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Editorial.

Consolidation of Holdings. The economic disadvantages of excessive fragmentation of holdings are well recognised and need no reiteration. Such fragmentation is due both to the laws of inheritance customary among Hindus and Mohamadans and to the method by which such laws are carried into effect with regard to division of property amongst the heirs; in fact, where fields vary in fertility and in the facilities they command with regard to irrigation and drainage due to the situation, the partition will not be equitable unless each field is divided among the heirs. Where a large proportion of the agricultural lands are cultivated by tenant cultivators who have no right to the property as in Madras, such fragmentation of holdings is associated with the worse evil—fragmentation of cultivation as well. Whether prevention of fragmentation of holdings will also prevent fragmentation of cultivation is a point that can be answered only when actual data are collected, on the acreage a cultivator usually takes up, which will of course vary with the tracts. We find from the report of the Royal Commission on Agriculture that such data are not available for any province except the Punjab.

While the evil of fragmentation is recognised all over the country, only in a few of the provinces like the Punjab, the Central Province and Bombay, have any attempts been made to overcome it. In the Punjab, sub-division has been checked to some extent by imposing

restrictions on alienation and in the case of certain grants, by the limitation of succession to a single heir. A purely permissive measure has been proposed in Bombay according to which an "economic holding" after registration as such, is to become impartible and not liable for further sub-division. There are certain inherent objections to the Bombay proposal. In the first place it will not be an easy proposition to determine the size of the economic holding. It will have to vary according to the tracts and the systems of cultivation adopted. For example, what is termed an economic holding in Tanjore will be obviously different from a similar holding for the Ceded districts. Secondly, the determination of the economic holding obviously defies the existing social systems. Thirdly, the economic holding principle is likely to be more availed of by the well-to-do classes and it might even affect adversely the poorer classes. The Royal Commission examining all the evidences submitted to it, came to the conclusion that there was no other practical suggestion to prevent the evil of fragmentation than by interfering with the laws of inheritance.

The only way of overcoming the evil effects of fragmentation is to consolidate the holding (i.e. to bring together scattered fragments of land into one compact block) by mutual agreement among the parties concerned. The only two Provinces where such consolidation has been tried with a certain amount of success are the Central Province and the Punjab. In the Central Province a Consolidation of Holdings Act has been passed in one of the divisions, by which if the majority of the people in a village assent to it a scheme will first be drawn up by a special officer appointed for the purpose, and when it is confirmed it becomes binding on all the land owners in the village. In the Punjab however, the consolidation movement is entirely in the hands of the Co-operation Department. There is continuous propaganda carried on by specially trained co-operative officials to educate the ryots about the advantages of consolidation. The movement is said to have been very successful and we are told that several lakhs of acres have thus been consolidated at a nominal cost of about Rs. 2 per acre. In so far as Madras is concerned there has not been any move in the matter. It is possible that the methods found successful elsewhere may not prove equally successful in Madras. The Punjab has the special advantage of possessing vast tracts of homogeneous soil, where land tenure is simple. In Madras, in addition to big differences in the quality of soils in the different parts, the tenure is also very complicated. But the problem is, we believe, so important that it is time some attempt is made to introduce this much-needed reform. In this connection we cannot but repeat the opinion of the Royal Commission regarding the matter. "Fragmentation of holdings is in many parts of India one of the most important of the factors tending to prevent agricultural improvement. There seems to be common agreement that its evil

effects are so great that the administrations should not rest content until a remedy has been found. We strongly hold that the initiation should not be left to the spontaneous action of the right-holders but that the state should do propaganda work, should explore the whole situation and should also bear the cost at the initial stages. Progress may be slower where tenures are more complex or qualities of soil more varied, but difficulties should not be allowed to become an excuse for inactivity."

The other Provinces and states are no doubt keenly watching the progress made in the Punjab regarding consolidation. Among the native States, Mysore had recently appointed a special Committee to determine the nature and extent of sub-division and fragmentation of holdings in the state and the practicability of bringing about a consolidation of the same. The commiteee after examining the scheme and measures adopted in Punjab and the Central Province has put forward certain recommendations which the Government has published inviting public opinion on them.

We had an occasion to point out in this journal some time ago, that unlike Madras, several Provinces were proposing to spend a portion of the grant given to them by the Government of India towards village improvement work on some agricultural schemes such as stock breeding, distribution of improved seed of crops, well boring etc. The Punjab had programmed to spend about 2 lakhs out of a total grant of 8½ lakhs on agricultural improvement works which included a lakh for a scheme on consolidation of holdings. But we understand that at a recent meeting of officials and non-officials convened to determine how the subvention should be spent it has been decided that all the 2 lakhs should be spent on the scheme of consolidation. It shows what great importance they are attaching to this agricultural reform.

Will it be too much to expect Madras to take some action in the matter? We now know very much more about rural indebtedness in Madras since the appointment of a special officer to make an enquiry and report about it. Cannot a similar thing be done with regard to the possiblities of consolidation of holdings?

The first question that might be considered would probably be the appointment of a special officer preferably one with revenue and co-operation experience with the object of making a special study of the question and gather information on the present state of fragmentation of holdings at least in certain parts of the Province, where the evil of fragmentation is excessive. This special officer might be later deputed to visit the Punjab, the C. P. and Bombay to study the actual conditions under which the scheme of consolidation has

worked successfully so that a beginning might be made in some part of Madras where similar conditions are known to prevail.

Agricultural Officer for the India XI. We congratulate Mr. C. Ramaswami, Assistant Director of Agriculture, Cuddalore, on his inclusion in the Indian Cricket team that is to tour England during this summer. Mr. Ramaswami has already earned his name on the tennis court as a doughty champion of Madras and his progress with the Indian cricket team in England will be watched with eagerness and interest by all his friends and well wishers.

BROADCASTING VERSUS TRANSPLANTING OF RICE

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Introduction. Of the two practices, direct sowing and transplanting, the latter is by far the more important and it may be said that wherever facilities for transplanting obtain people will prefer it to broadcasting. It would be safer to say that four-fifths of the rice grown in the world is transplanted, and almost all countries like Spain, Italy, Japan, etc., where the highest acre yields are recorded adopt transplanting. Drilling is to a certain extent replacing the practice of transplanting owing to labour difficulties of transplanting as in California. In Italy where also labour is very expensive they have evolved a transplanting machine which can be worked in the puddle.

Broadcasting is usually confined to tracts where the water availability is uncertain and the season is not always dependable. The fact that the yield per acre is definitely higher for a transplanted crop is well recognised though the reason for this increase has not been explained satisfactorily by experimental evidence. It has been sometimes explained that transplanting acts in a way like root pruning; the injury to the root system stimulating the growth of the sub-aerial portion and resulting in increased tillering. It is also stated that transplanting gives a shock to the plant which stimulates better growth and better tillering and consequently better yield. This shock theory cannot, however, be accepted since seeds actually dibbled in lines evenly, yield as much as, if not better than a transplanted crop. In a small-scale experiment conducted some years ago at the Paddy Breeding Station, Coimbatore, comparing actual dibbling with transplanting in the case of two varieties, one a short duration variety, 3½ months, and another a medium duration one, 5 months, the dibbled plots gave decidedly higher yields than the transplanted. Similar results have been obtained in other parts of India and even outside India. If a satisfactory and practical method of actually dibbling the seed directly in the puddled field can be evolved there is no doubt that such a practice should prove an advantage over transplanting. The comparative merits of direct sowing and transplanting have formed the basis of experiments conducted at several of the Departmental Research Stations and the present note deals about such an experiment conducted at the Paddy Breeding Station, Coimbatore, for three seasons 1931—32 to 1933—34.

The Experiment. The experiment was carried out with three strains as shown below:—

Season.	Strain No.	Duration of strain.
1931–32	Co. 1	5 months.
1932–33	Co. 1	5 ,,
,,	Co. 8	6 ,,
1933–34	Co. 9	4 ,,

A row of fields was divided into a number of 2½ cents plots and they were all very uniformly prepared. At the usual time of sowing the nursery, every alternate plot was well levelled and the sprouted seed was sown in it directly as uniformly as possible, and on the same day the nursery for the transplant plots was sown separately. At the time the seedlings were ready they were planted in the alternate plots in the row. The broadcasted plots were not interfered with in the beginning and at the time of transplanting, the plots were given a weeding and the seedlings were thinned out sufficiently so that the number of plants in an unit area was the same in both broadcasted and transplanted plots. At the time of harvesting, the plots were divided each into two equal halves so that the arrangement of the plots was of the A B B A fashion. Each sub-plot was now harvested separately and the yield data analysed statistically.

Besides determining the final yield, the number of plants per unit area (half a square yard), the number of earheads in it, length of the panicles, height of plants, etc., were also recorded from random samples in the different plots so that an explanation could be offered to account for the final yield differences. The sampling was done by putting in an iron ring, half a square yard in area at different spots chosen at random in all the plots and taking notes of the plants inside such rings. All the data obtained are given below.

Year.	1931–32		1932–33				1933–34	
Variety.	Co. 1		Co. 1		Co. 8		Co. 9	
Treatment.	Brord-casted.	Trans-planted.	Broad-casted.	Trans-planted.	Broad-casted.	Trans-planted.	Broad-casted.	Trans-planted.
Yield of grain in lb. of the experimental area—Total of 11 repetitions.	372	392	278	352	221	313	210	288·5
Acre yield in lb.	2,706	2,851	2,022	2,560	1,607	2,276	1,527	2,098
Yield expressed as percentage of mean.	98·6	102·7	88·2	111·7	82·4	119·6	84·0	115 8
Percentage standard error of the mean.	2·6		3·8		3·2		3·0	
Number of ears per unit area (½ sq. yd.).	133 ± 6.6	101 ± 3·24	105 ± 3·60	96 ± 2·25	114 ± 3·22	103 ± 2·01	67 ± 2·61	84 ± 4·45
Mean length of panicle in cms.	—	—	19·0 ± 0·05	20 54 ± 0·06	17·88 ± 0·13	21·07 ± 0·14	20·2 ± 0·09	19·6 ± 0·08
Mean height of plants in inches.	—	—	81·9 ± 0·80	88·4 ± 1·0	82·3 ± 0·84	97·8 ± 0·89	—	—

The season was a bit late in 1931–32 and the plants in the broadcasted plots which were infested by thrips (*Thrips oryzae*) could not make any headway in the early stages. This prevented proper thinning being carried out with the result the number of plants per unit area in the two treatments, broadcasted and transplanted, happened to be different. In the next two years there was no such difficulty experienced, but still the number of plants in the broadcasted plots was slightly more than in the transplanted plots.

Discussion of Results. In 1931—32, the yields of broadcasted and transplanted plots were almost the same. For the reason mentioned previously the broadcasted plot could not be thinned and it had nearly twice the number of plants per unit area as compared to the transplanted crop. The lower population density in the latter was made up by increased tillering. In the second year, the population density was only slightly more in the broadcasted plot in both the varieties, Co. 1 and Co. 8, and still the difference in yield in favour of the transplanted crop has been considerable. Though the number of ears per unit area has been slightly in favour of the broadcasted plots, the individual panicles of the transplanted crop have been definitely bigger in both the varieties, and the bigger ear has been the main cause for the difference in yield. In the trial with the *kar* variety, Co. 9, in 1933—34, the advantage of transplanting has again been brought about. Though it is usually considered that the two treatments cannot make a big difference with regard to short duration rices, under Coimbatore conditions in a normal season, transplanting appears to be better than broadcasting even in a short duration crop. Unlike in the two other varieties, Co. 1 and Co. 8, the increased yield of the transplanted crop in this case has been brought about mainly by the larger number of ears per unit area, the size of the ear in the two treatments not being different.

Other observations. *Root System.* Observations were made on the root system of some plants in the two treatments. It was found that in the broadcasted crop, the plants did not have such a well developed root system as in the transplanted crop. The transplanted plants had a more extensive and deeper root system and this is probably the reason for the broadcasted crop always having the tendency to lodge. In the transplanted crop the tillering and rooting zone is about an inch or two below ground level, and in the broadcasted crop, the seed having been dropped on the surface, the root system is more on the surface and it does not give sufficient anchorage to the plant.

Flowering, duration and height. Though in the experiments the sowing of the seed in the broadcasted plot and the sowing of seed in the nursery for the transplanted crop were done on the same date, the flowering of the transplanted crop was sharp and uniform, while in

the broadcasted crop, it was uneven and delayed. The harvest of the broadcasted crop could be made only a day or two later than the transplanted crop.

In 1932—33 where height measurements were recorded the transplanted crop in both the varieties, Co. 1 and Co. 8, was always taller in growth than the broadcasted crop, the differences between the two being significant. Although no actual weighments of straw yield were made, it was apparent that the quantity of straw was more in the transplanted crop.

Economics of the two treatments. While in the case of the broadcasted crop there is some extra expense due to the higher seed rate used and to the extra weeding that has to be given, in the case of the transplanted crop, the extra expenditure due to the raising of the seedlings and transplanting the same is very much more considerable. As the figures given below show, the value of the increased yield obtained from a transplanted crop not only covers the additional expenditure but leaves a clear extra profit. This net extra profit is about Rs. 14 in the case of Co. 1, Rs. 18—8—0 in the case of Co. 8 and Rs. 8—8—0 in the case of Co. 9 (*kar*).

	Co. 1. lb.	Co. 8. lb.	Co. 9 lb.	
Extra yield of grain per acre due to transplanting.	538	669	571	
	Rs.	Rs.	Rs.	
Value of this extra produce.	19—3—6	23—14—0	13—14—6	
Extra expenses incurred with transplanting.				Rs.
Cost of raising seedlings.				5—0—0
Transplanting charges.				2—4—0
Total.				7—4—0
Extra expenses in the broadcast crop.				
Cost of excess seed.				0-12—0
Cost of one additional weeding and filling gaps.				1—2—0
Total.				1-14—0
Net extra expenses in transplanting over broadcasting.				5—6—0
	5—6—0	5—6—0	5—6—0	
Net profit by transplanting	13-13—6	18—8—0	8—8—6	

Summary. The practice of raising a nursery and transplanting the crop in rice is always preferred to the direct sowing of the seed in the field. That the latter practice still obtains in some tracts is due to the uncertain seasonal conditions and inadequate irrigation facilities.

The comparative merits of the two practices were investigated into by regular experiments at the Paddy Breeding Station, Coimbatore. Three varieties of rice, a short duration *kar* crop, a medium duration *samba* crop, and a long duration *samba* crop were experimented with, and in every case transplanting was definitely found to be very much better than direct sowing. In the *samba* varieties the increased yield was brought about mainly by the bigger size of the earheads in the transplanted crop and in the *kar* crop by the bigger number of earheads per unit area. Even after allowing for the extra expenditure involved in the raising of seedlings and the transplanting of the same, the value of the extra produce obtained in the transplanted crop was enough to leave a clear net profit of Rs. 8 to Rs. 14 per acre.

CROP-CUTTING EXPERIMENTS.

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Introduction. One of the three factors necessary for estimating the yield of a crop, namely the "Standard or Normal yield", is admittedly susceptible of considerable improvement in many Provinces in India. The Agriçultural Department in each Province is responsible for fixing the "Normal Yield" per acre for the several crops in each district. The estimate of normal yield is based mainly upon a system of crop-cutting experiments made over a number of years. Under this system, plots of land of average quality are selected in each district by the officers of the Agricultural Department and the crops grown upon them are cut and weighed before them. The results of the experiments are reported to the Director of Agriculture, who on a careful scrutiny of all the reports received by him, and after comparing with such other information as may be available from trade statistics, settlement investigations and the like, fixes the "Standard Yield" of each crop for each district. The estimates are generally revised if necessary at the end of five years.

Reliance on crop-cutting experiments, the methods adopted in carrying them out, and the agency employed in conducting them have all been subjects of criticism in the past. But no satisfactory alternative basis for calculating the normal yield has been suggested. The Board of Agriculture after a very thorough examination of the point in 1919 and 1924 recommended that crop-cutting experiments must remain the basis of estimates of "standard yield". As regards the methods in use, criticism is mainly directed to two points, viz. that the number of experiments are too few to be capable of generalisation over a large area and that they depend for their success entirely on the ability of the officer to select the average field from a large number of fields growing different varieties of a crop at different stages of maturity. In selecting the fields, it is very difficult to give proper weight to

fields of very little or no productivity, and even in a normal year such fields are by no means rare. These factors make accurate selection very difficult. Another important defect of this method of selection, even though it is done on a large scale, is that it is not possible to make any generalisations from such experiments, because there is no method for determining the probable error of the results of such a "Deliberate selection" as opposed to a "Random selection". Naturally we fall back upon the method of "Random sampling" to give us a satisfactory estimate of the average yield per acre of any crop of a district.

Number of Samples. Suppose the average yield per acre of a crop from a sample is y with a standard deviation of s. Also suppose the total number of fields under that particular crop in the district is N, and that experiment is conducted in n out of the N fields. Then $X = \frac{N}{n}$ is called the sampling factor. Let $K = \frac{1}{X}$; then from a well-known formula the average yield per acre of the district is $y \pm s\sqrt{\left\{\frac{1-K}{n}\right\}}$

Hence n the frequency of the sample depends upon (1) the dispersion of the yield of the crop about the average yield; (2) the total number of fields growing that particular crop; and (3) the degree of accuracy expected as measured by the probable error of the yield. Generally 'N' is very large compared with n and so $K\left(\frac{n}{N}\right)$ is insignificant. Therefore for a given degree of accuracy $\sqrt{n}$ is directly proportional to s (the standard deviation). If the crop selected is of such a character that its coefficient of variation $\left(100 \times \frac{\text{standard deviation}}{\text{arithmetic mean}}\right)$ is small, the number of crop-cutting experiments necessary to give a fairly accurate result is also small, and vice versa.

To take a specific case, the coefficient of variation of the yield of rice in the several divisions of Bihar and Orissa was found to vary from 40 to 60 with an average of 48 in Mr. Hubback's crop-cutting experiments of 1925. Suppose that the standard error of any forecast should be 5% of the average

$$\therefore 100 \times \frac{s}{\sqrt{n} \times y} = 5$$

$$i.e. \frac{V}{\sqrt{n}} = 5 \text{ where V is the coefficient of variation}$$

$$\text{if } V = 40 \qquad n = \frac{40^2}{5^2} = 64$$

$$\text{if } V = 60 \qquad n = \frac{60^2}{5^2} = 144$$

Taking the upper limit, if 150 crop-cutting experiments are made per district the standard error will be about 5% of the average yield. If

225 experiments are made the standard error will be $\frac{60}{\sqrt{225}} = 4\%$. Hence to be on the safe side it is desirable to take 200 to 250 samples to get a reliable estimate of the average yield per acre.

Thus from a knowledge of the coefficient of variation of the yield of any crop the number of experiments for each sample can be fixed. For most of the important crops the coefficient of variation is not likely to be more than 60, and hence it is enough if for each crop 200 to 250 cuttings are taken to find the average yield.

Technique of Selection. It is very well-known that even in the compact area of a district, several crops are grown on a variety of soils of varying degrees of fertility, under different methods of cultivation (irrigated or unirrigated, intensive or light, and so on). To add to this there is a large number of varieties of the same crop including those of improved seeds. So if we want to divide the district into a number of homogeneous areas and then take a number of samples from each variety of the crop, the work will be impossible because it is almost certain that such homogeneous areas cannot be delimited with sufficient accuracy, and even then the number will be too large for investigation. Even if this could be done, it would be impossible to compute the probable error of such experiments. (In certain crops like cotton, where the cassification of separate varieties is of very great importance, the sampling method for different varieties could be applied).

So it is necessary to devise a method by which every unit in the aggregate shall have an equal chance of being included. In the present case the question arises whether the unit for sampling should be a village or a field comprised in a survey number. The defect of the former method is that we can select only a few villages, and in each village a selection has again to be made of a few plots. This restricts the scope for all varieties of plots being represented in the sampling because there is a very high correlation between the soil conditions, varieties of the crop and their yields in the same village as compared with the whole district. In fact this method is analogous to selecting 50 strips of 10 units each instead of a random sample of 500 units. (Vide F. L. Engledow and G. U. Yule, " The Principles and Practice of Yield Trials Section "). It is shown there that the standard deviation of such a method is greater than that of the random sampling method. So the best way of doing the whole thing is to prepare a list of the fields in the district, arranging the villages in a geographical or alphabetical order and in each village arranging the fields according to the survey number. Now suppose there are ' N ' fields (i. e. total of the survey numbers) and we want to select ' n ' fields. Let X be the nearest integer of the fraction $\frac{N}{n}$. Now mark the 1st, $(x+1)$; $(2x+1)$, $(3x+1)$; ....and so on, numbers in the ordered list and conduct

the crop-cutting experiments in those fields. Of course it is better to select the first field at random rather than selecting the first survey number of the first village in the list. Also if it is felt necessary, there is no objection to arranging the villages according to the different soils and types of cultivation. But this should be done before the selection is made from the ordered list. Thus due weight will be given to tracts where a large percentage of fields grow the same crop, and also the different types of cultivation and soil receive adequate representation. Of course if in the survey number selected the particular crop is not grown the nearest field growing the crop should be taken.

After the selection is made the adequacy and the randomness of the sample can be tested by computing the area of the crop of the whole district from the sample, as well as the land revenue assessed; and seeing whether the estimates differ from the facts by more or less than the computed probable error. A rough test can also be made by dividing this big sample into two, one comprising the sample of odd numbers and the other the even, and observing how the results of these two sub-samples agree.

Mr. J. A. Hubback in his "Sampling for Rice Yield in Bihar and Orissa" observed that the practical difficulties involved in the above method require a method which is more automatic in the distribution of sampling in time and space. The only difficulty pointed out by him is the necessity to find out the date on which the crop in each field would be ready for harvest and to arrange a visit to the village on that date. The alternative method suggested by him was to divide a tract of nearly 1,000 square miles into 12 regions. "It is necessary to fix 12 centres spread as evenly as possible over the area and to put down against each centre the day on which sampling is to be done. These days should be spread evenly over the period of harvest. The sampler should go out a fixed distance in one direction and, circling round, return from another direction, so that it is secured that he covers approximately the same area on each day. He could cut one sample from each field, where he finds harvesting in progress. He will be able ordinarily to get from 30 to 40 samples in a day when the harvest is in full swing and 10 to 20 when it is slack." Any officer could do the work quite well.

But this method will not be strictly random on account of the fact that however carefully the dates for sampling may be arranged, all the different units have not an equal chance of coming into the sample because only those fields which are homogeneous in certain respects will be ready for harvest during a particular period and so the fields having different varieties produced on different soils under different conditions will not all stand equal chance. Hence the random sampling method proposed above is the best, provided arrangements can be

made for the investigators to visit those particular fields when they are just ready for harvest.

Details of the Experiment. After selecting the field the next question is whether the average yield per acre of the whole field should be found out or again only a random sample of that crop should be taken or any other method should be adopted. The objection to finding out the average yield per acre of the whole field is that all the survey numbers are not of the same extent in area, and secondly that it is impracticable considering the cost and time that it takes. An alternative method is to follow the "*Danabandi*" (appraisement) system of rent payment followed in some parts of the country. It consists of the tenant cutting a small area where the crop is thinnest and the landlord where the crop is heaviest, mixing the two together and taking the result as a fair sample. But Mr. Hubback's objection to this method is that it presupposes that the true mean lies midway between the highest and lowest sample, which is very rarely found in practice. He says that in fact this method always gives an overestimate. An alternative method is to take 4 or 5 samples from each field and find the average of those to get the average yield of the field. But it was found by experience in Bihar and Orissa that even four samples instead of one are not worth while, because in the great majority of cases they do not differ among themselves enough to affect the mean or the standard deviation of the whole set of samples (vide Hubback's "Sampling for Rice Yields in Bihar and Orissa," p. 9).

Hence it is enough if a small plot of land (the area being constant for all sample) is chosen at random, under definite directions, and the average yield of that is taken to typify the field. For example the sampler may be instructed to go to the centre of the boundary of the field parallel to the line in which the harvest is proceeding and take a plot of area at a few steps say 5, 10, from that place. Of course for finding the absolute yield of that field that sample is not sufficient; but in the case of a large number of samples positive and negative errors cancel and the average yield of the whole district will not be disturbed. In this connection the question, what is the reasonable area of the plot of land for each sample, arises. In Mr. Hubback's experiment a mechanical device, by which a plot of land in the form of an equilateral triangle comprising an area of 13200 of an acre is formed, was used. But it is very difficult to find the area and to weigh the quantity of grain produced in such a small plot very accurately and even small errors in measurements and weights magnify the errors of the average yield per acre. So from practical considerations it will be better if a plot of land whose area is 1150 or 11100 of an acre is chosen, i. e. a plot of ground in the form of a square of side 10 yards or 7 yards roughly.

Conclusion. To sum up, the standard yield of any crop in any district can be estimated by cutting the crop on about 200 to 250 plots

of land each of area 1,100 or 1,50 of an acre, the plots being selected on a purely random basis. Of course every effort should be made to compare the results of the experiments with such other information as may be available from trade statistics, settlement investigations and the like.

ON SOME PARASITES FOUND IN ASSOCIATION WITH THE STEM WEEVIL PEST OF COTTON IN SOUTH INDIA (*Pempheres affinis*, F.) & THEIR ROLE IN ITS BIOLOGICAL CONTROL*

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It is now over two decades since the cotton stem weevil *Pempheres affinis*, F. began to attract some attention as a fairly important pest of cotton in South India, and the first paper (1) on the general features and life history of this insect was published by the senior author. Since then, this pest, which was in the early years confined chiefly to the cambodia variety of cotton, has been directing its attentions to other cottons and distributing itself fairly widely in the cotton areas of South India. As a consequence, special attention has had to be paid to this insect along with other important pests of cotton viz., the boll worms, and even the help of legislation had to be resorted to for the control of these important pests. Side by side, intensive studies on the different aspects of the problems connected with this insect have also been carried out by the Government Entomologist and by a special staff appointed for this work by the Indian Central Cotton Committee. The peculiar habits of this weevil as an internal feeder in its destructive stages have made it rather difficult to tackle it by means of the ordinary mechanical or insecticidal methods of control, and it is found that the only possible means of keeping the pest under some control must mainly consist of prophylactic cultural means and plant sanitation, the breeding of resistant strains of cotton. or by trials in biological methods by the use of parasites or predators. Speaking of biological methods and the agencies in that direction, with which this paper is mainly concerned, it is needless to add that it is in the first place essential to find out whether any such natural enemies really exist and get some definite ideas regarding their potentiality before any control measures in that direction are attempted. With a view to find out if the pest is subject to the attacks of such natural enemies the authors have been carrying on some work, and the experience of the past two or three years has so far shown that this insect, unlike some of our common insect pests, is not commonly subject to

* Paper presented at the Indian Science Congress, January 1936.

parasites or predators, and till now studies in this direction have revealed the existence of only a few parasitic wasps in comparatively very small numbers associated with the developing stages of this weevil pest. These being the first definitely identified and reared records of insect enemies of this stem weevil, the authors have thought it desirable to present this fact in this short paper with the available systematic and biological notes gathered so far regarding these parasites and their role as natural enemies.

The Parasites. The parasitic insects so far found associated with the stem weevil number five in all, and appear to belong to two different families of wasps; of these five, two are braconids and the other three which are smaller in size belong to the well-known group of chalcid wasps. Of the two braconids the larger form appears to be a species of the genus *Spathius;* since only a few specimens have been secured, it is proposed to record the exact specific identification after sufficient material of the parasite is secured; Species of *Spathius* are usually found attacking the larvae of powder post beetles (Bostrychidae) found damaging stems of trees, wooden posts, bamboo framework etc.; one species of *Spathius, Spathius piperis*, W has been noted however from the Dutch East Indies as a larval parasite of a weevil *Lophobaris piperis* and Beeson and Chatterjee have recently noted (4) two or three species of *Spathius* attacking weevils of the genera *Camptorrhinus, Osphilia* and *Mecistocerus* attacking forest trees. The smaller braconid of which only a single specimen has been so far reared out is a species of *Microbracon* closely allied to *M. gelechidiphages* described by the senior author (5) as parasitic on the cotton boll worm.

Of the three chalcid wasps noted so far in association with the stem borer weevil, one is a *Eulophid* and appears to belong to the genus *Olinx*, F—a genus not recorded before from India. One of the other two appears to be a *Pteromalid* belonging most probably to one or other of the two genera *Pachyneuron*, W or *Hypsicamara*, F. The smallest of the three which has only been noted very recently appears to belong to the family Encyrtidae. It is proposed to describe these parasites as soon as possible in a separate systematic paper elsewhere.

The biggest braconid was found in very small numbers and was mainly obtained from dead plants kept for emergence of adult weevils from the early sown cotton crop during the end of December. Some of the adult wasps were found to possess only vestigial wings. Examinations in March showed stray cases of the pupae of this wasp enclosed in thin tough dirty white cocoons. The pupae were found in the tunnel, one for each host grub. The incidence is found rather negligible as far as noted, since not more than a dozen have been obtained so far.

In the case of the chalcids, though adult parasites of the Eulophid were obtained even from stems collected at the end of the season which

were kept for observation during August, September etc., they were prominent only during March and in fact, at the fag end of the season, when the dominant stage was found to be the grub of the parasite. Stray adults also were found *in situ.* In April all the stages were being obtained viz., grubs, pupae and adults, the former two obtained to a smaller degree. In stray cases just emerging adults were noticed from the stems. There were also cases where the adults were found dead *in situ.* It appears that only the grub stage of the pest is attacked and that only one parasite attacks a single host grub and these grubs are generally found parasitised in the earlier stage. The grub of the Eulophid is very minute and is generally found associated with the host larva and can be detected only after careful observation; such a grub taken pupated in a day or two. In the case of the Pteromalid the grubs are generally stout, grayish in colour, and tapering at the ends with the central region bulged up, and these are found singly in the tunnel of the host with absolutely no trace of the latter; and in all such cases the parasitic grub is found to be a fully fed one which, when separated and kept in a tube, pupates almost in a day or two. Before pupation the grub throws out faecal pellets around it in a circular fashion and after undergoing shrinkage pupates. The pupa is white in colour at the outset but changes to a brownish dark tinge after three or four days, and the adult emerges at the end of a week or seven days. In the case of the pupa the head and thorax are dark and the abdomen alone is white. These two forms appear to be ectoparasites and so can easily be detected in the tunnel made by the grub. The braconid also appears to be ectoparasitic. It is interesting to note that the Eulophid wasp has also been noted as a parasite of the cotton stem borer buprestid beetle *Sphenoptera gossypii* in the Ceded districts.

As is the case with many other insect parasites these forms appear on the pest more at the end of the crop season than at any other time; anyhow the effectiveness of these parasites depends upon the degree of incidence which may vary in different cases.

Biological Control of the weevil and suggestions in that direction. In investigating the possibilities of utilising these parasites in the control of the cotton stem weevil one very important point to remember is, that, unlike numerous other crop pests, especially caterpillar pests of sorts which feed exposed on the plants and which offer easy access to numerous enemies, this pest in its destructive stages is a borer, spending all its earlier life stages inside the stem of a plant which has a fairly hard bark. It is therefore clear that it is not all parasites which can attack such an insect, but only those which are specially adapted to reach the grub inside the stem that have chances of exercising any control over the developing pest; and even in such cases the success of the parasite depends a good deal on the particular stage of the host which is vulnerable, and the favourable stage of the plant when the

parasite can get easy access through the stem. The economic entomologist, who is anxious to adopt biological methods of control against this pest by using parasites, has therefore to carry out preliminary investigations more or less on the following lines to get some idea of the potentialities of such natural agencies.

A. Carry on breeding of parasites from borer infested cotton in the different areas to find out (a) the different kinds of parasites; (b) the comparative incidence and habits of parasites in relation to the pest and its stages for one or more crop seasons; (c) the inter-relations and bionomics of the parasites themselves to find out if there occur any hyperparasitism, superparasitism or any such complexities which might interfere with the proper effectiveness of any of the parasites. It is not unlikely that a condition which may be called a parasitic complex might exist in the case of many pests as has been pointed by previous workers and by the senior author in his paper (9).

B. Study the parasites of other fairly common boring beetles or caterpillars, especially those of such weevils as the agathi weevil (*Alcides bubo*) the stem weevil attacking Gogu, Hibiscus and often cotton shoot (*Alcides affaber*) other species of weevils attacking lablab and other leguminous stems, the amaranthus weevil (*Lixus brachyrhinus*) and other beetles like the ground stem boring beetle (*Sphenoptera perotetti*), other borer beetles like Bostrychidae (powder post beetles), Ipidae (timber boring and ambrosia beetles), the longicorns like the coffee borer *Xylotrechus*, the mango borer *Batocera*) the fig borer (*Olenecamptus*) etc., and of boring caterpillars like the agathi stem borer (*Cossid*), the citrus shoot borer (*Arbela*).

The discovery of the alternate host plants which offer actual breeding facilities to this pest will also help not only in locating its haunts when there is no cotton in the field, but also to find out what parasites are found breeding on the insect in these alternate host plants. Ballard (2) makes the rather amazing statement that it has been found breeding in or feeding on many different plants and that it has been bred from the different plants not to speak of others on which the adult has been noted. Experiences of the writers and other later workers have however shown that though the weevil has been now and then collected from a few other Malvaceous plants besides cotton it has not so far been found actually breeding on any other plants except on Bendai (*Hibiscus esculentus*) to a small extent, on stray *corchorus* plants (3) and on Gogu (*Hibiscus cannabinus*). It has to be remembered that noting the adult of an insect on a plant and actually finding the same breeding on it (showing the grub and its other stages on it) are two different phenomena and one cannot conclude without sufficient evidence that the insect is breeding on it by merely noting the adult casually perching or mating on a plant. The study of the alternate hosts is to find out if there are any parasites common to any

of the above borer beetles and in any of the other host plants on this pest and if so whether any such parasites could be bred out in sufficient numbers artificially from two or more other hosts.

Information on items such as numerical, seasonal and reproductive aspects will also afford valuable clues as to the most promising methods of carrying on biological control. If predatory natural enemies are found available, the same lines of investigation as in the case of parasites may be pursued. It is needless to add that most of these lines of preliminary work will be found necessary in dealing with the control of any crop pest by the use of natural enemies, especially of insect parasites or predators and that the scientific values of such studies both to the systematist and the economic entomologist will be very great. A perusal of the very interesting paper by Pierce (6) on the valuable studies on the cotton boll weevil of Mexico and its parasites made during the past several years in the U. S. A. would give one an insight into the intricacies of the weevil pest problem and offer valuable suggestions for future lines of work against such pests. It may also be added that biological methods of pest control may not be quite successful in all cases, may be partially helpful in some, and not exclusively effective in most cases as may be seen by the perusal of a recent paper (7) by Sweetman on this subject where he gives a helpful list of all these categories.

In conclusion we can only quote the telling remarks of Dr. Thompson when he says (8) "Generally speaking, no one species of parasite or predator is likely to bring the host under control over the whole of the infested area. To produce this result, the introduction of additional species will usually be necessary, while in many cases, their efforts must be aided by the methods of agricultural, chemical or mechanical control". We would also commend to enthusiasts on Biological control Thompson's excellent papers on the subject before they attempt any serious work; for, in his own words "the idea of biological control has now become fashionable and is tending to degenerate into a kind of superstition or fad" (8). It has therefore to be reiterated that the study of the natural control of insects by biological methods and their proper utilisation demands a thorough study of the bionomics of the whole group of parasitic insects in relation to a single point which may be called the parasite complex of a pest.

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OMUM OR BISHOP'S WEED (*CARUM COPTICUM*)

BY M. R. BALAKRISHNAN, B. A., B. Sc. Ag.

Introduction. There is probably not a single household, rich or poor in South India, that does not keep a stock of omum water ready against any stomach ailment. As an infallible remedy against indigestion, its efficacy is known to all, and it is one of the few articles of medicinal use, that are sold by even the street hawkers.

The omum plant and its products have a glorious and ancient history behind them. In those early days of civilisation, when Egypt led the world, that country happened to be the sole source of supply to other nations. Later Afghanistan, Persia and other Mohammadan countries of Asia traded in this commodity and owed not a little to this plant, for their flourish and prosperity. It was in the 15th and 16th centuries that omum water came to be known in Europe for its therauputic properties, and references eulogising the excellence of the omum water received from Alexandria and Crete, can be found in the writings of Ponnet, who was physician at the court of King Louis XIV of France. This monarch whose name will go down in history for some famous gastronomic feats must have had,—perhaps at the instance of his physician—recourse to this carminative more than once in his life, to afford relief, when inordinate greed at the dining table made him feel for his indiscretion.

In India itself, omum water has been known and used from the earliest times. Bengal was the chief Province of cultivation and source of supply, but Ujjain—famous as the capital of the great Vikramadithya—has been known to produce the best quality of omum water from the middle ages.

Area and Soil. The total area under this crop in this country is about 100000 acres, of which Bengal occupies more than a third. Madras has about 5000 acres. Curiously there is an opinion that this crop does not thrive on fertile soils, and it is therefore often cultivated chiefly on the poorer types of soils. As a garden crop it is

grown almost throughout the country, in small areas here and there in between other major crops.

Cultivation. The method of cultivation is the same as that of other dry crops. It is said that manurial ingredients have a deleterious effect on the crop and it is therefore grown in a field where another crop had already been raised before, without any fresh application of manure. The sowing is done in October—November at the beginning of the north-east monsoon, which ensures a favourable start for the crop; as it however cannot stand water logging, sowing is done by dibbling the seeds 6 to 8 inches apart, on ridges which provide for surplus water draining away. About one Madras measure of seed suffice per acre, the yield from which ranges from 100 to 120 m. m. The duration of the crop is about six months, and during this period, if rains fail irrigation has to be supplemented from wells, otherwise the outturn is likely to be very poor.

The Plant. The omum plant is an erect and short annual, often about 1 to 2 feet in height and rarely growing beyond 3 feet; the whole plant is covered with minute hairs which give a bristling appearance. The leaves which are two to three pinnate have long stalks and look scattered; the inflorescence is an umbel, which shoots out in rays, the individual flowers being pure white and very pleasing to the eye in their snow white spread.

Omum products. The ovoid fruit is the product which is of the greatest importance and for which the crop is cultivated. It is occasionally used for culinary purposes and as an ingredient in chewing *pan*, but its chief use, is as a drug. Omum is used in medicine as the omum water, a product obtained by steam-distilling the fruit, the active principle being due to a compound called thymol—a—hydroxy derivature of benzene C_6H_3 $\begin{matrix}-OH.\\-CH_3.\\-C_3H_7.\end{matrix}$ and known by the popular name of *agowan oil*. This is a very costly oil ranging in price from Rs. 6 to Rs. 12 a pound, according to season and production and it is the mixture of this oil with water, that forms the omum water of the market. In addition to the oil which is about 25 to 30%, the fruits contain 16% of protein substances.

Trade. Ajowan oil enjoys a good amount of export trade although after the war the demand from outside markets has gone down. Before the war, out of a total of 8700 cwts. nearly 90% went to Germany, the balance being sent to America and Egypt. Latterly Japan has figured largely in the trade and it is said the oil is chiefly valued for the hydro-carbons-thymenes it contains, which are used for perfuming soaps.

Uses. The use of omum for culinary purposes has already been mentioned and as a corrective for indigestion the omum water is only

too well known. In addition, authorities claim for the omum products, aphrodisiac, diuretic and vermifugic properties. With myrobolans and rock salt it is made into a paste which serves as an expectorant for cases of sore throat. As a common household remedy against severe cold and heaviness of head, some omum moistened and crushed is packed up in a small cloth and used for inhaling.

Allied plants. The *umbelliferous* cousins of the omum plant are all interesting and useful plants. Many of them are familiar to us either in the kitchen or through grandmothers' recipes. *Hydrocotyle asiatica* (Tam. *Vallarai*) *Carum caruui* (Tam. *Shimai shombu*). *Carum Roxburghiani* (Tam. *Ashanta omum*) *Ferula nathen* (Tam. *Perungyam*) *Pencedanum graveolens* (Tam. *Shadakuppai*) *Coriandrum sativam.* (Tam. *Kothamalli*) *Cumin ceynium* (Tam. *Shirakam*) are all members of *Umbelliferae*, the family to which omum belongs. Of these, *Hydrocotyle asiatica* has now assumed tremendous importance because, the oil of the fruit is considered to be a specific against leprosy and figures prominently in modern anti-leprosy treatment; it is also used in treatment of syphilis and as an anti-dote against mercury poisoning; *Carum carui* is used for pectoral piles while *Carum Roxburghiani* is administered to relieve bladder pain and as an antispasmoic in hiccoughs; *Ferula nathen* is supposed to be a nervine stimulant and in cases of hysteria and angina pectoris finds a liberal use. *Pancedanum graveolens* besides being well known for its carminative properties (it is from this *dhil* water is prepared) is also used as an emmenagogue. Coriander and cumin, are well known as indispensables in a tastily prepared menu, and they are supposed to correct anti-bilious tendencies.

CRAMMING WITHOUT A CRAMMER

One of our most successful poultry breeders is well known to have "no use of scientists". He is not alone. It is quite a common mistake to suppose that there is a world of difference between the scientist and the practical man. But if the scientist be not practical, he is a bad scientist, though he does not need to be a practical poultry farmer. Practical poultry men rarely realise what they owe to research workers, in breeding, incubation, and nutrition, who probably never handled a bird in their lives. Mendel, the discoverer of "Mendelism", worked on peas.

The latest scientific help for poultry men comes from a more unlikely source still—the psychologist. A study of the psychology of the hen in relation to hunger and appetite has revealed a trick or two worth knowing for the fattener.

Certain German scientists starved hens for 24 hours and then placed a heap of wheat. 100 grams, about 3½ ozs. in front of each one. When they stopped eating it was assumed they had satisfied their hunger; on the average, they ate 50 grams (1¾ ozs.) each, and left the rest untouched.

But when a larger heap was put before a hen in the same state of hunger, she ate about half as much again. So it seems that the more she sees, the more she

will eat, whether hungry or not. This result was also supported when other kinds of grain were used.

In another experiment a hen was allowed to eat from a pile of nearly half a pound of food until she was satisfied and stopped eating. The food left was then entirely removed with a brush and immediately replaced. She invariably made another attack on the food and ate some more. When she stopped the food was removed as before and immediately replaced, and she began to eat again. In many cases the hens dealt with in this manner ate as much as 67 per cent. more than satisfied them at the first meal.

Although such a process looks at first sight too fiddling and impracticable to be employed by fatteners, it is certainly not without its possibilities as a method of making birds cram themselves.

Another experiment which gave results that will surprise most poultry keepers was concerned with the difference in the surfaces on which the food was offered to the birds. When a hungry bird was put before grain on bare wood it ate on the average about 1½ ozs ; or slightly less, but when the food was placed on soft felt it ate more than twice that amount. When birds were given their choice between eating from a hard surface and a soft surface, they always chose the food on the soft surface once they had tried both.

Curiously enough, when this experiment was carried a step further, and smaller lots of grain were offered on a hard and soft surface together, neither sufficient to satisfy the bird, it ate up all the food on the soft surface, and left the other. But if more food was placed on the soft surface it was immediately eaten.

The conclusion to be drawn from this is that the jar which the bird gets from pecking on a hard surface is painful, if only very slightly so, and on that account the bird is content to eat rather less than to carry on jarring its beak on a hard surface.

Another experiment, in which birds were fed from a surface of putty showed by the marks on the putty that the hungrier the bird, (i e., the less she had eaten before being offered grain on the putty), the much harder she pecked, whilst a half satisfied bird made much shallower marks on the putty.

The size of the grains of food offered also had a remarkable influence on the amount eaten. When whole and cracked rice were offered (the cracked being about one-quarter the size) in similar states of hunger, the birds ate two or three times more by weight of whole rice than of cracked rice. Evidently picking up small pieces is so much more troublesome that the birds get "fed up" with it very quickly.

Various colours of lighting also appear to have an effect on the appetite--yellow and red seem to stimulate it, blue and green appear to damp it.

Perhaps the most surprising experiment of all conceived the comparison between eating alone and in company. When a bird had eaten its fill and left the remaining food untouched, another bird, hungry, was put alongside the first. As soon as the hungry bird began to eat, the bird that had already had enough to eat began to eat again. In some cases a bird ate as much as 60 per cent. more after the hungry one had been brought in. Both birds ate still more when a third hungry one was added to the party. But when three well-fed birds had a fourth hungry one introduced, all three seemed to agree that they had had enough.

This last experiment does not appear to have much practical value, but some of the previous ones suggest lines that might be tried out.

For example, two battery houses containing similar quantities of birds of the same hatching might be compared, one with ordinary light, other with yellow or

red washed windows or lights at feeding time, and the amounts consumed measured.

Similarly, the effect of lining mash troughs with rubber could be compared. Every extra ounce of food consumed when cooped for finishing off increases the killing weight.

Frequent feeding of excessive amounts, and double feeding by removing the surplus after, say, 10–15 minutes, and feeding again, might be tried. It is possible that the labour involved would be more than paid for by the result. (*Feathered World*. No. 2427 December 27–1935).

Research Notes.

On the application of soluble manures—ammonium sulphate and super-phosphate—in swampy conditions for Rice

It is known that the fertilising principles nitrogen and phosphoric acid, in the soluble manures like ammonium sulphate and super-phosphate are immediately fixed in the soil soon after the application of these manures. But the conditions of rice cultivation are unique, quite unlike those for other crops as the rice crop is mainly grown under puddled and swampy conditions. Usually in the carrying out of manurial experiments on rice, elaborate precautions are usually taken against the leaching and washing out of manures by having separate bunds 1½' to 2' broad and 1' high and channels 2' wide and irrigation is carefully controlled to manured plots after the application of the manures. A simple preliminary experiment conducted at the Agricultural Research Station, Maruteru (C. R. Srinivasan 1929), indicated that there was no effect of ammonium sulphate beyond the area within which it was applied. Detailed experimental data were essential before any conclusions could be drawn and to arrive at a definite conclusion, an experiment was conducted at the Paddy Breeding Station, Coimbatore during the year 1933—1934.

Two fields that had strains Co. 1 and Co. 5 and planted in rows 1' apart between the rows and 6" in the row, were taken up for the experiment and the following manurial treatments were adopted.

1. Amonium sulphate at 100 lb. per acre.
2. Super phosphate at 200 lb. per acre.
3. Ammonium sulphate at 50 lb. per acre + 200 lb. super per acre.

Each field was divided into 3 portions one for each manurial treatment. In each of these portions, the manured and control (no manure) were arranged in AB. BA. plan giving 8 plots with each plot containing two rows of plants. There was no elaborate arrangement with regard to having bunds between the treatment plots except the demarcating line which was represented by a small mud elevation 2" to 3" high along the line. The manures were applied a month after planting for both the crops and the irrigation was controlled for a day or two at the time of application of the manure and no further precautions were taken afterwards with regard to irrigation and drainage. When the crop was ripe each individual line was divided into four equal parts and was carefully harvested and weighed. There were 16 replications for each treatment and the results are given in the table. It is seen that while the effect of manurial treatment was significant except in the case of super-phosphate (it has been found that there is practilally no response in paddy soils of Madras Presidency to phosphate manure), there is no significant response to manure in the no manure lines adjacent to manured lines showing there is no leaching effect with regard to ammonium sulphate applications.

We are indebted to Mr. K. Ramiah, Paddy Specialist at whose suggestion the expriment was carried out.

C. R. Srinivasan (1929). Mad. Ag. Station Report (1929—30)

a) Difference between manured and unmanured rows.

Treatment.	Strain.	Manured line. Mean of 16 repetitions.	Adjacent unmanured line. Mean of 16 repetations.	Mean Difference.	Standard error.	Mean difference / Standard error.
1. Ammonium sulphate to supply 100 lb. per acre.	Co. 1	922·3	755·3	167·0	25·70	6·50
	Co. 5	677·4	569·4	108·0	15·10	7·16
2. Super phosphate to supply 200 lb. per acre.	Co. 1	714·5	743·5	29·0	11·40	2·54
	Co. 5	565·9	571·9	6·0	17·40	0·35
3. Super phosphate to supply 200 lb. + ammonium sulphate to supply 50 lb. per acre.	Co. 1	823·7	754·1	69·6	18·70	3·70
	Co. 5	599·0	559·7	39·3	14·35	2·73

(b) Difference between unmanured rows.

Treatment.	Strain.	Line adjacent to manures. Mean of 16 repititions.	Line away from manures. Mean of 16 repetitions.	Mean Difference.	Standard error.	Mean difference / Standard error.
1. Ammonium sulphate to supply 100 lb. per acre.	Co. 1	740·0	755 5	15·5	29·00	0·57
	Co. 5	567·3	563·1	4·2	6·30	0·67
2. Super phosphate to supply 200 lb. per acre.	Co 1	746·3	743·5	2·8	14 00	0·20
	Co. 5	552 2	571·9	19·7	15·13	1·30
3. Supper phosphate to supply 200 lb. + ammonium sulphate to supply 50 lb. per acre.	Co. 1	770·5	754·1	16·4	21·42	0·77
	Co. 5	554·0	559·7	5·7	15·50	0·37

Value of 't' for P=·05=2.12

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ABSTRACTS

A method for making mechanical analyses of the ultimate natural structure of soils. By G. J. Bouyoucos. (*Soil Sc.* Vol. 40, No. 6, p. 481). Through a number of sieves, 10, 20, 40, 60, 80 and 100 meshes, soil is successively passed in the slaked state, the process being repeated, with the fraction passing through the first sieve being taken to the next one and so on. The several fractions retained on the sieves are weighed. All these together with the material passing through the finest sieve (100 mesh) were collected again, dispersed and mechanically analysed by the hydrometer method. At the finish, the dispersed material is again taken through the sieve procedure and the several fractions now obtained with

the dispersed soil are noted. Thus we get material passing with mere slaking and with dispersion and this gives a measure of resistant and non-resistant aggregates in the soil. M. R. B.

Cotton bark as a source of Rayon pulp. (*Imp. Inst. Bull.* Vol. XXXIII, No. 4, p. 446). Cotton pulp cut into small pieces and treated with alkali produced a pulp which had more ash constituents and less L-cellulose, than the material usually used for Rayon pulp, viz., bleached sulphite wood pulp. More drastic treatment with alkali to produce a finer pulp may be successful, but the yield will be too low for economical working. M. R. B.

The relation of soil treatment to the nodulation of pea-nuts. By H. B. Mann. (*Soil Sc.* Vol. 40, No. 6 p. 423). The paper is the result of an investigation of the effect of Calcium Carbonate and Sulphate, not so much on the final yield of nuts, but on the conditions of application and the effect on nodulation—an aspect which has not been well studied before. The experiment was done in pots, six treatments being studied, which included $CaCo_3$, $CaSo_4$, free sulphur, mixture of sulphur with $CaCo_3$ and with $CaSo_4$ and a control and three types of soils were examined. The results showed that (1) there was no correlation between growth of plant and nodulation (2) that the effect of lime on nodulation depends on the type of soil, being increased in soils poor in lime and getting reduced in soils rich in lime (3) Sulphur decreases nodulation and (4) that both Carbonate and Sulphate of lime are similar in their effects on nodulation. M. R. B.

The variation in the mineral content of vegetables. By J. Davidson and J. A. Leclerc. (*The Jour. of Nutr.* Vol. II, No. 1, p. 55). A paper that attempts to fill up the gaps of information on the mineral content of foodplants, which are necessary to make up a balanced ration. Samples of kale, broccoli, lettuce, cabbages and spinach were analysed for their ash content, and for potash, soda, lime, magnesia, phosphorus, sulphur, chlorine, manganese, iron and even copper, the examination covering the following factors which affect variation (1) variety, (2) place of growth, (3) type of soil, (4) fertilisers used, (5) dry or irrigated and if the latter, analysis of irrigation water used (6) insecticides used and (7) season. The results showed cabbage to be highest in phosphorus, kale in lime, spinach in magnesium and lettuce in potash. But, it was seen that each vegetable varied largely in its constituents due to the several factors, and each vegetable had its own range of variation for each particular constituent. Fertilisers and the nature of irrigation water used, seemed to contribute largely to the variation.

M. R. B.

The relation of soil erosion to certain inherent soil properties. By J. F. Lutz. (*Soil. Sc.* Vol. 40, No. 6, p. 439). A paper that studies the physical and chemical properties of several soils varying in their erosiveness, and the relation of these properties to erosion. Two soils were examined, one highly erosive and another comparatively non-erosive. Mechanical analysis and determination of aggregates showed that there is greater clay in the non-erosive soil; also it contains 15 to 16% more aggregates. Another important point is that these aggregates are in the form of large stable granules. The aggregates of the erosive soil in addition to being unstable, are dense and impermeable. A striking difference noted from the experience of previous workers, was the absence of any relationship between zeta potential and silica-sesquioxide ratio. Experiments on swelling and hydration, however, showed that hydration is a more important factor than charge, in determining the stability of colloid suspensions. The degree of hydration was measured by viscosity measurements. M. R. B.

Gleanings

State Aid for Marketing Crops. *The Coconut Industry Regulation Ordinance*: **(No. 18/1934)**—From the 1st of January, 1935, Regulations (No. 26 of 1934) concerning the export of copra came into effect. They provide that the moisture content must not be greater than 8 per cent, nor must defects and extraneous substances total more than 10 per cent, nor must there be more than 6 per cent mouldy plus immature pieces in a consignment. The defects mentioned comprise immaturity, insect attack, a smoky odour or discolouration by fire. *The Fruit Industry Regulation Ordinance.* **(No. 19/1934).**— Under this Ordinance the only crop dealt with to date has been bananas, the standards for which are laid down in Regulations (No. 25/1934) which came into effect on 1st January, 1935, Except for experimental purposes by the Department of Agriculture only the Canary (Cavendish) or Gros Michel varieties may be exported: they must be on the bunch, which in turn must not contain less than seven "hands," or combs: they must not be immature. over-ripe, damaged, bruised or broken, and must be free from disease. No bunch weighing less than 28 lbs. may be exported, and a prescribed standard of packing in a stout ventilated paper bag is laid down. A certificate of inspection under these regulations, which is given if the fruit is fit for export, is valid for 48 hours only. *The Bananas (Control of Exportation) Ordinance (No. 24/35).* Carriage of bananas by sea requiries special cool storage accommodation on ships and it is unreasonable to expect that any shipping company would instal such accommodation on their vessels unless a definite assurance of sufficient freight is forth-coming. In the complete absence of any local marketing organisation, Government has assumed this responsibility and has guaranteed freight on 25,000 bunches in 1935–6 and 50,000 bunches in 1936–7. A contract with a shipping company on these lines is now under consideration. Having given this guarantee it is obvious that Government cannot permit the export of fruit through any channel other than that on which public funds have been expended. Powers were therefore granted under the above Ordinance to prohibit the export of bananas except under licence being for such a period and subject to such conditions as may be directed. (*Extract from the Gold Coast Colony Agri. Dept.* for 1934–1935).

Packing of Nursery Plants. One grave error on the part of growers and sellers of tree plants is the carelessness and ignorance shown in packing for despatch to customers. How often do we see four years' work ruined in four days! Some people's ideas of packing young trees are most primitive. I have had bundles of trees despatched loose in the guard's van without any form of protection, with the result that all the outside trees were useless. This year I received trees packed in straw with canvas coverings, which when opened were so hot that it was hardly possible to put one's hand into the centre. Needless to say, the planting of such trees is merely throwing the good money and labour after the bad money and ruined material.

Thirty-five years ago, when nursery stock was scarce and relatively more expensive than it is to-day, we used to get large quantities of trees from Germany. Many a time we have been on tenter-hooks knowing that these trees had been despatched three weeks ago and not yet delivered. We need have no fear. With the excellent packing of the German nurserymen, the trees arrived at the end of three weeks as fresh and good as if they had come out of our own nursery. Their system of packing is now followed by at least one firm in Britain, but should be universal. Large shallow circular wicker baskets with handles were used and the young trees carefully packed with their roots in sphagnum moss, the heads

exposed to the air. Three or four stiff sticks were planted round the basket, and a tent-like arrangement with sacking protected the trees from too much air and sun on the journey. The baskets were charged for but returnable. As a matter of fact the cost was so reasonable, that we used to pay for and keep the baskets for own use.

Let us hope that our nursery-men will take this hint to heart, and cease to ruin their young trees that have taken so much time and anxiety to grow. (*Jour. of Forestry. Vol. 29. March 1935*)

AGRICULTURAL JOTTINGS BY THE DEPARTMENT OF AGRICULTURE, MADRAS

Cotton Pests in Bellary. In the 'Hindu' dated January 15, 1936, there appeared an alarming report that the 'Hingari' cottons round about Bellary were subject to a severe aphis attack called 'Karijigi' as a result of which 70 to 80% loss in yield was apprehended. An officer from the Entomology section, from Coimbatore was immediately deputed to visit the area, study the situation and take steps to combat the pest should it really be so serious. He traversed nearly the whole of the cotton belt in company with the Assistant Director of Agriculture, Bellary and found that there was absolutely no cause for alarm as the alleged pest nowhere existed on a scale depicted by the paper. Barring the presence of a few stainers and bollworms in isolated areas the cotton crop was generally found to be free from pest of any kind.

Bud and boll shedding was however found to be slightly more than normal in certain areas due to the drought conditions that had set in from November onwards. In certain tracts where drought conditions were acute immature bursting and mummifications of bolls known as '*Guggi*' in vernacular were also noticed.

Spraying Against Betel-vine Wilt Disease. Satyavaram village of Yellamanchili taluk in Vizagapatam district has been famous for its betel-vine cultivation for the last half a century. It exports betel leaves to distant places like Bombay Poona, Calcutta and Malabar. But in recent years a disease called 'wilt' has appeared resulting in the withering, wilting and eventually death of the vines. Damage has been, of late, so heavy, that gardens have been entirely swept away by the disease. The pre-disposing cause of this trouble appears to be the local practice of growing the same crop over and over for 4 to 5 years in the same plot though an interval of 2 to 3 years is allowed by leaving land fallow. The fungi causing the trouble are *Sclerotium rolfsii* and *Phytophthora Sp.* which are both soil inhabiting fungi. To demonstrate the methods of control a series of trials were laid out during the season in 1935. A definite number of rows were each treated with bordeaux mixture 1%. kerol ·07%, phenyl ·25%, and liming with an equal number of rows untreated for control. The above treatment was done alone and in conjunction with provision for drainage channels. The results observed so far have been satisfactory and the indications are that the above treatment in combination with provision for drainage was more successful than that without drainage which shows the great necessity for drainage in betel vine cultivation.

Money in Growing Flowers. In Madura District, flower growing especially of Chrysanthemum is mostly taken up by the Christian ryots round about Tirumangalam, Ammayanaickanur and Dindigul. They are small holders intelligent and industrious and make good profit per acre.

An enquiry conducted shows that they spend about Rs. 165 per acre from the raising of the nursery to harvest and the yield is about 20,00,000 flowers per acre and is sold at 0—4—0 a thousand which works out to Rs. 500. Deducting the cost of cultivation of Rs. 165, a net profit of Rs. 335 per acre is realised.

It is desirable that land owners near Madura, Tallakulam, Chockikulam and Pasumalai grow flowers as a trial on a small scale under the channel irrigation. They can easily sell their produce in Madura Town where there is a great demand. The area could be extended if they find the business paying.

Some ryots in Alankulam near Palamkottah in Tinnevelly District cultivate roses and jasmine in red loamy and gravelly soils and get very good profit per acre. Generally roses begin to give profitable yield from the 2nd year after planting to fifth year and yield about 225,000 flowers per year which sell at 0—3—0 a 100. Deducting the cost of cultivation etc. it is reported that about Rs. 270 net profit per acre, per year is obtained.

In the case of Jasmine there is no profit in the 1st year and profitable income is obtained from the 3rd year onwards to the seventh and annually about 6 400 *palams* of flowers are obtained which are sold at 6 pies per *palam*. After deducting the cost of cultivation, there is a net profit of Rs. 195 per acre for about five years. The flowers are easily marketed in Tinnevelly town.

It will be seen from the above that there is plenty of money in growing flowers provided ryots take advantage of growing them in suitable places round about towns. In big towns there is always a demand for them and marketing facilities are available.

Crop & Trade Reports.

Groundnut—1935—Fourth or Final Report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1933—34 has represented 48·2 per cent of the total area under groundnut in India. The area sown with groundnut in the Presidency in 1935 is estimated at 2,492,500 acres. When compared with the corresponding estimate of 2,323,300 acres for the previous year and the actual area of 2,350,934 acres according to the season and crop report of the previous year, the present estimate reveals an increase of 7·3 and 6 per cent respectively. The estimated area for this year is less than the normal area of 3,317,650 acres by about 25 per cent. The increase in area is general outside Ganjam, Vizagapatam, East Godavari, Bellary, Anantapur, Coimbatore, the South (Tanjore excepted) and Malabar. The increase is marked in the Central districts (Coimbatore excepted). The area in Bellary and Anantapur has fallen from 412,600 acres to 292,000 acres due mainly to an increase in the area under cotton and other dry crops. The harvesting of the summer and early crop of groundnut was finished by October. The harvesting of the winter or main crop is proceeding. The crop is expected to be below normal in Vizagapatam, Guntur, Cuddapah, South Arcot, the Central districts, Tanjore, Tinnevelly and Malabar. The seasonal factor for the Presidency works out to 92 per cent of the average as against 78 per cent in the previous year according to the season and crop report. On this basis, the yield is expected to be 1,143,400 tons of unshelled nuts as against 920,260 tons in the previous year, an increase of about 24 per cent. The yield in an average year is estimated at 1,660,990 tons.

The wholesale price of groundnut shelled per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 5—14—0 in Tinnevelly, Rs. 5—13—0 in Cuddalore, Rs. 5—8—0 in Vizagapatam Rs. 5—5—0 in Berhampore, Rs. 5—4—0 in Negapatam, Rs. 5—2—0 in Guntur, Rs. 5

in Vizianagram and Cocanada, Rs. 4—15—0 in Nandyal and Cuddapah, Rs. 4—12—0 in Adoni, Vellore and Salem, Rs. 4—11—0 in Coimbatore, Rs. 4—8—0 in Madura and Rs. 3—12—0 in Ellore. When compared with the prices for October 1935, these prices reveal a rise of 21 per cent in Cuddalore, 11 per cent in Ellore, 5 per cent in Vizagapatam, Guntur and Nandyal and 4 per cent in Cuddaph and a fall of 14 per cent in Coimbatore, 7 per cent in Berhampore, 6 per cent in Vellore, 5 per cent in Vizianagaram, 4 per cent in Madura and 3 per cent in Adoni and Salem. The price remained stationary in Tinnevelly.

Paddy—Final Forecast Report. 1935—36. The average of the areas under paddy in the Madras Presidency during the five years ending 1933—34 has represented 13·5 per cent of the total area under paddy in India. The area sown with paddy in 1935—36 is estimated at 11,000,000 acres as against 10,828000 acres for the corresponding period of last year and the finally recorded area of 11,055,587 acres in 1934—35. The present estimate falls short of the final area by 0·5 per cent and the area of 11,381 660 acres in an average year by about 3·4 per cent. 1,403,000 acres have been reported as sown since the last December forecast was issued. The extent so sown was large in Ganjam (125,000 acres), East Godavari, Chingleput (118,000 acres). South Arcot, North Arcot, Madura (103,000 acres), and Ramnad (152,000 acres). The area sown in December and January was greater than that sown in the corresponding period of last year by 286,000 acres or by about 26 per cent. The area under second crop paddy is expected to be generally below normal. The harvest of paddy is in progress. The yield is expected to be normal in Kistna, Guntur, Kurnool, Bellary, Cuddapah, North Arcot, Madura, and the Nilgiris, slightly above normal in South Kanara and below normal in the other districts. The yield was the lowest in Ganjam (84 per cent). The seasonal factor for the Presidency works out to 94 per cent of the average as against 96 per cent in the season and crop report of last year. On this basis, the yield works out to 98,090,000 cwt. of cleaned rice. This represents a decrease of about 1·6 per cent when compared with the estimate of 99,622,000 cwt. in the season and crop report of last year. The yield in an average year is estimated at 107,776,000 cwt.

The wholesale price of paddy per imperial maund of 82-2/7 lb. as reported from important markets towards the close of January 1936 was Rs. 2—12—0 in Nellore and Erode, Rs. 2—10—0 in Vizianagram and Cuddapah, Rs. 2—9—0 in Nandyal, Rs. 2—8—0 in Berhampore, Rs. 2—6—0 in Madura and Tinnevelly, Rs. 1—11—0 in Kumbakonam and ranged from Rs. 1—15—0 to Rs. 2—4—0 in the other markets. When compared with the prices reported in the previous month, these prices are stationary in Berhampore, Vizagaptam, Erode and Tinnevelly and are lower by 27 per cent in Kumbakonam and Salem, 24 per cent in Trichinopoly, 18 per cent in Vellore, 15 per cent in Cuddapah, 14 per cent in Madura, 9 per cent in Cocanada, 8 per cent in Negapatam, 6 per cent in Guntur, and 2 to 4 per cent in the other markets.

Cotton—Fourth Report. 1935—'36. The average of the areas under cotton in the Madras Presidency during the five years ending 1933—34 has represented 9 per cent. of the total area under cotton in India. The area under cotton up to the 25th January 1936 is estimated at 2,604,800 acres. When compared with the area of 2,135,100 acres estimated for the corresponding period of last year, it reveals an increase of about 22 per cent. 400 500 acres have been reported as sown since the last December forecast was issued. This extent is made up of an increase of 151,000 acres under Cambodia, 136,600 acres under Tinnevellies, 55,000 acres under Northerns and Westerns, 47,500 acres under Salems, 11,000 acres under Cocanadas and a decrease of 600 acres under other varieties of cotton in Vizagapatam due to the revision of estimates. The area sown in December and January exceeds that sown in the corresponding period of the previous year by

48,900 acres or by about 14 per cent. An increase in area in the current year occurs in all districts outside Vizagapatam, East Godavari, Kistna, Nellore, Chittoor, Coimbatore, Trichinopoly, Tanjore, Madura and Ramnad. In the Deccan, the area rose from 875,500 acres to 1,224,000 acres owing to the favourable season and the favourable price for cotton. The area under irrigated cotton mainly Cambodia is estimated at 266,400 acres as against 252,300 acres for the corresponding period of last year, an increase of 5·6 per cent. Pickings of the *mungari* or the early sown cotton crop in the Deccan are over. The yield was normal. Yields below normal are reported from all the main cotton growing districts outside Kurnool and the South. The seasonal factor for the Presidency works out to 94 per cent. of the average as against 87 per cent. for the corresponding period of last year. On this basis, the yield works out to 545,400 bales of 400 lb. lint as against 445,600 bales for the corresponding period of last year. It is, however, too early to estimate the yield with accuracy as the harvest has not yet commenced in the major portion of the area and much will depend upon the future weather conditions and the toll taken by insect pests.

The estimated area and yield under the several varieties are given below:-

(Area in hundreds of acres, i. e., 00 being omitted, yield in hundreds of bales of 400 lb. lint, i. e., 00 being omitted.)

Variety.	Area from 1st April to 25th January.		Corresponding yield.	
	1935-36. Acs.	1934-35. Acs.	1935-36. Bales.	1934-35. Bales.
(1)	(2)	(3)	(4)	(5)
Irrigated Cambodia	252,8	241,0	153.1	137.6
Dry Cambodia	311,5	243,2	66,8	48,7
Total, Cambodia ...	564,3	484,2	219,9	186,3
Karunganni in Coimbatore ...	136,6	122,3	29,7	25,0
Uppam in the Central districts ...	33,6	36,4	5,3	5,5
Nadam and Bourbon	3,3	22,7	2	1,0
Total, Salems ...	173.5	181,4	35,2	31,5
Tinnevellies *	480,6	465,3	123,8	107,4
Northerns and Westerns ...	1,224,0	846,0	138.9	86,8
Cocanadas	150,9	146,2	26 3	32,1
Others	11,5	12,0	1,3	1,5

* Includes Uppam, Karunganni and mixed country cotton in the South.

The wholesale price of cotton lint per imperial maund of 82-2/7 lb. as reported from important markets towards the close of January 1936 was Rs. 19-6-0 for Cocanadas, Rs. 24—14—0 for Northerns, Rs. 17—11—0 for early crop Westerns. Rs. 26—5—0 for Cambodia, Rs. 24—12—0 for Coimbatore-Karunganni, Rs. 21-13-0 for Tinnevellies and Rs. 20—9—0 for Nadam. When compared with the prices in the previous month, these prices reveal a fall of 5 per cent. in the case of Cocanadas, 15 per cent. in the case of Nadam and 6 to 9 per cent. in the case of Westerns, Cambodia, Coimbatore-Karunganni and Tinnevellies. The prices of Northerns was stationary.

Gingelly—1935—36—Third Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1933—34 has represented 12 per cent of the total area under gingelly in India. The area sown with gingelly up to the 25th December 1935 is estimated at 500,600 acres. When compared with the area of 462,600 acres estimated for the corresponding period of last year, it reveals an increase of 8·2 per cent. The increase in area is general outside Vizagapatam, East Godavari South Arcot, North Arcot, Salem and South

Kanara. The increase is marked in, Trichinopoly (+18,500 acres). There has been a marked decrease in Salem (– 16.700 acres). The main crop has been harvested except in the south where the harvest is in progress. The crop suffered from drought to some extent and the yield is reported to be below normal except in East Godavari, West Godavari, Kistna, the Deccan, Salem, Ramnad and South Kanara. The seasonal factor for the Presidency works out to 92 per cent of the average as against 84 per cent for the corresponding period of last year. On this basis, the yield is estimated at 61,700 tons as against 53,300 tons for the corresponding period of last year, an increase of about 16 per cent.

Sugarcane—Third or Final Report—1935. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1933—34 has represented 3·7 per cent of the total area under sugarcane in India. The area planted with sugarcane up to the 25th December 1935 is estimated at 131,120 acres. When compared with the area of 122,470 acres estimated for the corresponding period of last year, it reveals an increase of 7·1 per cent. The estimate of the previous year was less than the final area of 125,310 acres by about 2·3 per cent. The present estimate of area exceeds the second forecast by 5,730 acres. The excess occurs mainly in Ganjam, West Godavari, Guntur, Bellary, South Arcot North Arcot, Salem, Coimbatore, Trichinopoly and South Kanara. The increase in area in comparison with the final forecast of 1934 occurs in all districts outside Ganjam, Guntur, Anantapur, Salem, Coimbatore, Madura and Ramnad. The harvest has just commenced and normal yields are expected in all districts outside the Circars (Guntur excepted), Anantapur, Salem and Coimbatore where the yield is expected to be below normal. The seasonal factor for the Presidency is calculated at 97 per cent of the average as against 91 per cent in the previous year. On this basis, the yield is estimated at 360,410 tons of jaggery as against 320,940 tons estimated in January 1935, an increase of 12·3 per cent. The final estimate for 1934—35 was 351,100 tons.

The wholesale price of jaggery per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 6—14—0 in Nandyal, Rs. 6—6—0 in Tuticorin, Rs. 5—15—0 in Kumbakonam, Rs. 5—12—0 in Calicut, Rs. 5—9—0 in Madura, Rs. 5—4—0 in Bezwada, Rs. 4—15—0 in Masulipatam, Guntur, Bellary and Cuddapah, Rs. 4—8—0 in Rajahmundry, Rs. 4—7—0 in Salem, Rs. 4—6—0 in Vellore, Rs. 4—4—0 in Cocanada and Ellore, Rs. 4—2—0 in Vizagapatam, Rs. 3—14—0 in Coimbatore, Rs. 3—13—0 in Trichinopoly and Rs. 3—1—0 in Tinnevelly. When compared with the prices of the previous month, these prices reveal a fall of 19 per cent in Ellore, 14 per cent in Vizagapatam, Masulipatam, Nandyal and Trichinopoly, 13 per cent in Coimbatore, 10 per cent in Guntur, 9 per cent in Bezwada, 8 per cent in Bellary, 5 per cent in Rajahmundry and 4 per cent in Cocanada and a rise of 4 per cent in Cuddapah and Tuticorin. The price remained stationary in Vellore, Salem, Tinnevelly, Kumbakonam and Madura.

Imperial Council of Agricultural Research, Annual Report for 1934-1935—A Review.

The activities of the Imperial Council of Agricultural Research have attracted attention from the Indian States and enquiries, it appears, have been received from some of the important States as to the terms of admission to the Imperial Council of Agricultural Research.

Finance. During the year under review the council received a supplementary grant of Rs. 5,00,000 in lieu of the Annual Research grant that has been suspended, a grant of Rs. 2,50,000 for sugar research work, a special grant of Rs. 33,000 to

enable the council to make good earthquake damage at the Sugarcane Research Station at Mushari, Bihar and Orissa, and a grant of Rs. 33,000 for marketing expenditure on provincial portion of the marketing scheme. The Government further agreed to grant a sum of Rs. 4,16,000 for the establishment of a Central Dairy Institute.

Tobacco. The council has recently made grants to the local Governments and States concerned for the provision of flue-curing barns in connection with a co-operative scheme of experiments, to be carried out in consultation with the Director of the Pusa Institute, the general object of which is to ascertain in what areas the cultivation of cigarette tobacco could be extended. A scheme for a Central Tobacco Sub-station at Guntur, Madras, has since been sanctioned by the Governing Body. The site for the station has already been selected and it is expected to commence work in 1936–37.

Animal Health and Husbandry. During the year under review the Council continued its endeavours to stimulate research in the various branches of animal husbandry. The action taken by the Council to promote measures for the prevention and control of animal diseases by means of suitable All-India legislation was carried a stage further during the year. The draft bill and model rules which had been under the consideration of the Government of India were circulated to local Governments and minor administrations for their views. The following two schemes of animal diseases were sanctioned during the year, namely Investigations into vaccination of cattle against rinderpest in the Central Province, and Investigations of Johne's disease among cattle in Mysore. Under Animal Nutrition and Animal Industry, two schemes of Madras, one for animal nutrition and the other for sheep breeding were sanctioned.

Medicinal Plants. Under this head the scheme from Bengal for Research in the systematic cultivation of medicinal plants and study of food poisons, and a scheme from Mysore for the investigation of the Indian fish poisons and other Indian forest products for their insecticidal properties were financed during the year.

Progress Reports. The report then deals with the discussion of the Council on the progress reports of the various schemes financed by the Imperial Council of Agricultural Research such as rice research, rice physiology, potato breeding, investigations on cereal rusts, fruit research, dry farming, research into properties of colloid soil constituents, preparation of cheap synthetic manure from town refuse and waste materials, etc. In connection with the cold storage scheme of Bombay under fruit research, the report states that in view of the very limited cold storage facilities available at present between Bombay and London and of the difficulties at getting precise information as to the temperature and humidity conditions under which the fruit travelled, it has been decided to suspend experimental shipments, at least until the Poona experiments had yielded accurate technical data regarding the optimum conditions of storage and transport.

Sugar. The special sugar committee which met in July 1935 noted with appreciation the progress made in sugar research but considered that more intensive work was required in several directions, more especially in those connected with the improvement of the quality of the raw material, the raising of the standard of sugarcane cultivation, the combating of diseases and pests, the dissemination of information concerning improved methods, adequate demonstration and the more rapid multiplication and introduction of new seedling canes of proved value and their supply to cultivators. The Government of India made a grant of Rs. 2½ lakhs for financing existing schemes of sugar research during 1935–36.

The expansion of the sugar industry in India consequent on the grant of protection in 1932 has continued at a rapid pace. The United Province had the

largest number of the new factories. No less than 27 new factories began operations in the United Provinces in 1933–34, 14 in Bihar and Orissa, 5 in the Punjab, 2 each in Bengal and Madras, 4 in Bombay and 1 in an Indian State. The total number of cane factories reported to have worked during 1934–35 is 138. The statistical section of the Sugar Bureau collected and distributed statistics relating to the production, consumption, imports and exports of sugar for India and the principal sugar-producing and consuming countries of the world. During the year, 23 students were admitted for training in Sugar Technology at the Harcourt Butler Institute, Cawnpore, on the nomination of the Imperial Council of Agricultural Research. Of these 4 came from Bihar, 4 from Madras, 3 from the Punjab, 3 from Bengal, 2 from the Central Provinces, 2 from Bombay, 2 from the United Provinces and 1 each from Assam, Delhi and an Indian State.

Statistical Section. The statistician's help has been greatly sought after by the different provinces and constituent States in the planning of new experiments and in the interpretation of the experimental data. It might be stated that this section has considerably helped in generally raising the standard of agricultural experiments conducted all over India.

Locust. The locust survey work was continued on much the same lines as in previous years, the staff being distributed in three different circles each under the control of an assistant. In all the areas the desert locust still persisted in small numbers in the solitary phase. The staff visited all important localities in each circle periodically, so as to note the effect of seasonal conditions, on the habits and activities of the locust and on the fluctuation in its numbers. A substantial amount of information has been gathered in regard to breeding habits of locusts of the non-gregarious type and their general response to changes in the seasonal condition, but the data collected are insufficient to permit of definite conclusions. The delimitation of the areas important in regard to locust breeding has been made, and intensive survey work has been carried out in typical localities in such areas.

Marketing. The work in this section started with the appointment of an Agricultural Marketing Adviser in January 1935. He has a number of marketing and assistant marketing officers to help him and all the provincial governments and minor administrations and Indian States are actively co-operating by appointing their own separate marketing staff. The work consisted mainly of initiating a detailed survey of all crop and animal husbandry products.

Standing Committees for Rice and Wheat. The recommendations of the Crop Planning Conference with regard to the formation of standing committees for rice and wheat have been accepted. The functions of these committees would be to include the consideration of all matters relating to the production, marketing and general improvement of these two staple crops, periodical reviews of the statistical position of production and consumption (internal and external) of rice and wheat and progress in research in connection with these two cereals. These committees have just been formed and include representations from Government of India, Local Governments, Constituent Indian States, the Inter University Board, the Associated Chambers of Commerce and Industry.

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The Rice Committee of 45 members includes the following 7 representatives from Madras.

(1) The Director of Agriculture, (2) The Paddy Specialist, (3) The Zamindar of Devarakotta (Chellapallli) President, District Board, Kistna, Masulipatam (Rice Grower), (4) Prof. P. J. Thomas of Madras University, (5) Mr. N. Rangasamy Reddiar, Kuttalam, Tanjore District (Rice Merchant), (6) Mr. A. Pamidiah, Bezwada (Rice Miller) and (7) Mr. K. P. V. S. Mahammad Meera Rowther Sahib Bahadur, M. L. C. Negapatam (Trade Representative).

The Imperial Council of Agricultural Research— Advisory Board Meeting.

The half yearly meeting of the Advisory Board was held in Delhi from 10th to 15th of February, Sir Bryce Burt, Vice Chairman, presiding. Sir Jagdish Prasad, Hon. member for Health, Education and Lands presided over the opening sessions on the 10th and welcomed the members. He paid a tribute to Sir T. Vijayaragavachariar who was the Vice Chairman of the Council ever since its inception. He mentioned it as a pleasing feature that while the Board in its early stages was concerned with a number of applications for grants, at present it was dealing with a number of progress reports in regard to schemes financed by the council to see that the schemes are being worked on proper lines. The important feature of the Board meeting was, he stated, that scientific workers were no longer working in water tight compartments. He referred also to the co-operation of Universities in carrying out important investigations.

The various sub-committees, dealing with rice, soil science, fruit, plant diseases, dry farming, insects, animal husbandry, animal breeding, etc., met at later dates to examine progress reports of schemes already working and to examine new schemes put up to the council for financial help. One of the subjects considered at the Board Meeting was the question of the future research programme of the council and arranging for a special review of the present position of agricultural and veterinary research. One of the new schemes from Madras that came up for discussion at this Board Meeting was about research on coconuts and, we understand, it was passed by the Board with certain modifications.

There are a large number of schemes from the different provinces already approved by the Advisory Board and awaiting sanction of funds to start work on them. We are glad that the Government of India in this year's budget has provided for a grant of 30 lakhs towards agricultural research, and we expect this will enable the Imperial Council of Agricultural Research to provide funds for a large number of schemes that could not be started earlier for want of funds.

College News & Notes.

Students' corner. *Literary.* The valedictory address of the literary section of the Students' Club was delivered by Mr. N. G. Charley, Research Engineer on 13th March. "My tour to Kashmir" was the subject of the discourse. In the lengthy discourse lasting for nearly 2 hours, Mr. Charley touched on the various aspects of Kashmir and Kashmiri life and illustrated his remarks by a number of lantern slides.

Sports. There were a hockey match and a cricket match between the officers and the students. The former ended in a victory for the students and the latter for the officers.

Club Day. The Annual Day of the Agricultural College Students' Club was celebrated with great enthusiasm on the evening of February 22nd. Mr. S. R. U. Savoor, M. A. (Cantab), D. Sc. (Lon.), Bar-at-law, I. E. S., Principal, Victoria College, Palghat was the president on the occasion. The function started with a well arranged tea for guests and members of the club numbering in all over two hundred. While at tea the guests were entertained to a fancy dress competition. The tea was followed by the formal distribution of prizes for winners in various

competitions, literary and athletic. The variety entertainment got up by the students for the occasion was much appreciated by all. The function came to a successful termination after a short speech by the distinguished president. The following were the prize winners: *Essay competition.* 1st S. S. Sarma. 2nd K. Jayaram and J. Raghothama reddy. *Extempore elocution competition.* 1st J. Raghothama Reddy. 2nd H. Krishna Kumar. 3rd S. Krishnananda Sastry. *Colours for proficiency in games. Cricket.* Messrs. C. N. Babu, D. V. Rajagopalan and K. Dinker Rao. *Hockey.* Messrs. Joseph Dass, D. V. Rajagopalan and C. Sampath. *Football.* Mr. M. S. Kolandaiswami. *Parlakimidi cup* for all round proficiency in games and Athletics Mr. Moncey Joseph. *The victory (inter-class) cup.* 1st year. *The Parnell (inter-class hockey) cup.* 1st year. *The Rao Bahadur C. Tadulingam (inter-tutorial) cricket cup.* Mr. K. Ramiah's wards. *The R. Krishnamurthi Rao (inter-tutorial) hockey cup.* Mr. C. Narasimha Iyangar's wards. *The Rao Sahib V. Muthuswami Iyer (inter-tutorial) football cup.* Rao Bahadur S. Sundararama Iyer's wards. The handicap tennis doubles tournament:— *Winners.* Moncey Joseph and Abdul Ghaffoor. *Runners up.* P. M. Sayeed and Herbert Adiseshiah. *The Cecil Wood tennis cup.* (Singles). *Winner.* Moncey Joseph, runner up S. D. S. Albuquerque. *Badminton Doubles. Winners.* Messrs Herbert Adiseshiah and P. M. Sayeed. *Runners up.* Messrs. Subrahmaniam and D. Ramarao. *Badminton fives. Winners.* Mr. Moncey Joseph's team. *Tennikoit doubles. Winners.* Messrs. H. Ramanadha Rao and K. Jayaram. *Runners up.* Messrs. Moncey Joseph and Murugesan. *Basket ball fives. Winners.* Mr. P. Ramanatha Rao's team. *Volley ball sixes. Winners.* Mr. K I. Tobias, team. *Inter-class relay race.* First year. *Intermess tug of war.* West coast mess. *Ping pong. Winner.* Mr. A. V. Parthasarathy. *Runner up.* Mr. S. L. Narayana. *Carrom, Singles. Winner.* Mr. A. V. Parthasarathy. *Runner up.* Mr. Lakshmana Rao. *Doubles. Winners.* Messrs. A. V. Parthasarathy and S. S. Sarma. *Runners up.* Messrs. Somasundaram and J. Suneetha. *Chess. Winner.* Mr. Moncey Joseph. *Runner up.* Mr. J. Subrahmaniam. *Draughts. Winner.* Mr. Ramanujam. *Runner up.* Mr. K. Rajabaniah. *Blow ball. Winner.* Mr. R. H. Krishna's team. *Fancy dress.* 1st Mr. Kannyan. 2nd Mr. Chellappa. 3rd Mr. R. Ali Hyder. *Consolation Prizes.* Messrs. Shanmuganaianar, Gitachari and Ittyachan.

College Day and Conference. As already announced, the College day and conference will come off in July, and it is expected that His Excellency the Governor of Madras will preside. Persons desirous of reading papers at the conference are requested to communicate with the Secretary, M. A. S. U.

Ramasastrulu Munagala Prize. Elsewhere in this issue, appears an announcement regarding this prize. The attention of the members of the Union is invited to it.

The soil survey work in connexion with the Tungabhadra scheme has been completed and we understand that the officer has forwarded his report to Government. Consequent on the winding up of this work the appointments of 10 upper subordinates have been terminated.

Mr. Varahalu, Assistant in Chemistry has been awarded the M. Sc. degree of the Madras University for his thesis on the Chemistry of Jaggery Making.

Rao Bahadur M. R. Ramaswami Sivan, has been returned to the Senate by the Registered Graduates constituency.

The headquarters of the Soil Physicist to the Govt. of Madras has been transferred to Hagari from Coimbatore. Dr. Subba Rao and his assistants left Coimbatore on 29th inst.

Visitors. Mr. P. V. Isacc, Entomologist, Imperial Research Institute of Pusa is on a visit to Coimbatore, in connexion with the study of sugarcane insects.

Mr. F. H. BUTCHER

Mr. F. H. Butcher, Retired Curator of the Government Botanical Gardens, Ootacamund was born at Maresfield in Sussex on the 29th May 1881. He entered the Royal Botanic Gardens, Kew in 1905 after being trained at noted Gardens and Nurseries, including Longleat, the country seat of the Marquis of Bath. Whilst at Kew he obtained certificates for Systematic Botany, Geographical Botany and Physics and Chemistry and was also awarded a certificate for a collection of British plants.

In May 1907, Mr. Butcher was appointed by the Secretary of State for service in India and arrived at the Royal Botanic Gardens at Sibpur, Calcutta on 17th July of the same year, and after training was appointed Assistant Curator of the Garden. Subsequently he also acted as Curator for a short time. From Sibpur, he came over to Ootacamund as acting Curator of the Botanic Gardens and Parks in November 1908, and later was confirmed as Curator in 1910 and held the post until retirement.

During the period spent at Sibpur, he was deputed by the Botanic Survey of India with W. G. Craib, afterwards Professor of Botany at Aberdeen University to tour the Khasia Hills on a plant collecting expedition during which a large collection of herbarium specimens and living plants were made, one or two of which were I believe, new to science. At the Sibpur Botanic Garden he worked successively under Col. Gage, I. M. S., the then Superintendent and Sir William Wright Smith, the then Curator of the herbarium who for a time acted as Superintendent and is now Regius Keeper of the Royal Botanic Garden, Edinburgh and world famed botanist. It was mainly through Sir William's influence that Mr. Butcher was appointed to the Botanic Gardens, Ootacamund.

During his regime as Curator many new trees and plants have been introduced to the Nilgiris; the Agricultural Research Station at Nanjanad was established by him in 1917 and until a few years ago remained in his charge excepting for brief periods. The Pomological Station at Coonoor was also started by him in 1920 and still remains in his charge, the more important fruits successfully introduced and cultivated at this Station being the Japanese Plum, the Grape-fruit, Persimmon and one or two varieties of Apple. The Kallar and Burliar Fruit Stations are also in his charge and at these Stations the culture of the Mangosteen has received special attention and a large number of young trees of these have been established and are coming into bearing.

Mr. Butcher has been the Secretary of the Nilgiri Agri-Horticultural Society for over 27 years and was present at the Society's Annual Exhibitions every year with one exception.

He joined the Nilgiri Volunteer Rifles (now designated as the Nilgiri Malabar Battalion) in 1912, received his first Commission in 1915, rose to the Second in Command of the Battalion and retired with the rank of Major in 1934. He was the recipient of the General Service Medal for services rendered during the Great War, the Indian General Service Medal (Malabar) and the Volunteer long service Medal. Mr. Butcher is also a prominent Freemason and was for many years a keen *Shikari*. We wish him in his retirement, all health and happiness. (*R. C. B.*)

Weather Review (FEBRUARY 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	3·2	+2·5	4·8	South	Negapatam	4·2	+3·6	4·2
	Berhampore *	3·4	+2·5	5·1		Aduthurai *	2·0	+1·8	2·0
	Calingapatam	2·8	+2·4	2·9		Madura	2·5	+2·4	2·7
	Vizagapatam	3·7	+2·9	4·7		Pamban	1·3	+0·7	1·7
	Anakapalli *	4·6	+1·8	0·0		Koilpatti *	1·2	+0·5	1·3
	Samalkota *	7·2	+6·2	7·5		Palamkottah	1·4	+0·6	1·60
	Maruteru *	4·1	+3·9	4·1					
	Cocanada	3·4	+3·1	4·6					
	Masulipatam	4·4	+3·9	4·4	West Coast	Trivandrum	0·0	−0·7	0·4
						Cochin	1·5	+0·7	1·4
	Kurnool	1·7	+1·6	1·7		Calicut	3·3	+3·1	3·3
Ceded Dists.	Nandyal *	1·1	+0·9	1·1		Pattambi *	0·7	+0·1	0·7
	Hagari *	0·90	+0·5	0·9		Taliparamba *			
	Bellary	0·0	−0·2	0 0		Kasargode *	0·2	−0·1	0·18
	Anantapur					Nileshwar *	0 3	+0·1	0 3
	Cuddapah	0·5	+0 4	0·5		Mangalore	0·8	+0·8	0·8
	Nellore	1·9	+1·8	1·9					
Carnatic	Madras	2·5	+2·2	2·6	Mysore and Coorg	Chitaldrug	0·1	+0·1	0·1
	Palur *	2·4	+2·2	2·4		Bangalore	0·0	−0·1	0·0
	Palakuppam *	1·5	+0·67	1·53		Mysore	0·2	0·0	0·2
	Cuddalore	2·0	+1·1	2·0		Mercara	0·3	0·0	0·3
	Vellore	0·7	+0·3	0·7					
Central	Hosur cattle farm *				Hills.	Kodaikanal	0·6	−0·8	0·8
						Coonoor	2·7	—	4·2
	Salem	3·5	+3·3	3·5		Ootacamund *	0·8	+0·1	5·9
	Coimbatore	1·4	+1·0	1·4		Nanjanad *	0·8	+0·3	1·0
	Coimbatore Res. Inst. *	1·2	+0·8	1·2					
	Trichinopoly	0·6	+0·1	0·9					

* Meteorological Stations of the Madras Agricultural Department.

Summary of Weather Conditions. During the month a number of Western disturbances affected the North West Frontier. These disturbances caused thunderstorms and local rains in Kashmir, Baluchistan and North West Frontier. Thunderstorms gave nearly general rain in the West Central Provinces and local rain in the North Hyderabad, North Madras coast, Mysore and Malabar. Light

scattered rains were general in the South East Madras during the first week of February. Later there occasioned general rainfall in the South East of Madras.

Skies were moderately to heavily clouded during 2nd and 3rd week and lightly to moderately clouded in the 1st and last week of this month in the Peninsula.

Humidity was generally in excess in the Madras Presidency. The minimum temperatures in general, were above normal in the Peninsula.

Rainfall was in large excess in the Circars and in moderate excess in the Central and Southern districts and in Deccan and nearly normal elsewhere.

Weather Report for Research Institute Observatory:

Report 2/36.

Absolute Maximum in shade	93·5°F.
Absolute Minimum in shade	57·5°F.
Mean Maximum in shade	91·0°F.
Departure from normal	+ 0·4°F.
Mean Minimum in shade	67·9°F.
Departure from normal	+ 2·4
Total Rainfall	1·21"
Departure from normal	+ 0·81
Heaviest fall in 24 hours	1·14" recorded on 10th.
Total number of rainy days	1
Mean daily wind velocity	2·2 M. P. H.
Mean Humidity at 8 hours	75·4%
Departure from normal	+ 3·9

Summary. The maximum and minimum temperatures were above normal during this month. Humidity was in excess of the normal by 3·9%. A rainfall of 1·14" was recorded on 10th. The skies were moderately to heavily clouded during this month P. V. R. & D. V. K.

Departmental Notifications.

Gazette Notifications. 1. Mr. Butcher permitted to retire from 26--2—'36. 2. Mr. P. Abishekanathan Pillay appointed as curator, Govt. Botanic Gardens, Vice 1. 3. Mr. C. Ramaswami, A. D. A., Cuddalore, l. a. p. for eight months, outside India. Mr. S. Narayaniah to officiate as A. D. A,, Vice 3, posted to Tinnevelly. 4. Mr. R. N. K. Sundaram, A. D. A., Tinnevelly to be A. D. A., Cuddalore.

Subordinate Service. *Promotions.* Mr. V. Ratnaji Rao, Agricultural section from III grade to II grade (Rs. 225), with effect from 26—2—'36. Mr. C. S. Gopalaswami Rao, Mycology section—IV grade to III grade (Rs 200) from 26—2—'36.

Transfer. Consequent on the winding up of soil survey work in the Tungabadra project, Messrs. G. K. Chidambaram and C. Raghavendrachar to revert to their posts as Assistants in Chemistry under the G.A.C. Mr. K. Raghunatha Reddy to Agricultural Section, IV circle. Mr. K. Tejappa Shetty to Agricultural Section, III circle. Mr. M. Subba Reddy to Agricultural Section, Fruit Station, Kodur. Mr. M. Rama Reddy to Agricultural Section, II circle. Mr. V. V. Jaganatha Rao, Agricultural Section, I circle. Mr. M. Sitharama Raju, Agricultural Section, A. R. S., Anakapalle. Mr. W. Tirumal Rao to be offg. Assistant in Chemistry. Mr. A. B. Adiseha Reddy to be officiating Assistant in Chemistry. Mr. Bennet P. Masilamony to Agricultural Section, III circle. Mr. K. Venkataswami to Agricultural Section, IV circle.

Mr. M. C. Menon, F. M., Live Stock, R. S. Hosur to be F.M.A.R.S., Taliparamba, Mr. K. Krishnan, F.M.A.R.S., Taliparamba to Live Stock Section, Hosur.

Leave. Mr. V. Kumaraswami, A. D., Madanapalle, l. a. p. for 3 months from 15—4—'36. P. N. Muthuswami, A. D. Tiruppur (Co_2 Scheme) leave for two months from 19—2—'36. Mr. K. Veerabadra Rao, Assistant in Chemistry leave for 2 months and 17 days from 26—2—'36.

Termination of Appointments. Upper Subordinates, Messrs. P. C. Sahadevan, V. V. Rajagopalan, K. Minakshisundaram, K. M. Narayanan, B. G. Narayana Menon. K. Venkatadri Reddy, M. Srinivasa Rao, K Krishnamurthi, C. Vadamalai with effect from 1—1—'36

The Ramasastrulu—Munagala Prize, 1936.

1. The prize will be awarded in July 1936.

2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, carried out by him on any agricultural subject.

3. The subject matter shall not exceed in length twelve foolscap pages, type-written on one side.

4. Intending competitors should notify the President or Vice-President of the Madras Agricultural Students' Union not later than the 15th May the subject of the paper which they propose to submit, and the paper should be sent in so as to reach the President or Vice-President, Madras Agricultural Students' Union not later than the 1st June 1936, with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a nom-de-plume.

5. Four type-written copies of the essay should be sent in.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.

7. Papers submitted will become the property of the Union, and the Union reserves to itself the right of publishing all or any of the papers.

8. All references in the paper to published books, reports or papers by other workers must be acknowledged.

9. Any further particulars may be obtained from the President or Vice-President, Madras Agricultural Students' Union, Lawley Road, P. O., Coimbatore.

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JULY 1936