil conditions are the factors chiefly responsible for the poor growth of betel vine, and that drainage is the most important of these factors to be combated and overcome. In this connection, it will be interesting to read the report of the Government Agricultural Chemist, Bengal for the year 1925–26. Confronted with a similar problem he has arrived at similar conclusions, and attributes the poor yield of betel to defective drainage. But how is the ryot to tackle this problem effectively ? Attention has already been drawn to the fact that raising the beds has its limitations and cannot be resorted to always especially in loose soils. It has been suggested that small hand pumps might be installed in betel vine gardens to pump out the excess of water stagnating in the field; to be practicable and successful economically, this has to be done as a co-operative concern. Again, the system of land tenure obtaining in the locality is to a certain extent responsible for the physical deterioration of the soil. In a six-year lease, the tenant tries to take as much profit as possible from the land, with the result, that the continuous cropping with crops like betel vine and sugarcane, keeps the land very much in shade, and minimises the chances of the soil to get aeration and weathering. A fallow now and then, or a less vegetative crop included in the rotation, will ameliorate the conditions. Co-operation again seems to be the only panacea; a little understanding between tenant and landlord, between one ryot and another will go a long way to remedy the defects of the soil.

I have finally to express my thankfulness to Mr. B. Visvanath the Government Agricultural Chemist, for his help and guidance in writing this paper.

SUGARCANE *

By T. V. RAJAGOPALACHARYA

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Apart from the mythical halo surrounding the origin, introduction and cultivation of sugarcane which chroniclers often take delight in referring to, the culture of this crop has been carried on in this land from ancient times. References in literature are not wanting regarding the opinions held about the fertility of the tract growing sugarcane and statements about the prosperity of the villagers engaged in cane farming.

2. Hadi makes a delightful reference to the proud position sugarcane occupied in Akbar's time and quotes Faizi, Akbar's Minister. 'The grandee was the proud possessor of a sugarcane plantation deserving of high encomiums. Nowhere else in Malwa did sugarcane of equal nicety or taste display its growth.'

In South India also sugarcane has been a favoured crop with substantial farmers. In fact it is a rich man's crop, and tracts abounding in sugarcane cultivation have been eulogised by poets and historians. I may be allowed to mention here a couplet composed by one of the illustrious Tamilian Poets of the 9th or 10th Century in praise of a village whose original name persists to this day where this crop was largely cultivated and the villagers seem evidently to have been in a prosperous condition. The couplet sounds rather harsh and unmusical to the ear consisting mostly of gutturals in contrast to the sweetness of the subject the author refers to

'இக்கு முற்றிக்கணுச்சற்று விட்டெதெறித்திட்ட முத்தைக்
கொக்கு மொசிக்கக்கி விளிறு மச்சோலைக் குறுகுடியே'

Translated freely—this means that 'the villagers are prosperous and enjoy the fruits of sugarcane cultivation in plenty in the form of valuable pearls which burst and get scattered about from the hard ripe nodes that crack with a crash. These pearls are swallowed by the cranes and regurgitated by them on the ground.'

This is certainly a hyperbolical expression, but it cannot be doubted that its significance is real. Pearl is always associated with a rich man's possession and people of a sugarcane tract like the one the Poet refers to, were rich and prosperous and were adorning themselves in gems, pearls and jewels. This position is of course symbolised in the Poet's expression in such catching words.

3. My object in introducing this subject with these preliminary remarks is only to show that the sugarcane has been a very important crop in South India. It posits an affluent position of a ryot cultivating this crop and in fertile valleys favoured by nature this crop has always been popular with the farmers. One could therefore confidently assert that there is a large amount of experience and knowledge gathered round the cultivation of cane, and in suggesting or recommending proposals for the improvement in the cultivation of cane and for the amelioration of the sugar industry one cannot lightly ignore such experience and knowledge as results of trials and enquiries have largely tended to strengthen the views held by farmers in the country.

* Paper read at the M.A.S.U. Conference, July 1930.

4. Gentlemen, under these circumstances I propose to place before you certain salient features of sugar-farming and manufacture of jaggery.

5. *Soil.* Cane is cultivated in South India on various types of soil which range from sandy loams to heavy clays, best growth and best product are always associated with lands where the soil is a friable loam of good depth permitting free drainage and aeration. The surface soil may be a little heavy and sticky owing to long cultivation under puddle conditions, but the underlying sub soil should be of a loose nature permitting a free passage of water down. It is only in places where these soil conditions prevail that the product is good and highly priced.

Jaggery obtained from tracts of the above description is noted for colour, texture and keeping qualities. In the District of Coimbatore, Kodumudi in the Cauvery-Bhavani Valley, and Udumalpet in the Amaravathi Valley, answer to this description of conditions and the produce of these tracts is valued more. Similarly round about Hindupur in Anantapur district, in the Cauvery valley of the Mysore Plateau and in parts of Chittoor where also the soil conditions are similar sugarcane cultivation is carried on in a large scale and very profitably too.

There are other tracts, of course, like the Godavari Delta where cane farming is carried on extensively with the necessary processes of trenching and training and supporting the huge canes, which are offset against the initial defects in the soil texture associated with the formation of that delta.

6. *Climate and Season.* Soil conditions alone are not enough. The weather factor affects cane cultivation. The high tonnage of the cane crop in tropical islands in the Pacific is a sure evidence in this point. South India possessing tropical conditions of climate, is therefore equally well suited for the purpose and we are, as you know, in a position to grow heavy crops in several places. Except in places where water supply, labour scarcity and dearth of capital act as a deterrent factor cane is grown in this Province in some tracts or other all through the year, Coimbatore serving as a good sample of it. This of course, is an essential for a continuous supply of cane for a factory engaged in the manufacture of sugar direct from canes.

There are, however, even in Coimbatore two well defined seasons which are considered more suitable for starting a sugarcane crop. January to April and July to September are the usual periods when plantation is laid on a large scale. The idea seems to be that in one case advantage can be taken of the warm humid conditions of the early season to induce the crop to grow and finish its vegetative growth before the cold weather sets in and that in the other the harmful effects of high storms blowing in the north-east monsoon period on the tall and finished growths of the cane crops can be materially warded off.

7. In districts like Godavary, elaborate precautions are taken beforehand to counteract the effect of cyclonic storms that prevail in October and November. February-March planting seems to be the rule and canes grow tall and high with a surface root system—because of the nature of the soil conditions, and succumb to the heavy gales of the north-east monsoon if such precautions are not taken.

8. *Methods of Cultivation.* The ryot is quite alive to the necessity of producing a very good and deep tilth in sugarcane land. Various devices are adopted by him which are familiar to us. Several of these are rather clumsy and

the process is slow and costly. Improvements are therefore necessary and welcome. A fairly good heavy plough like the Chattanooga 45, a Turnwrest E. T. plough for heavy soils, a victory plough for lighter soils is necessary to produce satisfactory seed beds. In a friable loose soil, working once with this type of plough and following it up with two or three ploughings with a light plough and one or two harrowings in the interval would be found quite sufficient to produce necessary conditions. On the Central Farm here, this practice is followed. What is required, is, to set up weathering action and attain very fine tilth fairly quickly and for this 3 to 4 months of cultivated fallow seems to be necessary.

In Java, however, as the Sugar Commissioners say, 'a prominent feature of the cane cultivation is the rapidity with which land is prepared for cane plantation. The structure of the soil is such that they do not pack and dry into a hard mass when worked wet' and the land is therefore taken over for cane cultivation immediately after the rice crop is harvested. No ploughing is done. Trenches are made in wet soil and the bottom after some time is stirred up and cane sets are planted within a month or so.

Demonstrations of the economical method of preparatory cultivation as suggested above will when carried on under suitable circumstances be of much educative value to the ryot.

9. Details in laying out the cane area for planting are different in different tracts.

To a large measure, the long established local custom decides. Planting on the surface is practised in certain tracts like Godavary where the soil is easily softened and is of an yielding nature. The seedbed is divided into long strips with furrows between, which are opened by the country plough, and cane setts are planted on the moistened tops of these strips.

10. In almost all other places, fields are divided into ridges and furrows and planting is done in the furrows. Trenching is practised in certain parts, the bottom of the trenches is a bit loosened and setts buried in. Rarely small pits are dug at definite distances and sets put in and covered over with a thin layer of earth.

The distance between the sets again varies with places and the ryot is guided here by considerations of having a good stand of the crop, allowing for failures due to soil and weather conditions, soundness or otherwise of the seed sets, and the stooling capacity of the variety planted.

11. There is a fair scope for improvement in this line. The Godavary practice of broadcasting on the top is certainly a faulty method and line planting is therefore advocated and is nowadays largely adopted.

In other places where planting in line is a well established practice wider spacing between lines may be recommended. This question of spacing is to a large extent dependent on the soundness of the seed sets and on the individual quality of the variety to tiller. The seed rate adopted by the ryots varies from 12,000 to 30,000 sets per acre and sometimes even more. Where the ryot is forced by circumstances to prepare the setts out of the whole cane the seed rate is necessarily high, since the bottom portions contain over ripe buds which fail to germinate. Where he uses tops or top portions the seed rate is brought down to 15,000 or so.

If the nursery system, nowadays recommended for the rapid multiplication of seedling canes, is generally adopted, this seed rate problem can easily be

solved. In fact even here, ryots of certain tracts are alive to the benefits resulting from the nursery system. The 'Kondamunji' system in Ganjam of multiplying the seeds for the succeeding year's planting is an instance in point.

Roundabout Kodumudi this method is regularly adopted. The ryots on the other side of the Cauvery Valley grow seed canes for supplying seed to the cane growers of Kudumudi. The seed crop is cut when 7 or 8 months old just at the main planting season at Kodumudi and the ryots of the tract purchase these seeds. As a result of this practice, the seedrate in Kodumudi is only 12,000 to 13,000 setts. This method deserves to be widely popularised. In fact, a Society of Seed Growers can be established for a sugarcane tract nearby and the system at Kodumudi be regularised into a business. Anakapalle and Palur Farms are experimenting on this method. The Anakapalle report reveals that the seed obtained from a nursery plot of 6 months growth is capable of supplying seeds for nine times the area.

Ryots with limited resources of capital and facilities but living near a large sugarcane area could make a business of this system of nursery plot cultivation.

In this connection it may be mentioned that at Manjri experimental farm as the Sugar Committee reports, very good crops are obtained with a seed rate of 6,000 setts per acre planted in rows 5 feet apart, greatest care being taken in regulating the water supply, in keeping the land free and friable and in banking up the canes in high ridges.

12. Manuring is an important item of cultivation charges in sugarcane. Various manurial ingredients are used, cattle manure, cakes of different sorts, fishmanure, poudrette, leaf manure either bought from outside or grown on the land and ploughed in, and recently chemical manures as Ammonium sulphate and Superphosphate are being applied. We are not in a position to suggest or make definite recommendations as to the quantity and quality of the manure to be applied. Our experiments have not reached finality. However from an empirical analysis of the results of the various trials made on the Agricultural Farms, it would appear that with a basal dressing of well rotten farm yard manure of 15 or 20 cart loads per acre an application of a combination of cake and Ammonium sulphate to supply 100 lbs. of Nitrogen gives good results. In place of Farm yard manure it may be possible to grow *in situ* and plough in green manure, preferably Sunnhemp.

13. Manures seem to exercise an influence over the quality of the product turned out. Bulky organic nitrogenous manures tend to delay maturity and produce juice of less purity. Even here different organic manures act differently. It is the confirmed belief of the ryot of the Coimbatore district that wild indigo applied to cane when it is about 3 or 4 months old improves the colour and texture of the jaggery. So does groundnut cake to some extent, whilst Daincha seems to produce a dark coloured jaggery.

Large doses of nitrogen in any case over and above the actual requirements of the crop whether in the organic or mineral form tend to produce a very heavy crop which lodges and which in consequence does not mature uniformly. The resulting produce of cane juice contains much impurities.

14. *Irrigation.* To irrigation as well, a good deal of care and attention is to be devoted, where surface planting is done and the root system is not deep enough, constant watering is needed, in many cases amounting to as many as forty. This frequent application of water prolongs

the vegetative growth and interferes with proper ripening. If canes are planted deep enough and earthed up well, and sufficient spacing is given say about 3 feet between lines it would be possible to keep the soil worked up as often as necessary and as often as the soil admits between two irrigations. This will keep the soil moisture in the right proportion for the crop. It has been found possible to grow a successful crop of cane with about 10 or 11 waterings as against 30 or 40. The Manjri method is confirmatory of this statement. Hadi also in his latest book on the cane industry in the Bhopal State supports this view.

A large scope therefore exists for investigation into the question of manuring and irrigation. And to arrive at a definite solution as far as this Presidency is concerned I hope it will not be considered presumptuous if I suggest that definite experiments be laid out on the Sugarcane Farms and results worked out to secure statistical significance. Of course if cultivation methods as described above are carefully attended to, the outturn is bound to be satisfactory both in quality and quantity.

15. A large outturn means a large outlay. From an analysis of the figures of the Central Farm it is found that for a crop producing Rs 800 worth of jaggery about Rs 400 have to be spent on cultivation charges including manufacture. Our object should be to reduce by improved methods these charges to a reasonable minimum and to produce the maximum benefit. Savings could be effected in seed rate and by judicious manuring and irrigation, these three forming the major items in the cost of cultivation of the cane crop.

16. An outturn of 40 tones of cane giving about 20 candies of jaggery should be considered a very satisfactory yield for this Province. Samalkota and Anakapalle very often record this result. Ryots' field is generally below this figure, but there are not wanting tracts where a high yield of 12,500 lbs. of jaggery is obtained. The village of Budinattam near Udumalpet is one such.

Two years ago when the students visited the Sugarcane Farm of M.R.Ry. Rao Bahadur C. V. Narasimha Razu Garu at Etikopaka, a crop of J 247 was estimated at 15,000 lbs. of jaggery per acre, the estimate being based on the yield obtained from a previous crop of this same variety and of a similar stand. It seems therefore permissible to infer that growers of cane in South India may also reach up to the limits of Java yields provided facilities and resources and knowledge are placed at the door of the grower.

17. *Manufacture.* This phase of sugar farming demands a closer attention and investigation on the part of the members of this Department. Already sufficient attention is being given in this direction, in the construction of furnaces, in the introduction of efficient mills and in the methods generally to be adopted in boiling. Maximum extraction, general attention to cleaning, expeditiousness in the boiling process, proper clarification of the juice, and avoidance of waste are to be aimed at. The ryot requires to be educated in all these details. It is his want of knowledge of these details that is mainly responsible one could safely say, for at least 20 per cent reduction in the yield of jaggery.

Clarification he is not very particular about, though he removes the preliminary scum that rises to the surface. He does add lime to the juice which certainly helps in defecation and he is aware that the addition of lime helps to harden the jaggery. He is not particular about the colour, though in certain tracts colour is natural to the product due to the inherent quality of the juice. He is keenly alive to the keeping quality of the jaggery and therefore strives best to get a hard stuff. He is, however, handicapped in this inas-

much as the stuff gets soft and leaks out in rainy weather in certain tracts. A good deal of help, instruction and active propaganda is therefore essential to the lasting benefit of the sugarcane grower.

A word is necessary here in connection with reagents added for coagulation of albuminous and other miscellaneous impurities and for neutralisation of the juice. Coagulating agencies like milk, yoke of egg, or any mucilaginous infusion of certain plants like the Wild Bendi are added. These certainly exert an influence on the clarification of the juice.

Liming is generally adopted to neutralise either partly or in full the acidity of the juice. Partial neutralisation is in favour with some since the resulting product is not discoloured whilst complete neutralisation results in a dark coloured jaggery. Hadi suggests in the latest edition of his book 'Indian Sugar Industry' the use of Crude Sodium Bicarbonate which contains some sulphur as well. He recommends lime to a limited extent only when one deals with the juice of inferior qualities.

In this connection it may be of interest to know that trials made at Palur show that jaggery obtained from soil limed beforehand is of good quality and the juice does not need to be treated with milk of lime. It is also suggested that excellent jaggery is made at Chittoor without liming and this may be due probably to the lime already present in the soil.

Gentlemen, I am inclined to be sceptic about these results although I do not question the facts. To me, the effect of the addition of lime to the juice to promote certain action which is both chemical and mechanical should be certainly different from the effect of lime which may probably be present in the juice in organic combination being absorbed from the soil. I would attribute this result to the greater purity of the cane juice obtained from the crop of those soils. The addition of lime or the presence of lime in the soil should certainly bring about a better physical condition of the soil and thus promote growth of cane of better quality. Incidentally its absorption may also help to reduce the acidity of the juice. I would only leave it to Chemists to suggest an explanation.

18. One great defect in the manufacture of jaggery is the use of the open pan system which however under the present circumstances does not look like being dispensed with. The ill effects of boiling in the open pan system over direct fire are well known—inversion and caramelisation. The improvements suggested by us are intended to reduce the chances of this inversion and caramelisation to a certain extent.

The multiple pan method is an improvement in this respect inasmuch as clarification and concentration are carried on in two or three different pans over a long furnace in which the maximum heat is utilised in the process and thus solidification of jaggery is expedited.

I recall to my mind just now Mr. Vellinigiri Gounder's suggestion before the Tariff Board this month that Sugar manufacture may be encouraged as a cottage industry. Open pan system however carefully elaborated and worked, entails loss of sugar by inversion and to a slight extent caramelisation. The jaggery or the massecuite prepared from that for conversion into sugar contains comparatively less sucrose and more glucose than what are yielded from factories worked on modern methods. Hadi who has been at this work for the past 25 years says again that he gets only 50 to 55 per cent of sugar from the 'Rab'. One should therefore hesitate several times before one makes bold to suggest sugar manufacture as a cottage industry under the existing

condition. I should therefore prefer to look at this venture as a rural industry worked by small groups in co-operation. We are now advocating power crushing and boiling of juice into jaggery on a moderate scale to be worked by co-operative concerns and we say that the produce of 150 to 200 acres could be profitably dealt with, although it is regrettable to note that a concern like this started and working for some time very near Coimbatore closed the business for reasons best known to themselves. My suggestion here would be the addition of a device to the power plant mentioned above —a sort of vacuum pan in which the juice can be boiled down at low pressure and temperature? My object in making this suggestion is to find out a simple method by which the evaporation and concentration of the juice may be done in a closed receptacle under regulated temperature and reduced pressure. I am not a technician and I leave it to the Research Engineer to take it up, if he thinks it worth his while. I am sure that with the modern rapid advance with mechanical devices and in simplification of the same, it should be possible to design and instal a plant for milling and boiling on a moderate scale of investment of a few thousands of rupees to enable villagers to take up. We have small scale rice-hullers, decorticators and ginneries. A sugar milling and sugar boiling plant combined in a small rural factory cannot be an impossibility.

19. If this is done, as I hope it will be, in course of time, the problem of the sugar industry in this country will be to a great extent solved, for after all even with the wildest stretch of imagination you cannot expect for a long time to come more than 25 per cent of the population to consume crystallised sugar; the remaining 75 per cent is satisfied with jaggery. The demand from this 25 per cent of the population may therefore be successfully met from the existing area of sugarcane. From the increased production by the introduction of better strains, improved methods of cultivation, and of boiling should certainly leave enough surplus produce to be made into sugar in the rural refineries.

SUGARCANE BREEDING—ITS CHIEF CHARACTERISTICS *

By RAO BAHADUR T. S. VENKATARAMAN

(*Government of India Sugarcane Expert, Coimbatore*)

I. Introduction

I am grateful to the Working Committee of your Union for the opportunity they have given me to speak to you on the subject of Sugarcane Breeding. The success of the Breeding work attempted at my Station is directly dependent upon the amount of sympathetic interest that the Station is able to evoke from the Agriculturists assembled here and the guidance which the Station is able to get from them as to the kind of cane that is needed in each locality. I feel confident that both my colleague—Mr. Nand Lall Dutt, M. Sc., who is in immediate charge of the breeding of thick canes—and myself will have from this symposium many valuable suggestions that would materially influence our cane breeding programme with particular reference to at least Madras conditions.

As the time at my disposal is rather short—and I would add 'rightly so', as in such meetings the discussions that follow each talk are more valuable than the talks themselves—I shall confine myself to placing before you the

* Paper read at the M.A.S.U. Conference, July 1930.

salient features connected with cane breeding and incidentally refer to certain factors which appear to have contributed to the quick and satisfactory results that have resulted from it.

II. Variation in seed-grown sugarcanes

Perhaps the very first feature that would strike the novice to sugarcane breeding is the wide variation among a population of seed grown canes, even when the seed is obtained from 'selfed' flowers. The suggested explanation for this phenomenon is—to put it in the language of the Breeder—the heterozygous nature or the genetic impurity of the parent canes. It is believed that the extant canes must have originated in the remote past from true seed, such seed having resulted from a natural but complicated hybridization in the wild state. In the ordinary vegetative method of propagation (from cuttings) this heterozygous nature does not get a chance to show itself but does so when the sugarcane is reproduced from true seed. Thus visualized, certain of the sugarcane varieties which have been in cultivation over extensive tracts in Northern India and elsewhere may be said to have had practically the same genetic composition all these years and in every one of the millions of plants of each variety.

III. Emasculation inapplicable to cane breeding

The second peculiarity associated with cane breeding is the impracticability of carrying out, with anything like satisfactory results, emasculation of the flowers prior to cross-pollination. The flowers in the sugarcane are so minute—and in certain instances this minuteness is associated with such an extreme delicacy of the floral structure—that the current methods of the Breeder are inapplicable to the cane. As a result of this handicap, the cane-breeder's choice in the matter of parents is limited, as he has perforce to select as mothers only such varieties as have no fertile pollen of their own. The usual method has been to isolate such varieties and shower on their stigmas pollen of the male parent with which it is desired to cross. When such a pollination is done, it results, however, in quite a large number of crossed seeds from two or three such operations, as the cane inflorescence contains sometimes as many as 40,000 flowers, every one of which can develop a seed.

IV. Newly bred improved canes easy to propagate in cultivation

A third characteristic of sugarcane breeding which separates it rather widely from the breeding of most other crops, is the fact that, when a good sugarcane seedling is obtained by the processes above described, it is comparatively easy to keep it pure and multiply it in cultivation without serious risk of losing the good characteristics for which the new seedling was selected in the first instance. This is rendered possible by the vegetative method of multiplication which is possible in this crop. This is the method usually adopted in the cultivation of this crop, a method which, as already mentioned, ensures almost a genetic identity in the resultant plants.

V. Sugarcane breeding largely a work in the dark

There is, however, one very serious disadvantage associated with cane breeding, which needs to be brought to the prominent notice of the audience here. You all know how, with most agricultural crops, definite laws are being

discovered in the matter of inheritance of characters; and, with certain of them at any rate, it is becoming increasingly possible to predict the characteristics of a particular hybrid population with considerable amount of certainty. With the cane such laws about the inheritance of characters are yet to be discovered, though it needs to be mentioned that Breeding Stations with some experience are just beginning to see indications of these. In the present state of our knowledge, therefore, the cane breeder may be said to have to work largely in the dark as to the results to expect from a combination. This necessitates his raising as large a number of seedlings as possible—to increase his chances of securing the desired types—and laboriously working through this large number to pick out the types desired. In recent years as many as over 200,000 hybrid seedlings are being raised each year at Coimbatore and about 40,000 of these grown to maturity. When it is remembered that the cane is a comparatively long duration crop—twelve to fourteen months in this Presidency—and the bulk of the 40,000 seedlings need to be studied for their botanical, chemical and agricultural characters at various stages, it will be realized that the labour involved is considerable.

VI. Quick and satisfactory results

In spite of certain difficulties above mentioned the Breeding of Sugarcanes compares favourably with that of other crops in the field of practical achievements. The comparative rapidity of the results from sugarcane breeding would appear to be largely attributable to two factors already mentioned, viz., (1) the very wide variations in the seed population, which greatly increase the chances of the desired types appearing and (2) the ease with which the improved canes could be introduced into cultivation and kept pure. There would appear, however, to be yet a third and not unimportant reason which has suggested itself to me within recent times and which is likely to be not without interest to the other Breeders.

VII. Wide range of parents employed in sugarcane breeding

Consciously, or unconsciously the Sugarcane Breeder would appear to have used in his breeding programme a wider range of parents than Breeders of most other crops. It is now widely accepted that the work of Java experts offers perhaps the most striking example of practical achievements in the realm of sugarcane breeding. Their first successes in cane breeding, as is now well known, are associated with their memorable fight against 'sereh'. For breeding a cane resistant to this disease they crossed one of the canes they had in cultivation with an Indian cane which was specially imported into Java with considerable labour on account of its resistance to the 'sereh' disease. It has since been found that this Indian cane is of a different species from the other parent and the successful canes were therefore interspecific hybrids. Again, the cane '*Kassoer*' which has entered a great deal into the parentage of the later Java seedlings, is itself a natural hybrid between two species of Saccharums, viz., Saccharum officinarum and Saccharum spontaneum.

To come nearer home, the Sugarcane Breeding Station at Coimbatore has been indulging in species hybridization within the genus Saccharum from its very inception in the year 1912; and to Dr. C. A. Barber, C.I.E., belongs the credit for having deliberately used for the first time Saccharum spontaneum in the breeding of sugarcanes. To-day most of the Coimbatore seedlings which are giving such good accounts of themselves under North Indian conditions—and in recent years in foreign countries as well—are all rather

complicated interspecific hybrids within the genus Saccharum, at least three new distinct species being involved, viz., Saccharum officinarum, Saccharum Barberii, and Saccharum spontaneum. If the breeding of sugarcanes has any suggestions to offer to breeders of other crops, one such would therefore be the desirability of employing as wide a range of parents as might be possible.

VIII. Sugarcane X Sorghum hybrids

We succeeded last season in effecting at Coimbatore intergeneric hybrids between the sugarcane (P.O.J. 2725) and Andropogon Sorghum (Periamanjal of Coimbatore), apparently the first recorded intergeneric hybrid with the sugarcane. These hybrids are quite an interesting lot and certain of them show characters obviously derived from the cholam parent. This cross was attempted with the definite object of breeding short duration sugarcanes and certain of the hybrids have ripened off after a period of but five months growth, their juices at maturity proving almost as rich as that of the standard sugarcanes at harvest. These are being multiplied from cuttings at the Coimbatore Station. One of the obstacles to an extension of sugarcane cultivation has been its long duration on the land; and it now seems not unlikely that the new hybrids might yield sugarcanes that could be cultivated like certain of our cereals.

IX. Use of wild types as parents

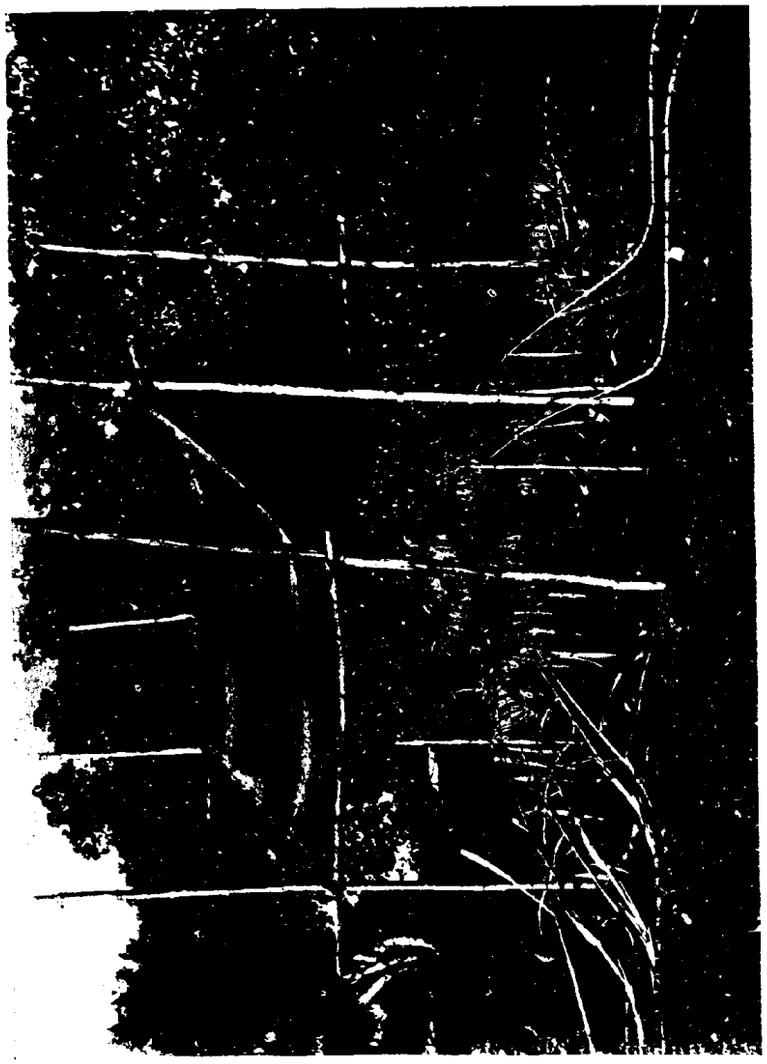
Secondly, the bulk of both the Java and the Coimbatore seedlings, which have proved successes in recent years, have the blood of the wild sugarcane, Saccharum spontaneum, diluted to varying degrees. It appears to me more than likely that this wild blood has definitely contributed to the greater vigour and the comparative disease resistance and hence the success of the recent productions. If my assumption is correct, an attempt to employ the wild types in the breeding of other crops is definitely suggested.

X. An appeal for help and Co-operation

Before I bring this little talk to a close there is one very important aspect of sugarcane breeding which I wish to bring prominently to the notice of the audience assembled here. I consider it most appropriate that I should mention it here and now.

The cane breeding work both in India and elsewhere is rapidly reaching a stage when the actual raising of the seedlings—and in as large a number as desired—would cease to be a problem. It is true that it has not yet been possible to employ as parents any and every cane variety one would desire; but it can reasonably be assumed from the trend of current events that considerable progress will ere long be made even in this direction.

For quick and satisfactory—and I might even add any—results, an efficient and quick means of testing the new productions in the localities for which they are intended is vital. Owing to certain difficulties both in the matter of flowering and the fertility of the flowers in the sugarcane, the cane breeding activities for the whole of India is at present carried on in one place at Coimbatore. The breeding done at Coimbatore is only half the problem and all that the breeder can do at Coimbatore is to make a preliminary selection of probable useful types. To facilitate this the standard canes of the various localities are grown at the Station and the new productions compared with these at almost every stage in their growth. But it is obvious that this



Isolated Sugarcane 'Mother' arrows waiting to be cross-pollinated.

Certain of the 'Wild Sugarcanes' for use as parents at the Imperial Sugarcane Station, Coimbatore.

can never take the place of the testing of the productions in the locality itself and under local conditions. To state the problem in a concise manner, the breeding of suitable improved canes for the various parts of India with its wide variation in soil and climatic conditions, is essentially a team work composed of the Breeder at Coimbatore and the officers in charge of the local testing stations. The Sugarcane Breeding Station at Coimbatore feels confident that, in the efficient testing of the new productions, it can count on the help of the audience here in a joint endeavour to place on a satisfactory footing the raw material for such a *Vital Food* industry as that of the *Indian Gur* and *Sugar Industry*.

THE MANURING OF SUGARCANE *

By B. VISWA NATH, F.I.C.,

Government Agricultural Chemist, Coimbatore

A crop of 30 tons of sugarcane per acre removes 80 lbs. of nitrogen, 50 lbs. of phosphoric acid and 180 lbs. of potash from the soil. An examination of the results of field experiments for 25 years at all the experiment stations in the Presidency, chiefly at Samalkot, Anakapalle and Palur, reveals that the problem of nitrogen nutrition of the sugarcane is of greater importance than that of either phosphoric acid or potash. In the manurial programme of the Experiment stations, the application of oil cakes is the chief item and the soundness of the scheme is reflected in its wide adoption in the sugarcane tracts.

An analysis of the results of work at the different experiment stations in the Presidency is attempted in this paper with a view to obtain information on the requirement of the sugarcane plant in regard to the three principal manurial constituents, Nitrogen, Phosphoric acid and Potash.

The economics of the different systems of manuring are not discussed here, as that would very widely with the locality, and the ruling prices of the manures and the crop. Attention is confined to a discussion of the relative merits of different manures and the combinations in which they are beneficial to sugarcane. The subject matter is divided into three broad divisions :

(1) manuring as affecting the yield,
(2) manuring as affecting the quality of the juice and the jaggery and
(3) manuring as affecting the vegetative and reproductive quality of the resulting seed material.

(1) Manuring as affecting yield

Evaluation of results: There are two ways of evaluating yields in sugarcane experiments.

(i) as weight of cane
(ii) as weight of jaggery.

The latter is doubtless important from the ryot's point of view but to an experimenter, it is open to certain objections. The yields of jaggery on weight of cane and on weight of juice vary up to 5 per cent. These differences are due to variations in mill efficiency, and to differences in the methods of

* Paper read at the M.A.S.U. Conference, July 1930.

preparation of jaggery. These were discussed at length in a paper by Kasinath and myself in the Year Book of the Department for 1928. For these reasons the discussions are based on weight of cane. There is experimental evidence, based on carefully controlled milling and jaggery boilings, to show that the brix values may be taken to compute the yields of jaggery, where such figures are required.

Nitrogen nutrition of the plant: The use of bulky manures, like cattle manure and green manure, is commendable wherever practicable with small additions of concentrated fertilisers like oil cakes and Ammonium sulphate. Judging from our knowledge of the present position, the invariable use of cattle manure, except for light basal dressings, is generally impracticable, and the availability of green manure is restricted to certain localised areas. The choice of nitrogenous manures has necessarily to fall on oil cakes and chemical fertilisers.

Sugarcane responds to all forms of nitrogenous manuring but in varying degrees as is seen in the following statement.

Relative merits of different mineral and organic fertilisers

Averages of 3 years with duplicate plots. (Coimbatore experiments).

Mineral manures			*Oil cakes*		
Percentage increase over standard: Calcium cyanamide			Percentage increase over standard: Safflower cake		
Calcium Nitrate	...	+0·46	Castor cake	...	+11· 8
Ammonium sulphate	...	+9·70	Groundnut cake	...	+ 2· 5
Potassium Nitrate	...	+1·27	Pungam cake	...	+ 1·76
			Gingelly cake	...	+12· 3

At Samalkot Ammonium sulphate was 10·9 per cent better than castor cake and 5·3 per cent better than groundnut cake, while at Palur Ammonium sulphate was 7·35 per cent better than groundnut cake.

Form in which nitrogen may be applied: Although Ammonium sulphate has been found superior to cakes, this superiority is not so great as to rule out the use of cakes. Besides, the possible adverse effects on the soil from continuous application of Ammonium sulphate and the losses of Nitrogen likely to occur in the absence of sufficient supplies of organic matter, have to be considered. This leads us to the study of the effect of combinations of cake and Ammonium sulphate nitrogen. The results of such experiments at Palur and Samalkot throw light on this subject.

At Pālur, castor cake plus Ammonium sulphate (75 lbs. cake N and 25 lbs. ammonium sulphate N) was distinctly better than castor cake alone while the results of experiments at Samalkot show that Ammonium sulphate by itself is as good as when combined with either groundnut cake or castor cake.

	SAMALKOT	PALUR
	Average of 3 years. (103 lbs. nitrogen.) Per cent increase over standard.	Average of 6 years. (100 lbs. nitrogen.) Per cent increase over standard.
Groundnut cake alone ...	Standard	
Groundnut cake plus Ammonium sulphate ...	+5·4	
Ammonium sulphate alone ...	+5·3	
Castor cake	Standard	Standard
Castor cake plus Ammonium sulphate ...	+11·6	+3·42
Ammonium sulphate alone ...	+10·9	...

A further analysis of the figures at Palur discloses better, the effect of manurial treatment, when the plots are divided into rich and poor ones. While the order of merit of the different treatments in the poor as well as rich plots remains the same as that we have already seen, the response is better in the poorer plots; cake plus Ammonium sulphate gave 11·8 per cent over the standard as against 6·4 per cent in the richer plots.

Another point to be noted is that as between castor cake and groundnut cake as manure for sugarcane, the experimental results reveal no appreciable differences and may it therefore be taken that groundnut cake and castor cake are of the same efficiency, on the basis of equivalent doses of nitrogen.

Optimum dose and combination of cake and mineral nitrogen: Progressively increasing applications of nitrogen result in progressive increases in yields but as would be expected the response per unit of increase is not proportional.

Palur experiments

Treatment	Per cent increase in yield over standard.	Per cent increase for every additional 50 lbs. N. over the previous one
Groundnut cake 50 lbs. nitrogen ...	Standard.	.....
Groundnut cake 100 lbs. nitrogen ...	+ 30·9	+ 30·5
Groundnut cake 150 lbs. nitrogen ...	+ 57·0	+ 19·9
Groundnut cake 200 lbs. nitrogen ...	+ 85·6	+ 18·3
Cake N. 40 lbs. plus mineral N. 10 lbs.	+ 16·0	.....
Cake N. 80 lbs. plus mineral N. 20 lbs.	+ 41·6	+ 22·1
Cake N. 120 lbs. plus mineral N. 30 lbs.	+ 50·3	+ 6·1
Cake N. 160 lbs. plus mineral N. 40 lbs.	+ 73·8	+ 15·6

N.B.—Cake N represents nitrogen given in the form of groundnut cake Mineral N represents nitrogen given in the form of Ammonium sulphate.

It is seen that, taking the yields for fifty pounds of cake nitrogen as the standard, increased yields are obtained as the quantities of nitrogen are increased either as cake nitrogen alone or as a mixture of cake plus Ammonium sulphate nitrogen ; but the increases are similar in both the systems of manuring only up to a point, i.e., up to 100 lbs. nitrogen either as cake alone or combined with Ammonium sulphate. Further, 100 lbs. of mixed nitrogen as 80 lbs. of cake and 20 lbs. of Ammonium sulphate are seen to be superior to 100 lbs. of cake here also as with 75 lbs. of cake and 25 lbs. of nitrogen, which we have already seen earlier in this paper to be better than when all the nitrogen was in the form of cake.

Above 100 lbs., mixtures of organic and mineral nitrogen are inferior to organic nitrogen and this is seen in the increments due to a unit of increase in nitrogen. For instance, taking the yield from 50 lbs. of cake nitrogen as the standard, the enhancement in yield due to increase of nitrogen from 50 to 100 is 30·5 per cent for organic nitrogen and 22·1 for mixed nitrogen; with increase from 100 to 150 lbs., the response over 100 is 19·9 per cent for organic nitrogen and 6·1 per cent for mixed nitrogen. Similar differences are noticed with 200 lbs. nitrogen. An examination of the effect of replacing cake nitrogen with ammonium sulphate nitrogen lends further support to these observations.

(1) Effect of Ammonium sulphate replacement

Particulars	Per cent increase or decrease over nitrogen given as cake alone.
(Cake N. 40 lbs. plus mineral N. 10 lbs.) over (Cake N. 50 lbs) ...	+ 16·0
(Cake N. 80 lbs. plus mineral N. 20 lbs.) over (Cake N. 100 lbs.) ...	+ 8·2
(Cake N. 120 lbs. plus mineral N. 30 lbs.) over (Cake N. 150 lbs.) ...	− 4·3
(Cake N. 160 lbs. plus mineral N. 40 lbs.) over (Cake N. 200 lbs.) ...	− 6·4

It is seen that even when the ratio between organic and mineral nitrogen is kept constant, the effectiveness of Ammonium sulphate is gradually diminished as its quantity is increased, and above a certain quantity is even detrimental. This view finds support in another set of experiments to determine the optimum proportions of organic and mineral nitrogen,

Proportions of cake and Ammonium sulphate

Treatment	Percent increase in yield over standard.
Cake N. 50 lbs. ...	Standard
Cake N. 100 lbs. only ...	+ 30·9
Cake N. 80 lbs. plus mineral N. 20 lbs. ...	+ 41·6
Cake N. 60 lbs. plus mineral N. 40 lbs. ...	+ 56·5
Cake N. 40 lbs. plus mineral N. 60 lbs. ...	+ 38·2
Cake N. 20 lbs. plus mineral N. 80 lbs. ...	+ 49·6
Mineral N. 100 lbs. only ...	+ 40·5

Effect of Phosphates on yield. Of the three phosphates tried, the addition of super phosphate has shown an increase of 8.1 % over the nitrogen plots. Curiously enough fish guano and bonemeal have depressed yields, the former more so than the latter. Whether this is due to the richness of experimental plots in all the stations or to the doubtful nature of the quality of fish guano and bonemeal it is difficult to say. Almost immediately after the beginning of these experiments fish guano has become a rare commodity and instances are not wanting when fish guano and bonemeal are not what they are supposed to be. These results must therefore be taken with caution. Nevertheless, phosphates are a necessary factor in any scheme of sugarcane manuring, irrespective of their effect on yields.

Effect of potash on yield. There seems to be no need for applications of Potash. There is on record one experiment of only 3 seasons' duration in which the yields were depressed to the extent of 40. 2%, which is surely a sufficiently powerful deterrent to pursue further.

(2) Effect of Manuring on the Quality of Juice

Using 100 lbs. of nitrogen with and without phosphates, no differences are visible in the analyses of juices from the differently manured plots in so far as the sugars and non-sugars are concerned.

Average figures for 2 years 1928–29 and 1929–30 for Palur

	Groundnut cake.	Cake plus Ammonium sulphate.	Ammonium sulphate.
Brix ..	21·59	21·75	22·05
Sucrose ...	20·01	20·22	20·28
Co-efficient of purity ...	92·64	92·81	91·90
Glucose ...	0·53	0·63	0·62
Non-sugars ...	1·05	0·90	1·16

Average figures for 3 years 1925–26 to 1927–28.

	Fish	Castor	Castor Cake	Castor Cake
...	Guano	Cake	+ Amm. Sulphate + Super. (50 lbs. P_2O_5)	+ Amm. Sulphate + bonemeal (50 lbs. P_2O_5)
...	...	...		
...	...	...		
...	...	...	...	...
Brix	21·02	21·18	20·86	21·18
Glucose	0·73	0·66	0·76	0·75

There is however a large volume of opinion that heavy application of nitrogenous manures especially of Ammonium sulphate tend to produce jaggery which will not easily set and which runs in wet weather. There is no experimental evidence with us on this point but Mr. Sanyal at Pusa observes that jaggery obtained from cane manured with Ammonium sulphate is of inferior quality. Phosphates are believed to counteract the bad effects of Ammonium sulphate in the production of jaggery and how far this holds good under our soil conditions has yet to be tested.

(3) Manuring as affecting the Vegetative and the Reproductive Quality of the Resulting Seed

The investigations on the influence of manuring on the vitality of the resulting seed, which have been in progress in our laboratory were extended to Sugarcane also. I am indebted to Rao Bahadur T. S. Venkataraman, and Mr. Nandalal Dutt for affording facilities for the conduct of experiments at their respective stations. As in the case of the other crops experimented with, significant differences exist in the cropping capacities of the setts obtained from differently manured plots. The setts from mineral manured plot were 15·0 per cent superior to those from unmanured plot, while the setts from the organic manured plot were 35·9 per cent superior to those from the unmanured plot.

These results suggest the possibilities of increasing yields by producing vigorous seed material from a well manured nursery plot. Apart from this, the point of interest now is that by heavy manuring in the nursery plot the quantity of manure supplied to the bulk planting area may be reduced. Indirect confirmation of this on the field scale is available from the results of the interesting work at Anakapalle by Messrs. A. C. Edmonds and S. Sitarama Patrudu on what is called *the short crop seed method*. I am indebted to them for the information obtained from them and from their published annual reports and papers.

The short crop seed material is raised in a fairly heavily manured nursery and therefore is more vigorous than the normal material from the planting area. While distinct differences are seen in the yields from high and low manurial treatments when planted with ordinary seed material, no appreciable differences are seen when the short crop material is used. With normal seed material plots receiving 134 lbs. nitrogen have given an increased yield of 7·1 per cent over these receiving 106 lbs. nitrogen, while with the setts from more heavily manured nursery, the difference in favour of plots receiving 134 lbs. nitrogen as against these receiving 106 lbs. nitrogen was only 0·77 per cent.

Summarising, it may be stated that

(1) Sugarcane responds best to nitrogenous manuring.
(2) a mixture of cake and Ammonium sulphate in the proportions of 4 : 1 or 3: 2 is the most profitable.
(3) 100–150 lbs. nitrogen is the optimum dose per acre.
(4) phosphates do not directly contribute to increase in yields, but are necessary for the proper ripening of cane and the production of good jaggery.
(5) potash depresses yields.
(6) using 100 lbs nitrogen with or without phosphates, the quality of juice, as judged by analysis, is not appreciably affected.
(7) large applications of nitrogenous manures specially Ammonium sulphate tend to produce soft jaggery with poor keeping qualities.
(8) the use of setts from a crop raised on a well manured plot gives a better crop and permits reduction of the quantity of manure for the planting area.

SUGAR-CANE INSECTS IN SOUTH INDIA*

By RAO SAHIB Y. RAMACHANDRA RAO, M.A., F.E.S.
Government Entomologist, Coimbatore

Our Sugarcane Pests

Sugarcane is no more free from the attentions of insect-pests than the other major crops cultivated in South India. The setts that are planted are attacked by white ants; very often the joints are eaten up until they are reduced to mere shells, and the germination of buds is affected. The shoots are liable to attack by, at least, three kinds of caterpillar borers, which kill them outright. These borers may also attack the joints of canes during their growth and cause a decrease in the yield of sugar. The leaves may be infested with various kinds of sucking insects: mealy-wings (Aleurodes), mealy-bugs, plant-lice and leaf-hoppers. In some tracts, the Paddy grass-hopper—Hierogiyphus—may invade the crop and reduce the leaves to mid-ribs. Cockchafer grubs may in some places damage the planted crop. Rats, squirrels and jackals are also known to carry their depredations into the cane crop.

Sugarcane Pests in other Lands

Although South India has a goodly share of ills due to insect-agency, still she has upto now been free from various insect foes known to infest other countries of the world. In Hawaii, one finds the serious leaf-hopper pest—*Perkinsiella saccharicida*—which has been, after long-continued efforts, brought under control by biological agency i.e., by the introduction of parasites. Secondly, there is the weevil-borer, *Rhabdocnemis obscura*, found also in some of the islands of the Lesser Antilles, and thirdly, Hawaii has the stemborer—*Dialraea saccharalis*—different from the Indian species. In Fiji, the major pests are the wireworms and certain beetle borers. In Queensland, the chief

* Paper read at the M.A.S.U. Conference, July 1930.

pest is the cockchafer larva—the so-called 'whitegrub' of the planters; army worms are also reported to occur sometimes in serious numbers. In Mauritius, three different borers are present. In Java, the roots are damaged by the grubs of the 'wawalan' beetle—*Apogonia destructor*—while the stems are attacked by the 'kantjoek' beetle—our familiar friend—*Oryctes rhinoceros*. In addition, three borers are also present. In Egypt. sugarcane is seriously affected by a mealy-bug. In Trinidad, the control of the froghopper—*Tomaspis varia*—has proved a serious problem. British Guiana and Trinidad are the home of the giant borer—*Castnia licus*. The moth-borer—*Diatraea saccharalis*, is an insect of great consequence in Argentina, Louisiana, and Mexico, where it is sought to be controlled by the biological method.

India has thus to beware of the danger of importation of various foreign insects, the introduction of which is day by day becoming more and more imminent owing to the progressive quickening of the means of transport, especially by the extensive development of the air-ways. Chief among them are the weevil-borer, the moth-borer and scale-insects, and stringent quarantine regulations have to be enforced to keep them out, especially as there are, in addition, various very serious diseases of cane, such as the Fiji disease, the Sereh disease, and the bacterial leaf scald,—not recorded at present in India—liable to be introduced.

The Pests of Cane in South India

Of the Cane insects of South India, the most important economically are the moth-borers and the white ants, and it is on these that some detailed work has been done in this province. Of the others, however, there are a good many that are locally important. This is the case with the Cane Hopper—*Dictyophara pallida*, the Cane mealy-wing—*Aleurodes*, and mealybugs—*Pseudococcus sacchari*, but in most cases, these pests become abundant only when ratoon crops are raised, and as far as possible it is advisable to avoid ratoon crops. Plant-lice—especially *Aphis maidis*—have assumed importance as carriers of the Mosaic disease, but are otherwise not serious pests of cane in South India. The Paddy Grasshopper—*Hieroglyphus banian*—has been reported to be causing damage to cane in Ganjam and Vizagapatam districts. The attack is, however, generally of the nature of an overflow from the surrounding Paddy crop. In the case of a heavy outbreak noted at Anakapalle in 1923, the only practicable method of dealing with the pest was found to be the organization of a general drive with the help of coolies towards one end of the field and their subsequent destruction. Cockchafer grubs have been reported from North Arcot damaging the roots of cane, but no reliable measures could be recommended in the absence of a detailed study of the insect.

The Major Pests of Cane

The borers share with the white ant the distinction of being pre-eminently the major pests of sugar-cane. Since 1927, a detailed study of the cane-borers has been made in all its various aspects by Assistant Mr. V. Tirumal Rao at Anakapalle at the instance of Mr. A. C. Edmonds—the Deputy Director of Agriculture, I Circle, Vizagapatam; and fairly interesting results have been obtained thereby, and it is the object of this paper to indicate briefly some of the results obtained.

The Borers: There are four species of borers present in South India, of which only one is really important, viz. *Argyria sticticraspis*. The other

borers are (1) *Sesamia inferens*—the maize-borer, also breeding in maize, ragi and sorghum. This usually appears on cane during the dry month of January–April. (2) *Diatraea venosata*, appearing as a shoot-borer on the half-grown crop in June–July, and (3) *Scirpophaga auritlua* and *S. monostigma*, the top-shoot borers of the maturing crop, rather rare in South India.

The borer, *Argyria sticticraspis*, attacks the shoots of the young cane crop in April–May and causes the formation of 'deadhearts' in the primary shoots to the extent of 10 to 50 per cent according to the variety concerned, B. 208 being found to be the most susceptible to attack. The secondary shoots are also attacked, but to a smaller extent—2 to 20 per cent. In order to estimate the extent of the losses caused by borer attack, clumps that had had such attack were carefully kept marked and compared as regards yields at the time of harvest with their controls—known to be absolutely free from deadhearts. The results have shown significant differences upto 10 per cent in favour of borer-free canes. Secondly, the borer has also been found to attack the internodes of cane during the growing period, viz., July–September, the second and third generations of the pest being concerned in such damage. Ten to fifteen per cent has been recorded, the quantity and quality of cane-juice being thereby found affected. Thirdly, it has been customary to advise cultivators to discard all joints attacked by borer in planting the new crop. Careful observations made in experiments, where the use of such setts was tested, have shown that there is no harm really in using them, unless (1) the buds are actually damaged, (2) there is live borer in the setts, and (3) the joints show fungus attack.

As to methods of control, (1) dusts of sodium fluosilicate, levosol fluosilicate, lead arsenate and lime, and Paris Green and lime were tried at Anakapalle and also at Coimbatore with the aim of reaching the very young caterpillars that usually live a free life scraping the green matter of the leaves before they begin to bore in. This was, however, only partially effective as but a small percentage of borers was found thereby affected. There was in addition a certain amount of scorching of leaves, especially at the axils. (2) Light traps were ineffective. (3) Trash traps—were tried according to Dr. Kunhikannan's method. It was observed that the moths hid themselves, under the conditions of the Circars, in cracks in the soil and under clods, instead of in the trash heaps placed in the newly planted field; on the other hand, on days succeeding an irrigation fairly good catches were obtained. (4) Trials of *handpicking of eggmasses* showed that it was not a very practicable affair, for the eggs of Argyria hatch in 3–4 days and are difficult to detect; and an inspection of the crop at sufficiently close intervals to serve the needs of efficiency is not an economic proposition.

It was also noted that the September plantings showed very much lower infestation than the April–May ones.

As to the utilization of the natural enemies, the borer is found subject to the attacks of three different parasites: 1. A Braconid attacking the full-grown caterpillar in the stem;—not very efficient, as the highest percentage of parasitisation noted was about 10 per cent. 2. There are two small parasites breeding in the eggs of the borer: (1) *Phanurus sp.*—found active in the dry months with an effectiveness ranging upto 70 per cent, and (2) *Trichogramma sp.*—flourishing during the rains and showing 90 per cent. efficiency in the later stages. Propagation of these parasites artificially on a large scale in the laboratory has not yet been attempted, but will doubtless give good results ultimately, as in America and West Indies.

The Termite problem : At the Thick-cane Breeding Station of the Imperial Department of Agriculture, Coimbatore, three different species of Termites were noted to be responsible for damage : 1. *Eutermes biformis*—The workers emerge from holes in the ground, cut portions of cane leaves—especially of the seedlings—and carry the bits into their nests. The grass-cutting habits of this species is, of course, well-known, but this is the first time that they are recorded as damaging cane. The spraying of deterrents like, Crude oil emulsion, was effective in keeping them off. 2. *Odontotermes obesus* and *Calotermes sp.* have been recorded to be destructive to planted setts in many parts of South India. Their depredations are specially serious in the case of cane seedlings raised in the Cane Breeding Station, in view of their potential value as the *canes of the future.* 1. A soaking application of Crude oil emulsion or tar emulsion to the base of the affected seedlings with a watering can, after a preliminary hoeing, was found very effective. 2. It was also found that when trash was buried in shallow trenches among the affected rows, the attentions of the termites could be diverted from the canes. 3. In certain cases the nests of the white ants were located in the narrow bunds of the wetland fields, and could be easily dug out and destroyed.

THE DISEASES OF SUGARCANE *

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(*Government Mycologist*)

The diseases of Sugarcane may be broadly classified according to their origin under the following heads :

(1) Fungus diseases.
(2) Bacterial diseases.
(3) Virus diseases.
(4) Physiological diseases.

As usual, fungus diseases out-number diseases of other origin and the number of fungi recorded on sugarcane aggregates over 200 which constitutes a record for any one single species in cultivation by man. Fortunately, only a small fraction of this vast number causes any disease of economic importance and of this small number not all are let free by wise Nature to appear in one and the same part of the globe where sugarcane is grown. There are over two dozen parasitic diseases on record in India but it is not possible even to make a passing mention of all of them in the purview of a short paper and I would therefore confine my attention to the more important diseases of sugarcane occurring in the Madras Presidency.

Fungus Diseases

Red-rot (*Colletotrichum falcatum*). The most important fungus disease of cane in Madras is 'Red-rot' caused by the fungus *Colletotrichum falcatum.* It has a cosmopolitan distribution in almost all the tropical cane growing countries and is known throughout the cane tracts of India. As the name implies, the most characteristic symptom of the disease is the reddening of the internal tissues which is noticed when an infected cane is split open.

* Paper read at the M.A.S.U. Conference, July 1930.

The discoloration is intense in the vascular bundles and often red blotches with white transversely elongated centres are found. Usually the disease exhibits itself in a crop approaching maturity and the first external symptom is the marginal drying of the mature leaves. With the progress of the disease the whole crown of leaves withers and dries up as if from drought. The disease occurs in patches and usually all the canes in a diseased clump are infected. It is our experience that the disease is more serious in thick canes than in thin ones. Usually the reddening proceeds from the base upwards, though infection of a few internodes in the middle caused by local infection may rarely occur.

As the disease progresses, the mycelium penetrates the pith which dries up and the rind of the cane collapses causing longitudinal hollows on the surface. The mycelium subsequently forms acervuli of the fungus which burst through the rind and bear spores of the fungus particularly on either side of the nodes. Fructifications of the fungus are also formed on the dried up leaves and leaf-sheaths.

Effects. The effect of the disease on sugarcane is two-fold. First there is a distinct loss in tonnage through withered clumps. Secondly, in the unwithered canes the quality of juice gets deteriorated with the result that the juice on boiling does not set or produces a poor quality of jaggery.

The chief agencies in the spread of the disease are (1) diseased setts and (2) infected soil and (3) airborne spores.

(1) *Sett infection.* This is the agency in spreading the disease from infected to healthy areas or fields and for multiplying the disease in an already infected field. The mycelium of the fungus present in infected setts gives rise either to infected shoots which die an early death or causes the development of the fungus in whole clumps. It also leads to the infection of the soil from the fungus developed on the plant debris such as roots, stumps, leaves, etc. Under Indian conditions infection through setts has been found to be the most important source of disease.

(2) *Soil infection.* As a rule, the fungus is incapable of making its entry through the unwounded host. The most common method of entry into the uninfected host is through the cut ends of the setts. Once the entry is effected the fungus penetrates the sett, its progress being very rapid in the ripe setts rich in sugar. Very often the fungus spreads so rapidly that the setts fail to germinate or when germinated the seedlings are killed outright.

(3) *Aerial infection.* Aerial infection takes place mostly through the adventitious roots and root-eyes. But compared with the other sources of infection this is less important.

Control. The methods of control are preventive, aiming at the reduction of the sources of infection to a minimum. Firstly the seed used for planting should be free from disease. This is done best by selecting setts from an uninfected field. Selection of setts from fields entirely free from disease is an ideal rarely attainable, so that one often has to direct one's attention to the selection of his planting material from clumps which are free from the disease. The experiments conducted by this Department on the Samalkota Agricultural Research Station (Godavari delta) have shown that when setts are selected from disease-free clumps, the percentage of infection is reduced to a minimum. The practice was to reject canes which showed the slightest trace of disease and when in a stool a single cane showed the reddening, to reject the whole stool of cane. Steeping the sets in Bordeaux mixture before planting and

dipping the cut ends in tar were tried at the Samalkota Agricultural Research Station during the years 1906–07 with satisfactory results.

The only practical method of preventing soil infection is the practice of rotation of crops. The fungus is known to live saprophytically in the debris of sugarcane and some intervening crops like paddy or plantains on which the fungus cannot live will starve out the fungus.

Varietal resistance. There is a wide range of variation in the susceptibility to disease among different varieties of cane. The experience in Godavari shows that the indigenous canes were, as a rule, highly susceptible, while the exotic varieties were able to withstand the disease better. The latter after a time became susceptible and were in turn replaced by varieties from other localities.

The disease occurs more in low lying water-logged fields than in well drained ones. A water-logged soil increases the susceptibility to the disease and therefore attention to drainage is as important as the other precautions above mentioned. With this end in view, cane culture should as far as possible be confined to the top plots in wetland areas where good facilities exist for drainage.

Smut *(Ustilago Sacchari).* The fungus is known throughout the oriental cane growing countries. In India it is of common occurrence in the thin cane tracts of Northern India, though it is not unknown in the thick cane tracts of the South.

Symptoms. The disease is characterised by the production either from the growing apex or from the side shoots of a long, black, sooty, whip-like appendage which on its emergence is enclosed in a thin white papery sheath which encloses the spore-bearing shoot, but which is later torn asunder exposing the mass of fine black powder which constitutes the spores of the fungus.

As a rule in a newly planted seedling crop the disease occurs when the canes are approaching maturity, but infection may also occur from the seedling stage onwards. In a ratoon crop, shoots growing from smutted clumps are invariably affected. There are two distinct forms in which smut occurs. In the first the terminal shoot is infected, while in the second, one or more side shoots developing from the stem are infected. Infection has been proved to take place in three ways. Firstly through infected setts cut from infected canes which contain the mycelium. Secondly through spores which come in contact with the cut ends of setts and thirdly through spores which on germination effect an entry into the growing cane through vulnerable points, e.g. the bud hairs, root eyes, wounds, etc.

Losses. The disease is not regarded as one of very serious consequence. Except when the disease is multiplied year after year both through sett infection and spore infection, the loss from it is negligible.

The writer has succeeded in getting infections by injecting a spore suspension in water into a hole made in a growing cane with the aid of a cork borer and also by pouring a spore suspension into the cavity of the emerging terminal shoot.

Though no variety is totally immune to it, a very wide range of variation in resistance exists among different varieties of cane. Butler records that the varieties *khari*, *nanal*, *saretha*, *sanabili* and *katha* suffer very severely at times. Among thick canes, as a rule, the disease is seldom severe. At Palur the variety J 247 has, however, been found to be very susceptible.

Control. The chief method of control is the cultivation of resistant varieties. To prevent spore infection, infected shoots should be collected and burnt as soon as they emerge. In view of the fact that the fungus produces spores in great profusion, the practice reduces the chances of spore infection of growing cane as also the possibility of infection of the soil by viable spores.

Pine apple disease *(Thielaviopsis paradoxa).* This disease takes its name from the peculiar odour of the ripe pine apple which the infected canes emit, and possibly also from the fact that the same fungus is a parasite of the pine apple also. The most characteristic symptom of the disease is the occurrence of a hollow tube through the axis, which is dark coloured and sooty black when fully developed. The dark discoloration is brought about by the profuse formation of dark coloured spores. The identification of the disease can therefore be easily confirmed by the microscopic test.

The disease is essentially a wound parasite which cannot gain access to uninjured cane. The greatest loss from this disease in other cane-growing countries is from its attack on planted cane setts. The fungus enters through the cut ends and rapidly pervades the tissue. It causes the wide spread death of the germinating sett thus producing several failures in sprouting. To a lesser extent, the disease occurs on standing cane the attack being near the ground level. Once the fungus has gained its entry, it kills the cane in the course of a few weeks.

Though it has been found in some parts of the South, it has not so far been reported to have taken epidemic form anywhere. The researches in Coimbatore have shown that the same fungus causes the 'bleeding disease' of the coconut, the arecanut and the palmyra palms. This disease being of very common occurrence in this country, a great danger lies lurking at our doors awaiting opportunity to invade cane and no effort should be spared to stamp it out.

Virus Diseases

There are two virus diseases which have come into importance during recent years and these are 'Mosaic' and 'Streak'. Of these, Mosaic has gained entry into almost all the cane growing countries of the world and has therefore obtained international importance. Streak is still but meagrely studied and is apparently less widely distributed than Mosaic.

Mosaic disease. As the name implies the disease is characterised by a peculiar mottling of the leaves. From a distance a badly infected field shows a dull green or yellowish tint instead of the healthy dark green colour. A close examination of infected plants shows that there exists on the leaf surface innumerable whitish or yellowish elongated blotches possessing wavy margins. The pale areas alternating with the normal green colour form a distinctive pattern the details of which vary with different varieties of cane. There are however two distinct types of markings known in South India. In the first which is the commoner type and in which the majority of varieties fall, the green colour forms a background for irregular white blotches. In the second type, e.g., Java-Hebbal and *Vellai* the normal dark green colour appears as a few irregular islands on a pale green background. As a rule the disease is most conspicuous on the leaves but in advanced cases of infection a mosaic pattern is formed on the internodes also. Such patterns are conspicuous on the dark-rinded varieties, and their colour contrast is intensified after the leaf sheath which encloses the internode falls off.

Distribution. The disease is recorded in almost every sugarcane growing countries of the world, viz., Java, Cuba, Hawaii, Argentine, Porto Rico, Trinidad, Jamaica, Lousiana, Natal, Queensland and India. Mauritius alone stands out as a singular exception among the world's important cane fields, thanks to the vigorous quarantine measures in vogue in that country. In India it is known to exist in all the provinces to a greater or lesser extent. As a result of a survey of the disease made in Madras, it has been recorded from portions of Godavari, South Arcot, Coimbatore, Trichinopoly and Malabar districts.

The effect of the disease. Mosaic may be rightly described as a wasting disease which does not kill the cane outright, but it causes material reduction in the tonnage of cane per acre. The loss due to the disease varies according to the intensity of the disease and according to varieties. Some varieties like Red Mauritius and Java-Hebbal do not show perceptibly marked ill effects while varieties like B 208 are distinctly stunted in growth. The loss from Mosaic has been estimated to be up to 40 per cent in Porto Rico and 50 per cent in Hawaii. Losses up to 70 per cent have been recorded in individual varieties. Chemical analysis of healthy and infected canes side by side failed to show any difference in the quality of juice and in jaggery making the quality of the finished product did not suffer. But in advanced cases of infection the stem gets shrunk, the rind cracks and the percentage of juice falls.

Control. Based on the knowledge of the disease attained so far, three methods of control can be recommended. These methods severally and in combination have proved to produce very salutary results.

(1) Planting of setts from Mosaic-free clumps.
(2) Systematic weeding of infected stools.
(3) Planting of resistant varieties.

The idea underlying the first recommendation is the prevention of primary infection, i.e., the elimination of diseased setts which in turn give rise to diseased seedlings. Sett selection is rendered easy in tracts like Kallakurichi where the cultivators reserve a portion of their fields for setts and all portions of the cane are utilized for planting. An attempt has been made in this direction during the current season in the villages of Mudianur and Pennadam (Kallakurichi taluk) where J 247 has been recently introduced by the department.

The 'roguing' of infected stools is meant to prevent secondary infection, i.e., the elimination of diseased material from which the insect vector carries infection to the healthy plants. The selection of resistant varieties involves a knowledge of the relative resistance of several varieties. All attempts made at Coimbatore to correlate morphological and histological characters with disease-resistance have failed. However, a reliable method of testing the relative resistance of sugarcane varieties has been developed in Coimbatore by means of which the relative resistance could be gauged with a desirable amount of precision and the results made available in the course of a year. The method consists in planting uniform rows of the varieties to be tested in a serial order interlined with Mosaic-infected rows of cane, thus providing equal opportunities for all the varieties to take secondary infection. Periodical counts are then taken of the number of infected stools and percentages struck of the progressive totals. Under Coimbatore conditions, it is found that secondary infection takes place during the first 5 months of the crop i.e., between the months of February and June. As such, the relative resistance

of cane varieties could be judged with fair accuracy within a period of 5 months.

The adjoining tables give the results of varietal trials conducted in Coimbatore during the last two years.

Varietal Trials 1929

Variety	Plot A.			Plot B.		
	No. of infected clumps.	Total No. of clumps.	Percentage of infection.	No. of infected clumps.	Total No. of clumps.	Percentage of infection.
Co 205 ...	0	30	0	0	29	0
Co 210 ...	31	35	91·5	34	34	100
Co 213 ...	24	25	96·0	30	30	100
Co 214 ...	0	35	0	0	30	0
Co 223 ...	27	29	93·1	29	31	93·5
Co 244 ...	0	28	0	0	36	0
Co 250 ...	23	25	92·0	36	37	97·3
Co 281 ...	24	32	75·0	27	35	77·1
Co 287 ...	33	38	86·8	29	35	82·9
Co 290 ...	19	36	52·8	19	33	57·6
Kassoer ...	0	35	0	0	36	0
Chunnee ...	27	28	96·5	30	31	96·8
P.O.J. 2714 ...	0	30	0	1	31	3·3
P.O.J. 2727 ...	2	26	7·7	3	28	10·7
Pattapatti ...	20	32	62·5	14	25	55·0
H 109 ...	15	26	57·5	...	...	...

Varietal trials, June 1930

No.	Name of variety	Percentage of infection	
		May	June
1	Co 205 ...	Nil	Nil
2	Co 213 ...	91	96
3	Co 214 ...	Nil	Nil
4	Co 244 ...	Nil	Nil
5	Co 290 ...	2·5	43·5
6	Co 299 ...	42	62
7	Co 312 ...	54	79
8	Co 313 ...	85	90·5
9	Co 314 ...	1·25	1·25
10	Co 315 ...	Nil	Nil
11	Co 316 ...	Nil	Nil
12	Co 317 ...	45	57·5
13	Co 318 ...	Nil	Nil
14	Co 330 ...	80	95
15	Co 334 ...	87	91·5
16	Co 335 ...	Nil	Nil
17	P.O.J. 2878 ...	Nil	Nil
18	Kassoer ...	Nil	Nil
19	P.O.J. 2714 ...	2	5

It is apparent from a cursory glance at these tables that some of the varieties which possess desirable qualities from the agriculturist's point of view are defective in disease resistance and the need for infusing mosaic-resistant blood into them is a problem which the breeder has to face.

It would be interesting in this connection to mention that stray cases of mosaic have very recently been observed on maize, ragi and elephant grass on the Central Farm. The external symptoms of the disease are very similar to cane mosaic. The fact that these host plants were in fields within close proximity to the mosaic experimental plot has given room for the suspicion that the disease has passed to these plants from cane. In the case of ragi and maize which are raised from seeds, it is found that the mosaic is not transmitted through seed. Experiments are now in progress to see whether elephant grass mosaic is transmitted vegetatively through slips.

Streak disease. Streak disease is in several respects very much allied to mosaic. Like mosaic primary infection takes place through infected setts and secondary infection has been reported to take place through the agency of an insect. The difference lies in the dissimilarity in the patterns which the two viruses form on the leaf. While mosaic forms blotches of irregular margins, streak forms patterns of straight lines whose margins are clearly defined. The disease is found in Pusa and a case of streak has recently been recorded on Co 213 in Coimbatore; but it appears to be of very rare occurrence in India.

PHYSIOLOGICAL DISEASES

The only disease of distinctly physiological origin that is of common occurrence in South India is Chlorosis. It is a common observation that it takes some years before sugarcane gets accustomed to the land in which the crop was not raised before, and in some localities the first few crops show a lack of chlorophyll development which results in a subnormal development of the cane. Sometimes the whole leaf is affected but at other times longitudinal bands of chlorotic areas parallel to the veins are observed. This phenomenon is more conspicuous in garden lands newly planted to cane and in varieties whose mother stock was for several generations planted under different soil conditions. For instance, canes brought from the wetland areas of Kuniamuthur and from Malabar when raised in Coimbatore garden lands gave a chlorotic crop. The exact cause of this disease is unknown, but the general consensus of opinion is that chlorosis is associated with iron starvation.

DISCUSSION

After the reading of the last paper the subject was thrown open for discussion in which a large number of the District Officers took part. Mr. C. S. Seshagiri Ayyar desired to be enlightened on the following points:

1. Methods of planting canes with reference to spacing of setts,

2. The quantity of phosphoric acid to be added for clarifying the juice during boiling,

3. The yielding power of the short duration cane hybrid variety, mentioned by Rao Bahadur T. S. Venkatraman.

Mr. K. Krishnamurti Rao then narrated his experiences in the Bellary tract, where boiling was done in very large pans and where the Scindwahe furnace could not be successfully demonstrated. He also said that experience at the Cane Breeding Station showed that sugarcane manured with *Kolinji* gave a better coloured jaggery than that manured with *Daincha*.

Mr. K. M. Venkatachalam Pillai in giving his experiences in Salem District pointed out the difficulties of growing cane in *Padugai* (lands adjoining rivers and liable to inundation) lands, which become submerged for two months in the year, due to floods in the Cauvery and wanted to know therefore, whether a nine to ten months variety could be obtained for that tract. Mr. K. Suryanarayana said, that application of Ammonium sulphate could not be done in the Anakapalle area as no rains were received after planting, and late applications delayed maturity. Mr. Bhairy Shiva Rao pointed out that the Scindewahe furnace was very successful in the Chittoor District; the chief difficulty there for the cane grower, was water scarcity during some periods of the growing season, irrigation being mainly from wells; this hastened arrowing and ripening of the canes. Mr. M. R. Balakrishnan incidentally pointed out that colour of jaggery was evidently not a very important factor in the Vellalore tract of the Coimbatore District, because, the weekly shandies ensured speedy disposal of the produce whatever be its quality. Mr. Venkatachalam Pillai however remarked that colour was certainly considered to be an important factor in the Mohanur tract of the Salem District. Rao Bahadur D. Ananda Rao speaking on this aspect, referred to certain varieties like Fiji B, being rejected by the ryots because they produced jaggery of unfavourable colour. In regard to phosphoric acid as a clarifying agent, he said that more information on this head was wanted,

He also stressed on the necessity for investigations to be made, to find out the most suitable time for, and the number of doses of application of, manures to cane. With reference to width of planting, he said that it was dependent upon facilities for irrigation, and remarked that the possibility of minimising irrigation by cultural operation or otherwise, was a problem worth investigating into. He concluded by referring to rapid propagation trials at Palur which showed that J 247 and canes with long internodes proved most suitable for this purpose.

Mr. T. V. Rajagopalachariar in his reply to the points raised in the discussion, remarked that in Java about 500 lbs of Ammonium-sulphate were applied to the lands every year without any adverse effect, showing that much depended upon the nature of the soil. According to him, trials with fish guano were worth continuing. With reference to the question whether nurseries, as in paddy, could be raised, his opinion was, that it could be adopted only for filling up blanks and even then it was not very successful. Regarding the statement that vitality in setts is improved by liberal doses of manure to the nursery, it seemed to him, to be more due to the high content of glucose in the setts from nurseries manured liberally. Liberal application of manure to the crop he said, would result in vigorous growth and would retard flowering. With reference to the colour of the jaggery—a point raised by some speakers—he said that as a factor of importance it varied largely with the tracts. He also referred in his reply to a point which he had mentioned earlier in his paper viz. the invention and adoption of suitable pans for boiling juice under low pressure, and said that if the Research Engineer could evolve a suitable device, it would become a factor of great economic importance in jaggery industry.

Rao Bahadur T. S. Venkataraman observed that on the face of it, it would be unfair to compare a short-duration hybrid with a normal crop, with reference to yield, but said that the hybrid could be included in the rotation in the place of other short-duration crops. He pointed out that canes flowered in Java also but were not condemned for that reason, if at the same time the varieties were good. The work started and conducted by his colleague Mr. Nandalal Dutt on this aspect of the problem, made him feel quite optimistic as regards the future of thick canes in this part of the country. His experience was that sheep-penning and application of nitrogenous and organic manures delayed flowering, while phosphatic manures proved otherwise. He stressed on the importance of proper planting material, and said that the attention paid to this, by the cane grower in Java was something remarkable. He said that good manuring decidedly improved the vitality of setts. With reference to filling up blanks, he remarked that the seedlings could be made to catch up if done properly, and even with tillers as was done in Louisiana. He concluded by saying that purity essentially depended on variety, and the Hospet tract could profitably try better varieties obtained from the Imperial Cane Breeding Station.

Rao Bahadur B. Viswanath rising next, explained that the figures he gave were an analysis of those for the last 25 years and not averages for those years. In regard to the number of doses of manure, he said that much data were not available but from what was available it would appear that 2 or 3 applications were better than a single one. Phosphatic manure, though it did not contribute to appreciable increase in yield as nitrogenous manure did, was essential for enriching the qualities of juice and jaggery. This however, required further investigation. He had no experience of the use of phosphoric

acid as a clarifying agent, and hoped to conduct tests at Anakapalle on this. He concluded by pointing out that setts obtained from better manured plots do have a better vitality.

To a question put by Mr. M. Gopala Chetti, Rao Sahib Y. Ramachandra Rao replied that J 247 was less susceptible to borer attack than other varieties.

For want of time the discussion had to be closed at this stage and the president in winding up the proceedings said that he was glad to see that the discussions centred round the cost of production, which was the one point that they had to tackle, if, as they all desired, the area under the crop and the yield per acre should increase. He said that what they had learnt that afternoon, was by no means exhaustive and made a forcible appeal that contributions on the subject might be made to the *Madras Agricultural Journal*.

THE TWENTIETH COLLEGE DAY AND CONFERENCE, JULY 1930

The twentieth College Day and Conference came off this year between the 15th and 18th July—both days inclusive. One feature of this year's functions was the absence of the mofussil Gazetted officers of the Department. That was, however, unavoidable as the Gazetted officers having been deputed once for the Gazetted Officers' Conference in February this year could not be deputed once again in July as usual. Every one at Coimbatore and those that came from the mofussil missed those familiar faces from the districts both on the sports grounds and in the Conference. But for this all the functions connected with the College Day and the Conference came off successfully and the various committees are to be congratulated on the successful termination of their labours. The Union offers its grateful thanks to one and all of the several ladies and gentlemen who had contributed in so many directions to the success of the week.

The Athletic Sports. The usual annual Athletic sports came off on Tuesday the 15th instant in fine weather. A light monsoon breeze which kept blowing the whole day contributed to the comfort of the competitors and the spectators, and to the gentle flutter of the multicoloured festive flags. The athletic events were conducted on strict Olympic lines. Mr. K. M. Thomas and his committee who were responsible for the conduct of the sports introduced a number of innovations of an excellent nature and worthy of being copied in future years.

The first bugle which synchronised with the stroke of three from the Research Institute Clock tower announced the commencement, and the competitors trooped in at regular intervals to compete for their respective events. The more serious events were appropriately punctuated by items like children's races, musical chairs on bicycles, sack melee, obstacles race, and peons' race which provided endless amusement to the spectators. All the items on the card were keenly contested and time and again hot favourites disappointed their supporters who were left guessing in their choice of the champion of the day. History once again repeated itself when towards the close, Ponnappa, the long-race specialist, emerged triumphant in the half-mile race annexing with it the championship honours with 30 marks to his credit.

The Union was at home to the guests and the Union is grateful to Mrs. Munro, Mrs. Charley and Mrs. Cherian who very kindly looked after the arrangements for the 'At Home.'

At the conclusion of the sports, President of the Union Mr. P. H. Rama Reddi thanked in a neat little speech, the visitors and the officials of the course who contributed to the success of the evening's function, and requested Mrs. Munro to give away the trophies and the prizes. After the distribution of the prizes a vote of thanks to Mrs. Munro and three hearty cheers lustily responded to, brought the function to a close,

Below is the list of prize winners :

Cross country race	...	Ponnappa, N. G.	I
		Abdul Samad, A.	II
		Varadarajan, S.	III
Hundred yards dash	...	Daniel, F. L.	I
		Lakshminarayanan, K. S. ...	II
		Sounderarajan, A. R.	III
Long Jump	...	Varadarajan, S.	I
		Muhammad Obeidullah Shah ...	II
		Patnaik, U.	III
Shot put ...	...	Vaidyanathan, N. S.	I
		Muhammad Obeidullah Shah ...	II
		Balasubramanyan, T. S. ...	III
High Jump ...	...	Varadarajan, S.	I
		Kallapiran, K. G.	II
		Krishnan, L.	III
Quarter Mile ...	...	Abdul Samad, A.	I
		Krishnamurti, K. S.	II
		Soundararajan, A. R.	III
Half Mile ...	...	Ponnappa, N. G.	I
		Tejappa Shetti, K.	II
		Muhammad Obeidullah Shah ...	III
120 Yards Hurdles	...	Mudanna Shetti, H.	I
		Vedantam, K.	II
		Parthasarathi, P.	III
One Mile ...	...	Ponnappa, N. G.	I
		Soundararajan, A. R.	II
		Kallapiran, K. G.	III
Cricket ball throw	...	Patnaik, U.	I
		Tejappa Shetti, K.	II
Sack melee ...	...	Krishnamurti, T.	I
		Krishna Menon, K. M. ...	II
Musical chairs (On bicycles)	...	Krishnamurti, T.	I
		Saptharishi, K.	II
Obstacles race ...	...	Varadarajan, S.	I
		Krishnamurti, T.	II
		Krishnan, L.	III
Old Boys' race ...	...	Hanumantha Rao, K.	I
		Sankara Ayyar, C. B.	II
		Gopalan, M. K.	III
Invitation race ½ mile	..	Aldridge, J. (Stanes High School)...	I
		Singh, R. R. (Forest College) ...	II
		Narayanan (Central Recruit School).	III
Relay race ...	...	Rao Sahib Y. Ramachandra Rao's Wards.	
Tug of War ...	...	Rao Bahadur B. Viswanath's Wards.	

The Exhibition. On the 16th and 17th, the different sections of the Research Institute and the Government of India Sugarcane Station, put up an interesting exhibition showing the nature of the problems under investigation, the results obtained so far and the lines on which future work is proposed to

be carried. The exhibition was instructive both to the scientific and to the laymen. The members of the different sections were there to explain to the visitors and to give more detailed information to those that wanted it, and which, the exhibits did not by themselves furnish. It must be said that both the district officers and the workers at Coimbatore were benefited by the exhibition. The district officers were made aware of the trend of the latest thought and work on the different problems and the members of the Sections at Coimbatore, could, as the result of discussion with the district officers, form an idea how far their investigations would be of practical value and the directions in which modifications of their lines of investigation would be necessary.

Ploughing demonstrations were also held in Field No. 37, F. No. 50 and the Farm wetlands.

Entertainment. On the night of the 16th, the students staged 'Krishna Tula Bharah' a puranic drama, in Telugu, and 'Golden Fetters'—a Social drama by Sambandam in Tamil. A unique feature of this year was that all the actors were students, and every one of them acquitted himself most creditably.

The General Body meeting. The General Body meeting of the Union was held at 1 o'clock on Thursday the 17th July, presided over by the President, Ex-officio, Mr. P. H. Rama Reddi. The attendance was good. In fact it was the largest we had in recent years. It was very pleasing to note that practically all the members that attended, stayed on till the close of the meeting at eight o'clock in the night.

After the budget and the accounts had been passed, (the budget and the accounts are printed elsewhere in this issue Appendix I), it was resolved that arrears to the extent of Rs 600 on account of Building Fund donations, and the accumulated arrears on account of subscriptions and other dues up to December 1929 be written off the books unconditionally. The subject of Ramasastrulu-Munagala prize was next taken up. The competition for this prize was not as keen as it should be, and the one or two papers that came were not often really up to the mark. The Working Committee thought, that the demand for an account of original research or enquiry on any agricultural subject, was perhaps too much, and suggested, that the conditions of award might be so altered, as not to insist on original research or enquiry. The general body rejected the consideration of the proposal, on the ground that they were only trustees for the administration of the fund, and as such, they had no power to interfere with the conditions of award originally prescribed by the donors, and resolved, that the matter be referred to the original donors or their survivors. The position taken up by the general body was perfectly right. Even if it had the power to change the conditions of award, we do not agree to the lowering of the standard. The award of the prize being restricted to the members of the Union, the small number of competitors and the low standard of the theses, submitted may be due mainly, if not entirely, to the fact that a major portion of the members of the Department are not members of the Union.

The subject of change of rules was next taken up for consideration. The rules as amended are printed elsewhere in this issue of the Journal (Appendix II). The most important features of the changes in the rules are, that the name 'Working Committee' is changed into 'Managing Committee' and the functions of the council and the Managing Committee, and the relationship between the two bodies are more clearly defined. The Managing Committee will be the sole executive of the Union working under the direction of the

Council. Under the new constitution, the Council manages the affairs of the Union with the Managing Committee as its executive, so that, the Managing Committee is not directly and legally responsible to the general body but only indirectly and morally. The Council is not, ordinarily, to interfere with the administration of the affairs of the Union by the Managing Committee, except on a specific reference made to it, by the Managing Committee on a resolution at its meeting, or at the specific requisition signed by a third or more of the members of the Managing Committee. Another important feature of the change in the rules is the separation of the Students' and Officers' constituencies.

There was considerable discussion on the proposals for changing the name of the Union. As would be expected there were two camps, the 'No-changers' and the 'Pro-changers.' The 'No-changers' appealed to sentiment and tradition. The 'Pro-changers' argued that change and fight are evidences of life. In the end the 'No-changers' won the day. A subject of this kind can be argued both ways. What is there in a name? A diamond is still a diamond whether you call it carbon which it really is, or a diamond which it also is; but then, if a diamond is labelled carbon would anybody care to look at it, while there will be plenty to grab at a mere carbon—till they are disillusioned—if it is labelled diamond. Apart from the merits and demerits of these considerations and arguments, the discussion brought home to the members that a good deal more of useful work can and should be done for and in the name of the Union.

The election of office-bearers for the year 1930-31 as laid down by the new constitution was next proceeded with. Rao Bahadur T. S. Venkatraman was elected resident Vice-President and Mr. K. M. Thomas was elected Secretary. Rao Bahadur B. Viswanath was re-elected Editor. The following is the full list of office-bearers elected.

Council (15)

1. P. H. Rama Reddi (*President*).
2. Rao Bahadur T. S. Venkatraman (*Resident Vice-President*).
3. Rao Bahadur D. Ananda Rao (*Mofussil Vice-President*)
4. K. T. Alwa. (*Mofussil Vice-President*).
5. C. Ramaswami (*Mofussil Vice-President*).
6. K. M. Thomas (*Secretary*).
7. Rao Bahadur B. Viswanath (*Editor*).
8. G. N. Rangaswami Ayyangar.
9. V. Muttuswami Ayyar.
10. M. C. Cherian.
11. Rao Bahadur J. Chelvaranga Raju.
12. Jogi Raju.
13. U. Vittal Rao.
14. K. T. Bhandari.
15. (*Student*)

Managing Committee (9)

1. *President.*
2. *Resident Vice-President.*
3. *Secretary.*
4. *Editor.*
5. S. V. Duraiswami Ayyar (*Manager*).

6. M. Rajagopala Ayyar (*Treasurer*).
7. K. Krishnamurti Rao.
8. M. A. Sankara Ayyar.
9. (*Student*).

Editorial Board (7)

1. *Editor*. Rao Bahadur B. Viswa Nath.
2. *Secretary*. K. M. Thomas.
3. *Manager*. S. V. Duraiswami.
4. Rao Sahib Y. Ramachandra Rao.
5. M. R. Balakrishnan.
6. C. S. Krishnaswami.
7. *Student member*.

The Conference. At 12 noon on Friday the 18th July, the Conference assembled in the spacious hall on the ground-floor of the Research Institute with Mr. G. R. Hilson, B. Sc., the Director of Agriculture as the President. Many messages of good wishes were received; prominent among which were from the Rajah of Parlakimidi, Hon'ble Mr. A. Y. G. Campbell, Hon'ble Dr. P. Subbarayan, Hon'ble Mr. S. Mutthia Mudaliar, Mr. C. Tadulinga Mudaliar and Rao Bahadur M. R. Ramaswami Sivan.

After the President declared the Conference open, the President of the Union, Mr. P. H. Rama Reddi, read his welcome address. He, in extending a hearty welcome to the visitors, referred touchingly to the absence of Mr. Anstead and Mr. Tadulinga Mudaliar. He congratulated Mr. Hilson on his appointment as the Director of Agriculture and assured him of the hearty and loyal co-operation of all in all his undertakings. Mr. Reddi regretted that none of the senior mofussil members were to be seen at the Conference with the solitary exception of Rao Bahadur D. Ananda Rao, and hoped that the coming year would see the restoration of the practice of deputing the Gazetted officers, for the occasion.

The Secretary Mr. M. C. Cherian, then read the annual report for the year ending 30th June 1930, which is published elsewhere in this issue. Mr. Hilson then delivered his Presidential address (printed elsewhere in this issue) the theme being 'The duties of the Agricultural Demonstrator', in the course of which he showed, how the position of the Agricultural Demonstrator is at once honourable, responsible, and difficult, how the ryot is a man of many-sided activities, and emphasised, that if the agricultural demonstrator is to get at the ryot, win his confidence, and do what the department wishes him to do, he must be equally as many-sided as the ryot, and be capable of helping the ryot in many ways.

Prizes were then awarded to the following successful candidates in the B. Sc. (Ag.) Degree examination held in April last:—

1. *The Robertson Prize Medal*. Awarded to Mr. T. Nataraj for obtaining the highest number of marks in Agriculture in Part II of B. Sc. (Ag.) Degree Examination held in April last.
2. *The Clogstoun Prize Medal*. Awarded to Mr. T. Nataraj for 'General Proficiency.'
3. *The Keess Prize Medal*. Awarded to Mr. C. R. Seshadri for obtaining the highest number of marks in Agricultural Chemistry of Part II of the last B. Sc. (Ag.) Degree Examination.

4. *The R. Raghunatha Rao Prize*. Awarded to Mr. D. Achyutarama Raju for obtaining the highest aggregate number of marks in Practical Agriculture of the College Terminal Examinations and of the last B. Sc. (Ag.) Degree Examination.
5. *The D'Silva Memorial Prize*. Awarded to Mr. K. R. Ramaswami for obtaining the highest number of marks in Animal Hygiene of Part I of the last B. Sc. (Ag.) Degree Examination.
6. *The Goschen Medal*. Awarded to Mr. D. V. Krishna Rao for obtaining the highest number of marks in Entomology in Part I of the last B. Sc. (Ag.) Degree Examination.
7. *The Anstead Medal*. Awarded to Mr. G. Krishnamurti being the best student in 'Plot cultivation.'
8. *The Venkataramier Medal*. Awarded to Mr. K. Bhushanam being the best student of the first year class.
9. *The Certificate Course Cup*. Awarded to Mr. H. Anantarama Rao for obtaining the highest number of marks in Agriculture in Part I of the B. Sc. (Ag.) Degree Examination.

We congratulate most heartily the recipients of the prizes.

The following five papers were then read:—

1. 'Sugarcane', by T. V. Rajagopalacharya.
2. 'Sugarcane Breeding—its chief characteristics' by Rao Bahadur T. S. Venkataraman.
3. 'The manuring of Sugarcane' by Rao Bahadur B. Viswanath.
4. 'Sugarcane insects in S. India' by Rao Sahib Y. Ramachandra Rao.
5. 'Sugarcane Diseases' by S. Sundararaman.

The reading of the papers was followed by a discussion. The papers and the discussion are printed separately in this issue. Mr. Hilson in his concluding remarks stated that the discussion was by no means exhaustive and asked the members to write on the subject in the journal, and thus make the journal more useful not only to the members of the Union but also to the cultivator and to the revenue officials who have got to read them. He stated that 75 per cent of these were educated. He asked the members to imagine what should be the number of subscribers who ought to read the journal and derive benefit from it.

The Resident Vice-President Mr. K. Krishnamurti Rao proposed a hearty vote of thanks to the President and expressed the gratefulness of the Union for the interest he had been evincing in its affairs. He also thanked all those that had assembled there that afternoon, and those that contributed papers.

The Conference then came to a close.

At 5 p. m. the members and the visitors witnessed a demonstration of groundnut harvest by H. M. Guntaka and R. E. Guntaka arranged by Mr. Charley, the Research Engineer. With this as the last function, the College Day and Conference week came to a close.

THE DUTIES OF THE AGRICULTURAL DEMONSTRATOR

By G. R. HILSON, B. Sc.

(*Director of Agriculture, Madras*)

(*Presidential address to the Madras Agricultural Students' Union at the 20th Annual Conference at Coimbatore, July 18th 1930.*)

Let me first of all thank you for your very kind congratulations on my promotion to the position I now hold and let me also assure you that I rely upon you for your hearty co-operation in helping me to run the department as it should be run. I shall take this opportunity to say a few words on the subject which, I think, should be of sufficient interest to you all and that is 'the duties of the agricultural demonstrator.'

The agricultural demonstrator is in a position which is at once honourable, responsible and difficult. It is honourable because he is, as it were, in the forefront of the battle which we are waging to improve the conditions of agriculture in this presidency. The rest of the department acts as a sort of reserve, the base of operations, they render assistance to send reinforcements and they supply the demonstrator with ammunition. The demonstrator himself is in the exposed position in the front where if there are any going, he is most likely to be hit. His position is responsible because we rely upon him to interpret to the cultivator results which we obtain in our research work. His position is difficult because he goes about as an apostle of change. The human animal wherever you find him, is very much a creature of habits. And the man who comes along with the proposal to break this habit has a certain amount of initial difficulty to overcome. That is the first handicap which the demonstrator has in carrying out his work. The practical cultivator does not realise that the results which the demonstrator places before him are, as it were, the opposite of experience. What we are doing is what he has been doing. We are doing it in a more sound manner. It is as I said born of experience. The cultivator does not realise this and he has an initial dislike of changing his habits. These two things together form a very formidable handicap to the agricultural demonstrator in his work. As I have said, the agricultural demonstrator has this very definite handicap to fight against. The first thing he must then do is to obtain the consent of the cultivator. And it is this particular point which I wish to emphasise, which I wish you to take away and think over at leisure. The cultivator, generally speaking, is a man of many-sided business. He is not just doing one thing. He keeps cattle. He has to feed them. He has to house them. He has to look after their health. Now, that being the position of the cultivator, the man that can look after his cattle, his manuring, his land and his crops possesses the greatest opportunity for getting into touch with him and gaining his confidence. Therefore the man who knows best about these, when the cultivator comes to him and tells him that his crop has had a disease, the man who can inform him what to do and give him 'first-aid' is much more likely to gain his confidence and to get the reputation of being of some use than the demonstrator.

I have raised this subject chiefly as a result of what I have heard in going about the presidency. The impression that I have gained is that the agricultural demonstrator is of the opinion that cattle-breeding and the care of cattle are not the things that he is called upon to interest himself in very much. These impressions I should like to see fade away as quickly as possible. The cultivator has to depend on his cattle for the proper cultivation of his land and if his cattle are not good the cultivation of his land cannot be good and therefore it is a matter of primary importance that the agricultural demonstrator should be able to qualify in looking after the cattle and getting the best possible results. That is the point I want you to think over. The fact that the cultivator is a man of many-sided business has got to be learnt in the light of different things and therefore the agricultural demonstrator if he is to get at the cultivator should win his confidence and do what we wish him to do viz., to be equally as many-sided and be capable of helping the cultivator in respect of his work.

Annual Report of the Madras Agricultural Students' Union for the year 1929–30

The Working Committee of the Madras Agricultural Students' Union beg to submit their report for the year ending 30th June 1930.

The last College Day and Conference were held from the 9th to the 13th July. Dr. Fowler, Principal, Harcourt Butler Technological Institute, Cawnpore, presided over the conference. After the Principal's welcome speech and the reading of the Annual Report by the Secretary, Dr. Fowler delivered his Presidential Address on *Wealth from Waste* in which he emphasised the immense gain which would accrue to India by the utilisation of the waste materials 'of the farm and country as well as those of cities and towns.' When the address was over, the President presented the prizes to successful students in the B. Sc. Ag. Degree examinations. The portrait of Mr. Anstead, presented by the council of the Union was then unveiled by Mr. E. F. Thomas, Collector of Coimbatore, and accepted by the Principal on behalf of the College. Two papers, one on *The role of the Teacher in Rural Reconstruction* by Mr. S. V. Duraiswami Iyer and the other on *A plea for the inclusion of Agriculture in the school Curriculum* by Mr. R. Swami Rao, were then read and discussed after which the first session came to a close. The second session was devoted to a symposium on cotton. The following four papers were read and discussed:

1. 'Cotton Research Work and its relation to the work of the Agricultural Department' by Mr. G. R. Hilson.
2. 'The Manuring of Cotton' by Rao Bahadur B. Viswanath.
3. 'Our present position as to Cotton Pest Control in South India' by Rao Sahib Y. Ramachandra Rao.
4. 'The Diseases of Cotton in the Madras Presidency' by Mr. S. Sundararaman.

As Dr. Fowler had to leave for Cawnpore the same evening, the Director and the Principal expressed their thankfulness to him for kindly presiding at the Conference.

The third session was presided over by Mr. Anstead. Four papers namely:

1. 'The influence of weather on parasite breeding' by Mr. K. P. Ananthanarayanan,
2. 'Village reconstruction in the Ceded Districts' by Mr. Ambikacharan,
3. 'Gulla or looseness in soil' by Mr. Jogi Raju, and

4. 'The place of co-operation in Agriculture' by Mr. N. Subramania Iyer were discussed. A portrait of Mr. Sampson presented by the Sampson Memorial Committee was then unveiled by Mr. Anstead. Before declaring the Conference closed Mr. Anstead thanked the Union for allowing him to preside over the last session of the Conference and then, in view of his impending departure on leave preparatory to retirement, took leave of the officers of the department formally.

The sports were held on the 7th July under ideal weather conditions. The various events were keenly contested for. Till the last moment it was not possible to spot out the champion. The contest for the championship cup was a neck to neck race and at last it was won by Mohamad Ali by obtaining 40 marks, Hanumantha Rao coming next with 39 marks. Mrs. Anstead kindly gave away the prizes to the winners.

As usual, visits were arranged to the breeding stations and laboratories.

Journal. Next to the celebration of THE COLLEGE DAY AND CONFERENCE the most important activity of the Union is the conducting of a Journal. The Editorial Board and the Working Committee spent most of their time in trying to bring the Journal up-to-date and they feel that their efforts in that direction have not been in vain. The change of the press to Madras, though it entailed some more expenditure, has been a welcome change indeed and the punctuality of the Journal is to a good extent due to the hearty co-operation of our printers, the Christian Literature Society Press. Though the number of subscribers to the Journal during the year under review increased from 312 to 520, the Committee are pained to see that out of the total of about 446 officers in the Department only 256 are subscribers to the Journal. They are however, grateful to the Director of Agriculture for the keen interest he is taking in the Journal and they hope that with his help and the co-operation of the brother officers of the department, the number of subscribers will be increased to four digits when it will be possible for the Committee to bring out the Journal without entailing any loss to the Union funds.

Lectures. Under the auspices of the Union, Sir T. Vijiaraghavachari, Vice-Chairman of the Imperial Council of Agricultural Research and one of the honorary members of the Union delivered a public lecture in the College Hall on 'the origin, constitution, objects, and working of the Research Council'. The Committee hope that lectures like this, will form a regular feature of the activities of the Union in coming years.

Finance. The financial position of the Union during the year under review, as disclosed at the general body meeting, is not quite satisfactory. In this connection the Committee wish to point out that the financial stability of the Union depends to a great extent on the success or failure on the Journal. Efforts should therefore be made to increase the number of subscribers and to make the Journal self-supporting.

Ramasastrulu Munagala Prize. Two papers were submitted this year for the Ramasastrulu Munagala Prize. They were judged by a committee of three, Messrs. Rao Bahadur D. Ananda Rao Garu, A. K. Yegnanarayana Iyer and L. Raman Menon. The prize this year goes to Mr. C. Narasimha Acharya for his paper on 'The Biochemistry of the Cholam plant in relation to its importance as an agricultural crop'.

In conclusion the committee wish to express their warm thanks to Dr. Fowler, the President of last year, Mr. and Mrs. Anstead, Mr. Tadulingam, Mr. P H. Rama Reddy, our present President, to Mrs. Karunakar and other conveners and members of Committees and to all other ladies and gentlemen who helped in various capacities to make *The College Day and Conference* a success.

A CORRECTION

Grant of Rs 10,000 to Mr. K. Sankaram Pillai by the Imperial Council of Agricultural Research: In the June issue of our Journal, we published that Mr. Sankaram Pillai of Guntur had been given a grant of Rs 10,000 by the Imperial Council of Agricultural Research for conducting experiments on the 'Flue curing of Tobacco'. We now understand that it was not the Imperial Council of Agricultural Research that made the grant but the local Government under the 'State Aid to Industries' Act. We are very sorry for the Error.—[Ed. M. A. J.]

GLEANINGS

Eradication of Hariyali (Cynodon dactylon) grass by tractor ploughing

In an article published in the *Journal of the Mysore Agricultural and Experimental Union*, Vol. XI No. 1, Mr. S. H. Bannur of the Babbur Farm, gives details of trials made with the McCormick Deering tractor and Brush Braker plough, to eradicate Hariyali grass badly infesting a field of black cotton soil on the farm. The work of this tractor plough, the effect, and the cost, were compared with those turned out by a Ransomes fallows plough and by manual labour, the former in the same field, the latter some distance away. The tractor was of 75–30 B. H. P. and opened a furrow 1 foot deep and 1.2″ wide, finishing 4.1 acres in a day, though the soil was moist below six inches from the surface. The fallow plough was worked by three pairs, and turned a furrow 8″ by 10″ doing 3½ acres a day. By manual labour the land was dug to a depth of 10″. The cost per acre in these cases worked out to Rs. 10–4–8, Rs. 8–2–6 and Rs. 30–0 respectively the pay of the driver and depreciation charges being omitted, in the first case.

The trials were held about the end of March and the beginning of April 1929, and the effect of these trials was observed in May when a crop of cotton was on the field and during which there was a rainfall of over 5 inches. The tractor-ploughed field and that which was hand-dug were completely without hariyali, while the bullock ploughed area had about 10–15 per cent of hariyali still growing. In the first and the last, however, the crop was equally good and promising, while in the hand-dug field the crop was less promising. The author remarks that this might be due to other causes as the plot was far away from the other two which were adjacent.

Food for dogs

In the *Science* for June 6, 1930 there is a note on food for dogs based on the investigations of Dr. William Lentz, Director of the small Animal Hospital at the University of Pennsylvania. Dr. Lentz asks you not to feed your dogs on choice cuts of meat but on the internal organs—the parts generally thrown away. According to his investigations of dogs which reached the age of 20 years or more, the great majority had access to the waste material cast out by butchers which consisted of the softer internal organs and not the firm muscular portions of the meat.

Plant Patents Bill

According to *Science* of June 6, 1930 both the houses of the United States Congress have passed a bill by which Plant Breeders can protect their new hybrids as if they were mechanical or chemical inventions and President Hoover has signed it making it into law. The Act contemplates protection only to plants that are propagated by cuttings, grafts and similar asexual methods and not to new varieties propagated by seeds. Plants propagated asexually by tubers such as potatoes are also excluded from the purview of the Act.

Peasant Citizenship in Denmark

In an article under this heading appearing in *Triveni* (March–April 1930) Mrs. Kamaladevi Chatopadyaya surveys the growth and nurture of citizenship among Danish peasants from the middle ages to the present day. Passing through the viscissitudes of the Napoleanic and other European wars and the hardships that followed in their wake, Denmark has yet been able to hold its head high on account of the great attention paid by leaders to Agricultural exploitation and rural reconstruction. Co-operation in matters agricultural, adult education on sound lines for farmers and cultivators, reclamation of waste lands, and the inculcation into Danish peasantry of a desire for full civic rights and a free cultural life, have been the chief features of the growth of citizenship in Denmark. As the author rightly points out at the conclusion of the article, the village is the dominating problem in India and the features of the Danish movement are of vital significance and benefit to us.

The Pan-American Agricultural Conference

We learn from *Science* of the 13th June 1930 that in accordance with a resolution of the Sixth International Conference of American States at Havana in February 1988, the first Pan-American Agricultural Conference will be held at Washington from September 8 to 20, and will be devoted to practical problems of agriculture, giving special attention to agricultural problems of an economic and scientific nature.

Immunisation of new born calves

According to *Science*, of 13th June 1930, the control of bovine tuberculosis by immediate isolation of new born calves from infected mothers appears possible from a recent report of the work done by Drs. Theobald Smith and Ralph R. Little of the Rockfeller Institute's Department of Animal Pathology at Princeton, N. J. Calves born from tuberculosis cows are at birth usually free from the disease. A large percentage of them soon acquires it, however, from contact with infected mothers. Attempts to prevent the spread of tuberculosis to the second generation in an infected herd by immediately separating the new born calves from the diseased mothers have not been successful heretofore. In spite of the most careful hygenic care, practically all the calves thus isolated developed gastro-intestinal disease, joint disease, or blood poisoning. Four-fiiths of them died within the first few days. Bacteriological examination of these calves has shown that it is usually not due to the common contagious diseases, but to the invasion of the living tissues with the ordinary colon bacillus, dung bacillus or other presumably harmless environmental micro-organisms. Evidently the calf at birth is unprepared to resist invasion by ordinary harmless bacteria, micro-organisms causing practically no disturbance in adult cows. It has been found that calves isolated will remain free from such infections if they are allowed one natural feeding before separation from a diseased mother. In the first feeding they do not obtain the usual milk, but a specially secreted pre-milk, or colostrum which immunises a new born calf against the usual non-pathogenic environmental bacteria.

The rice blast fungus

Conidia of *P. oryzae* on diseased straw and seed, when kept [illegible] at room temperature may live more than 1 year, while the mycelium, kept under the

same condition may remain viable much longer. Both conidia and mycelium die much sooner under moist conditions. The mycelium which has overwintered produces conidia on the surface of the substratum when moist, and most luxuriously at 18—30° C. Either such conidia or the mycelium within the tissue of diseased spots are the principal means for over-wintering of the fungus.—*Ann. Phytopathol. Soc. Japan* 2 : 99–117, 1928.

[Experiments to test the longevity of the rice Blast fungus in South India showed that the spores retain their vitality for seven months in the straw under field conditions in hay stacks. *S.S.*]

The Vitality of Buried Seeds

Two long term seed tests have been started in the United States, and are still in progress. The first was started by Dr. W. J. Beal at the Michigan Agricultural College. In this test, one half of the kinds germinated after forty years. The other was begun by the Seed Laboratory, Bureau of Plant Industry, U. S. Department of Agriculture, in 1902 at Arlington Farm, Virginia. At the end of twenty years, fifty-one of the 107 kinds planted were viable. Other sets of seeds in both tests remain buried and will be taken up and germinated at intervals. These two tests have been particularly suggestive with respect to revegetation and crop rotation in relation to weed control.

It now seems desirable to put down a more comprehensive long-time series of tests to determine the effect of typical soil and climatic conditions on the length of time seeds will remain alive when embedded in the soil. Such a test is now being planned by the Seed Laboratory, Bureau of Plant Industry, U. S. Department of Agriculture. The success of the project will require the co-operation of many interested organisations and individuals. Suggestions as to characteristic areas with reference to both soil and climate will be welcomed as well as suggestions as to the kinds of seeds of particular interest in these typical localities. It is expected that the seeds used will be of the crop of 1931, and that they will be placed in the ground during the fall of that year. *Science, New Series*, May 30, 1930.

QUERIES AND ANSWERS

Q.—APN. (The Thottam, Salem) writes to us asking for information on the nutritive value of Cambu as fodder and the form in which it can best be used for milch cows. He also wants to know the effect of ashes on plants, the necessity and advisability of using ashes as a manure for paddy and if used the dose per acre. We publish below available information in answer to his queries.

A.—1. Where cholam straw is available, Cambu cannot be considered to be a good cattle fodder as, analytical figures and experience show that Cambu straw is inferior in quality to cholam straw. Where it has to be used it is preferable in the green state for milch cows, but as it is difficult to get green straw all the year round the best thing will be to convert the green straw into hay during seasons of heavy production and storing against a dry period. Hay is better than dry straw and is eaten with more relish by the cattle.

2. Ashes do have a tendency to scorch plants on account of their caustic properties. As insecticides they can be used in very small quantities for vegetable plants, but too much may cause harm. Ashes do not appear to be necessary as manure for the paddy crop, unless the land is extremely poor in potash—a rather rare occurrence in South Indian soils. If however a necessity is indicated, a dose up to 100 lbs. per acre may be applied. [*Editor M.A.J.*]

College News and Notes

The occasion of the Annual College Day and Conference was availed of for playing matches in Foot-ball, Hockey and Cricket in which the visitors, students, past and present and others participated. The Students of the College also played during the month friendly games at foot-ball with the London Mission High School and the Government College, Coimbatore winning the former by a goal to nil while the latter ended in a draw after an even struggle for honours. It is gratifying to note that the newly recruited first year students supplied good strength to the College team and with a little readjustment, more team-work and practice our College team will be a tough opposition to any other in the Abraham Memorial Tournament which is coming on apace. On the 27th of July the College team played a match at cricket with the Government College. Entering first we were all dismissed for 132 runs. The Visitors managed to pile up the necessary runs for a win with the last over of the day for the loss of only five wickets. Missed catches and indifferent fielding contributed greatly to the visitors' success and if this department of the game were paid more attention to in the selection of the team the College will certainly be able to give a better account of themselves.

On the 27th of July Mr. R. O. Iliffe, Paddy Specialist left the station on 4 months' leave after handing over charge to Mr. K. Ramiah, Assistant Paddy Specialist.

Annual Meeting of the Association of the Upper Subordinate Officers

The second Annual General Body meeting and At Home of the Association were held on the 16th July in the Freeman Building when a large number of the Upper Subordinates were present. The meeting commenced at 4 P.M. with Mr. S. N. Chandrasekhara Ayyar in the chair. The following resolutions were unanimously passed.

1. This Association requests the Director of Agriculture to become the Patron of the Association.

2. This Association requests the Director of Agriculture to make arrangements at an early date, for defining the jurisdiction of each subordinate officer working in the districts, so that whenever such an officer is put in additional charge of another sub-circle, he may be eligible for the usual compensatory allowance permissible under Fundamental Rules.

3. This Association while expressing gratefulness to Government for sanctioning a few additional posts in the higher grades of the Upper Subordinate cadre, begs to state that such sanction has not in the least improved the situation by way of relieving the congestion in the lower grades.

4. This Association views with a keen sense of disappointment the decision of the Government as contained in their reply No. 1372—III 30-1 dated 3rd May 1930, not to take up for consideration the suggestions put forward by the Association in the Memorandum submitted to Government in October 1929. This Association would respectfully urge however, that the Government may be pleased to sanction in the ensuing year as many posts in the higher grades as would be necessary to conform to the percentages shown below.

I grade—12% of the total. II grade—16 % of the total.
III grade—23% of the total. IV grade—24 % of the total.
V grade—25 % of the total.

The meeting then adjourned for Tea after which the following office-bearers were elected for the year 1930-31.

President—Mr. S. N. Chandrasekhara Ayyar; *Secretary*—Mr. S. V. Duraiswami; *Members of the Committee*—Messrs. T. Rajagopala Aiyangar, V. T. Subbia Mudaliar, and K. K. Raghavan.

The Director of Agriculture has been pleased to become the Patron of the Association. It is earnestly hoped that all new members will kindly remit at an early date Rs 1-8 (subscription and entrance fee) and old members rupee one only, to the Secretary and enrol themselves as members for the year 1930-31. (July to June).

Weather Review

JULY 1930

Rainfall Data

Division	Station	Actual	Departure from normal	Total from 1st January
Circars	Gopalpore	6·0	—1·6	21·5
	Vizagapatam	5·2	+0·8	18·7
	Cocanada	2·3	—3·7	15·3
	Masulipatam	3·9	—2·3	18·5
Ceded Dists.	Kurnool	4·9	+0·1	10·0
	Bellary	1·8	+0·1	8·6
	Anantapur	3·0	+0·8	8·6
	Cuddapah	3·9	...	16·0
Carnatic	Nellore	1·9	—1·7	15·4
	Madras	1·1	—2·7	16·0
	Cuddalore	1·5	—1·6	29·7
Central	Vellore	1·0	—3·3	17·0
	Salem	3·4	—0·3	17·6
	Coimbatore Town	0·3	* —1·1	10·1
	Coimbatore Research Institute	0·4	—2·0	10·2
	Trichinopoly	0·1	—1·4	15·9
South	Negapatam	0·1	—1·8	26·7
	Madura	0·7	—1·2	14·7
	Pamban	...	—0·5	16·5
	Palamcottah	...	—0·3	7·1
West Coast	Trivandrum	2·4	—5·0	36·7
	Cochin	11·7	—10·7	59·9
	Calicut	16·9	—12·9	65·8
	Mangalore	33·8	—4·2	89·1
Mysore and Coorg Hills	Bangalore	5·7	+1·6	18·0
	Mercara *	...	...	...
	Kodaikanal	1·4	—2·9	20·7
	Coonoor *	...	...	...

General Summary of Weather conditions

The weather was dominated at the beginning of the month by a deep depression at the head of the Bay, which induced an indraught of the monsoon over South India, and occasioned some moderately heavy rain in the North of the Presidency. This depression passed inland on the 2nd. Three other depressions formed at the head of the Bay but their effect on the weather in the reporting area was negligible. The monsoon was weak almost throughout

* Records not available.

the month on the west coast, except during the first and third weeks when some heavy rain fell on the South Kanara Coast. Pressure was markedly above the average almost throughout the month over the greater part of the Presidency, though the distribution was normal.

Rainfall was generally below the average, the defect being most marked in the area covering the west coast and south, this area having had the heaviest rain during the month of May in connection with the storm which passed over the south of India. Rainfall was normal or in slight excess in the Deccan, in slight defect in the Circars, and in moderate to large defect elsewhere. The most notable falls of rain were: Mangalore 5·6 inches (20th) and 4·00 Inches (25th).

Temperature was generally above the average throughout the reporting area, owing to the absence of rain and a weak monsoon.

Weather Report for the Research Institute Observatory

Absolute Maximum in Shade	92° · 0
Do Minimum in Shade	67° · 0
Mean Maximum in Shade	89° · 0
Do Minimum in Shade	71° · 9
Total Rainfall in month	0 ·44 inches
Average rainfall for July	2 ·42 ,,
Departure from Normal	—1 ·98 ,,
Heaviest fall in 24 hours	0 ·24 ,,
Number of rainy days	1
Mean daily wind velocity	8 · 7 M. P. H.
Mean 8·00 Hours wind velocity	7 · 2 ,,
Mean Humidity	68 · 2 %
Total Hours of Bright Sunshine	226 · 0 Hours
Mean daily hours of Bright Sunshine	7 · 3 ,,

Summary of weather conditions

Pressure was low at the beginning of the month and rising slowly reached the highest point on the 17th during which time weather was fine and the monsoon weak. The barometer fell again at the end of the month with a revival of the monsoon on the west coast.

Rainfall was scanty and totalled 0·44 inch., there have been practically no rain during the first 25 days of the month. Rainfall was not of the usual type accompanied by South West winds, as is usual during the monsoon, it was due more to local formations of clouds and was accompanied by a Northerly movement of the upper air currents. Cumulus in the region over the hills to the west was frequent, though neither lightning nor thunder were recorded.

Temperature ruled fairly high during the first of the month, and the diurnal variation was 24·5° on the 9th during a spell of clear weather.

Cloud amount and Humidity were low during the month, there being an average of 7·3 hours of bright sunshine per day against 5·36 in June.

Winds were mostly from the South-West, and velocities were high on the 2nd and 4th during the passage inland of the Bay Depression, and again on the 19th while the Bay storm was centred over Deltaic Bengal.

The scanty rainfall of the month and the month before seem to be the consequence of the abnormally heavy rain of May.

P. V. R.
B. S. N.

Departmental Notifications

First Circle: Mr. T. Rangabrahma Rao, Agricultural Demonstrator, Parlakimidi transferred to the Research Station, Samalkota to join before 15-7-1930.

The Sub-circle of Parlakimidi will be closed temporarily. Mr. M. Narasimham, Farm Manager, Research Station, Samalkota, will be retained till paddy planting is over and relieved in the last week of July 1930.

Second Circle: The Resignation tendered by M R.Ry. B. V. Venkatacharya of his appointment as Agricultural Demonstrator, V Grade (on probation) is accepted with effect from the date of expiry of the six weeks' leave granted to him from 22-5-1930.

Third Circle: Mr. S. Varadarajulu, Agricultural Demonstrator, Gooty granted leave on average pay for three weeks from 4-7-1930. The leave on average pay granted from 4-7-1930 to Mr. S. Varadarajulu is extended by five weeks in continuation thereof.

Fourth Circle: The resignation tendered by Mr. A. S. Nityakalyani Reddi of his appointment as Assistant Agricultural Demonstrator is accepted with effect from 21-5-1930. Mr. V. Kumaraswami, Farm Manager, Kalahasti transferred to Palakuppam Agricultural Research Station for farm training, on the expiry of the leave. Mr. P. S. Venkatasubramanyam, Farm Manager, Palakuppam transferred to Kalahasti Farm. Mr. V. Kumaraswami, Farm Manager, Kalahasti is granted an extension of leave on average pay on medical certificate in addition to leave already granted.

Sixth Circle: Mr. V. G. Danakoti Raju, Agricultural Demonstrator, Ambasamudram granted leave on average pay for three weeks from 9-7-1930 on account of his father's demise. The Agricultural Demonstrator, Tinnevelly on return from Coimbatore will take over charge.

Seventh Circle: Mr. E. Achyutan Nayar, Assistant Farm Manager, Agricultural Research Station, Kasargode transferred to Palghat to undergo training in District work under the Agricultural Demonstrator, Palghat.

17 days' leave on average pay already granted to Mr. A. P. Balakrishnan Nayar is extended by 10 days. Mr. P Narayanan Nambiyar, non-technical teacher, Agricultural Middle School, Taliparamba, granted leave on average pay on medical certificate for one month from 5-6-1930.

Eighth Circle: Mr. V. S. Narayanaswami Ayyar, Agricultural Demonstrator transferred to Omalur to be in independent charge of Omalur Taluk with headquarters at Omalur. Mr. T. S. Sundaram, probationary Agricultural Demonstrator to take over charge of the Salem Taluk from Mr. V. S Narayanaswami Ayyar.

Live-Stock Section: M.R.Ry. K. Ramanuja Acharya, Farm Manager, on the expiry of his leave on 16-8-1930 to be Cattle Manager, Live Stock Research Station, Coimbatore. Mr. T. G. Anantarama Ayyar on relief by Mr. K Ramanujacharya to join duty at the Live-Stock Research Station, Hosur to be in charge of cattle. M.R.Ry. M. C. Menon, Farm Manager, on relief by Mr. T. G. Anantarama Ayyar to join duty at the Live-Stock Research Station, Guntur. Mr. M. Alagiriswami, Assistant Farm Manager, Chintaladevi is granted leave on average pay for three weeks from 19-7-1930 or date of availing. Mr. A. Venkatachary, Assistant Farm Manager, granted leave on average pay on medical certificate for three months from 9-7-1930 in continuation of leave already granted.

Entomologist's Section: Mr. C. V. Sundaram, Assistant, is granted leave on average pay for four months from 24-8-1930 with permission to affix Christmas and New Year holidays.

Agricultural Chemists' Section: Mr. T. Varahalu, Assistant, Anakapalli Research Station is granted leave on average pay for 2 months from 18-7-1930. Mr. M. Sundaram, Assistant, V Grade, permanent, provisional to be Assistant, V Grade. Mr. C. V. Raghavendrachar, Assistant, V Grade on probation-provisional to be Assistant, V Grade. Mr. S. V. Kuppuswami, officiating assistant to continue to officiate vice Mr. C. V. Ramaswami Ayyar on Foreign Service.

Paddy Specialist's Section: Mr. R. O. Iliffe, Paddy Specialist, granted leave on average pay for four months from 27-7-1930. Mr. M. K. Padmanabhan granted extension of leave on average pay on 5th and 6th July 1930. Mr. T. Lakshmipathi Rao, Second Farm Manager, Maruteru granted leave on average pay from 7-7-1930. Mr. N. Parthasarathy, Assistant, granted leave on average pay without medical certificate for one month from 10-7-1930. The extension of leave on average pay for two days granted to Mr. M. K. Padmanabhan is cancelled.

Millets Specialist's Section: Mr. V. Gomatinayakam Pillai, Assistant, is granted leave on average pay for one month from 7-7-1930.

Cotton Specialist's Section: Mr. G. Sundaresan, Assistant is granted leave on average pay for one month from 14-6-1930. The services of Mr. G. Sundaresan, Assistant, will be dispensed with with effect from 12-8-1930 afternoon. Mr. M. Ramiah Shetty, Assistant, granted leave on average pay for one month on medical certificate from 7-7-1930.

The resignation tendered by Mr. G. Sundaresan, Assistant on probation is accepted with effect from 19-7-1930.

APPENDIX I

Statement of receipts and expenditure of the Madras Agricultural Students' Union, for 1929–30

Receipts

	Rs	A	P
Building Fund ...	8	0	0
Hire on crockery ...	52	11	2
Entrance fees ...	42	0	0
Journal subscriptions and advertisement charges ...	2,133	9	6
Journal Postage recovered ...	33	6	0
College Day Donation...	331	8	0
College Day entertainment ...	251	4	0
Miscellaneous sale of articles ...	5	3	9
Interest on current account ...	14	2	0
Interest on F.D. ...	68	11	0
Withdrawn from current account ...	2,530	15	0
	5,471	6	5
Add opening balance ...	140	7	1
Total ...	5,611	13	6

Expenditure

	Rs	A	P
Ground rent ...	0	8	0
Establishment, Clerk, Peon, etc. ...	281	13	0
Furniture ...	13	0	6
Stationery articles ...	22	4	0
Postage charges ...	182	15	3
Lighting charges ...	13	9	0
Journal (Printing, blocks, conveyance, etc.) ...	2,482	8	6
College Day reception...	259	6	9
Sports, etc. ...	136	0	3
Entertainment ...	194	5	9
Ramasastrulu Munagala prize ...	35	0	0
Miscellaneous (Tea, photo, peons) ...	79	8	0
Current Deposits ...	1,774	13	0
	5,475	12	0
Closing balance ...	136	1	6
Total ...	5,611	13	6

College Day Account for 1929

Receipts

	Rs	A	P
Donations ...	331	8	0
Entertainment ...	251	4	0
Miscellaneous Sales ...	4	3	9
Total ...	586	15	9

Expenditure

	Rs	A	P
Reception expenses ...	259	6	9
Sports ...	136	0	3
Entertainment ...	194	5	9
Miscellaneous ...	58	10	0
Total ...	648	6	9
Loss ...	61	7	0

Journal Account for 1929–30

Receipts

	Rs	A	P
Subscriptions ...	2,097	9	6
Advertisement ...	130	0	0
Blocks ...	6	0	0
Total ...	2,233	9	6

Expenditure

	Rs	A	P
Printing charges, transport, etc. ...	2,482	8	0
Establishment ...	281	13	0
Miscellaneous ...	0	10	0
Total ...	2,764	15	0
Loss ...	531	5	6

Liabilities

	Rs	A	P
Building Fund ...	8	0	0
Capital Fund ...	4,920	6	5
Total ...	4,928	6	5

Assets

	Rs	A	P
Cash with Uurban Bank.	429	14	11
With Treasurer ...	136	1	6
Fixed deposits in bank.	566	0	0
	1,000	0	0
	500	0	0
Ramasastrulu Munagala Endowment ...	726	6	0
Furniture ...	30	0	0
Drama ...	400	0	0
Flags ...	10	0	0
Sports materials ...	15	0	0
Old journals ...	15	0	0
Crockery ...	130	0	0
Photos, light, etc. ...	20	0	0
Union building ...	1,550	0	0
Total ...	4,928	6	5

M. A. Sankara Ayyar
V. Gomathinayagam Pillai, } Auditors.

Budget for 1930–31

Receipts

	Rs	A	P
Cash balance ...	136	1	6
Cash at Urban Bank ...	419	14	11
Fixed Deposit (P.F.) ...	1,000	0	0
Ramasastrulu Munagala Endowment ...	726	6	0
College Day donation and Drama ...	450	0	0
Journal subscription ...	2,000	0	0
Journal advertisement ..	200	0	0
Arrears collection ...	50	0	0
Miscellaneous ...	50	0	0
Entrance fee ...	10	0	0
Total ...	5,552	6	5
Grand Total ...	5,552	6	5

Expenditure

	Rs	A	P
College Day Celebration.	500	0	0
Furniture ...	25	0	0
Repairs to furniture ...	50	0	0
Lighting charges ...	15	0	0
Stationery ...	50	0	0
Journal printing ...	1,800	0	0
Postages ...	100	0	0
Ground rent ...	0	8	0
Establishment ...	360	0	0
Miscellaneous ...	10	0	0
Total ...	2,910	8	0
Closing balance ...	2,641	14	5
Grand Total ...	5,552	6	5

M. C. CHERIAN
Secretary

APPENDIX II

The Rules of the Madras Agricultural Students' Union

(As passed at the General Body Meeting held on 17th July 1930)

1. *Name and headquarters.* The Association shall be called 'The Madras Agricultural Students' Union'. The headquarters shall be at the Agricultural College and Research Institute, Lawley Road P.O., South India.

2. *Objects.* The objects of the Association shall be:

(*a*) to encourage an *espril de corps* among its members;
(*b*) to protect and promote the interests of its members;
(*c*) to act as an employment bureau for members;
(*d*) to exchange opinions and experiences in matters agricultural and make a record of the same;
(*e*) and to disseminate knowledge in agriculture.

3. *Objects how attained.* The above objects shall be attained by

(i) the annual celebration of a College Day ordinarily on the 14th July, the date on which the College at Coimbatore was opened in 1909;
(ii) the Union acting as trustees for endowments entrusted to it;
(iii) the holding of a Conference during the College Day week at which papers will be read and discussions held on agriculture and allied subjects;
(iv) arranging for lectures and discourses on subjects of general agricultural interest;
(v) the submission by the Union of suitable representation to proper authorities on matters which affect the general interest of members;
(vi) the conducting of a journal as an organ of the Union which shall be known as the 'Madras Agricultural Journal';
(vii) the maintenance at the Union Building of a Reading Room for the use of the members; and
(viii) the encouragement of enquiries on rural problems.

4. A. *Membership.* The following are eligible to become members:

(i) Old boys of the Agricultural Colleges (Saidapet and Coimbatore),
(ii) present students of the Coimbatore Agricultural College,
(iii) officers of the Madras Agricultural Department (whether in active service or in retirement.)

B. *Subscriptions.* Every member shall on joining pay an entrance fee of Rupee one and an annual subscription as stated below:

Students under training	...	Rs 2
Members with an income of Rs 120 and less	...	„ 3
Members with an income of over Rs 120 and not more than Rs 250	...	„ 4
Members with an income of over Rs 250	...	„ 5

N.B. The subscription is payable in advance.

Associates. (*a*) Bona fide students of recognised schools and Colleges in India, may become associates by paying Rs 3 as annual subscription, and (*b*) persons interested in agriculture by paying Rs 5 as annual subscription.

Honorary Members. Men of eminence in the scientific world or in public affairs who take an interest in agriculture may by a special resolution of the Council be requested to become Honorary members.

Patrons. Persons interested in agriculture who donate not less than Rs 100 may become patrons of the Union.

5. A. *Council.* The affairs of the Union shall be managed by a Council with the Managing Committee as its Executive. The Council shall not ordinarily interfere with the administration of the affairs of the Union by the Managing Committee except on a specific reference made by the Managing Committee on a resolution at its meeting or at the specific requisition signed by a third or more of the members of the Managing Committee.

Any changes in the rules or policy of the Union shall be submitted by the Managing Committee to the Council for approval prior to placing them before the General Body.

The Council shall consist of *15* members, viz., a President (The Principal of the Agricultural College shall be *ex-officio* President), a Resident Vice President, three mofussil Vice-Presidents, a Secretary, an Editor, four mofussil members, three resident members and a student member.

For a meeting of the Council, five members will form a quorum.

B. *Managing Committee.* The Managing Committee shall be the sole executive of the Union working under the direction of the Council. It shall be responsible for preparing the Budget and submitting it to the Council before presentation to the General Body.

The Managing Committee shall consist of *nine* resident members, viz., the President, (The Principal of the Agricultural College ex-officio), the Resident Vice-President, the Editor, the Secretary, the Treasurer, the Manager, two other resident members and one student member. For meetings of the Managing Committee, four members will make a quorum.

C. *Editorial Board.* The Editorial Board shall be responsible for the conduct of the Journal. It shall consist of *seven* resident members, Editor, Sub-editor, Secretary, Manager, two other members and one student member.

Election of Office Bearers. This will take place by *ballot* at the Business meeting in July. The resident Vice-President, the Secretary and the Editor shall be elected at the General Body meeting from a panel of members duly nominated. The Secretary will forward by 1st May a list of resident members to all the members of the Union and call for nomination for the resident Vice-President, Secretary and Editor. The nominations should reach the Secretary before the 1st July in sealed envelopes. The nomination should be proposed by one member and duly seconded by another. (Quorum for the General Body will be 10 per cent of the members on rolls.)

Student office bearers of the Council, Managing Committee and the Editorial Board will be elected by the constituency of student members and other office bearers shall be elected by a constituency of non-students.

7. *Journal.* One copy of the Journal will be supplied free to Patrons, Associates, and members (other than Honorary Members) who have paid up their annual subscriptions. An annual subscription of Rs. 4 shall be cellected from all others.

8. *Vacancies.* Vacancies other than of the resident Vice-President occurring in the Managing Committee or the Editorial Board in the course of the year will be filled by the respective bodies. In the case of the resident

Vice-President, the vacancy will be filled in by election at a General Body meeting of the resident members.

9. *Finances.* The finances of the Union shall be made up of (1) Entrance fees, (2) subscriptions, (3) Donations and (4) Miscellaneous income. The Managing Committee shall be responsible for the regular collection of income and control of expenditure.

Entrance fees, donations from Honorary Members and Patrons and two per cent of the other collections will be added to the *Reserve Fund* every year under a separate account. The fund shall not be utilised for any purpose except by a specific resolution of the General Body at the Annual Meeting. The Managing Committee shall arrange to invest the several funds of the Union in the District Urban Bank or in the Co-operative Stores and Bank Ltd., Coimbatore.

For general expenditure the budget for the following year shall be passed by the General Body, the draft being published one month in advance of the College Day. The financial statement for the year together with a balance sheet including assets and liabilities as it stood on 31st May shall also be published along with the draft budget. The accounts of the Union shall be audited annually by a certified auditor.

10. *Report.* The Managing Committee shall ordinarily submit two reports in the year, one on the opening day of the Conference and the other before the annual business meeting. The former shall deal with important affairs of the Union and matters of general interest in agriculture. The latter shall deal with the activities of the Managing Committee and other bodies of the Union; it shall include a statement regarding the financial condition of the Union and the draft budget. The Managing Committee shall once a quarter publish an account of the working of the committee and the council and a statement of income and expenditure.

Members, benefactors and associates admitted prior to 17th July 1923 will exercise all rights and privileges under old rules then in force, but may elect to come under the rules provided no concession is claimed for the paid up subscriptions for membership in whole or in part.

Arrears of any kind to the Union will disentitle a person to continue or become a member unless and until the arrears are paid up.

Amendments to the rules shall be proposed by one member of the Union and seconded by another member before being put to vote at the General Body Meeting. Notice of such amendments should reach the Secretary before the 30th of April for giving due publicity to the members. No rule or amendment, passed at the Annual General Body Meeting shall on any account be rescinded unless it has been in working for one full year.

Subjects for the agenda for the General Body Meeting shall include only such as have been notified to the members at least one month prior to the date of the meeting.

All meetings of the Managing Committee shall be presided over by the President, in his absence by the Vice-President and in the absence of both by one of the members present.

The Secretary shall be the sole executive of the Managing Committee, under whose directions and on whose behalf he shall act. The Treasurer will be responsible for the maintenance of cash and the posting of cash book, ledgers, and other books and registers connected with accounts. The pass books and cash certificates shall be in his custody.

The Managing Committee may frame such by-laws from time to time as are not repugnant to the spirit of the rules.

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