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CONTENTS

THE EFFECT OF TIME OF PLANTING ON SOME ECONOMIC CHARACTERS OF THE COTTON PLANT *

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Introduction. To the plant-breeder familiar with Indian cottons, and to a smaller extent to the grower, middleman and the spinner, a general decline in the chief characters of the cotton plant with the advance of the season is a matter of common knowledge. To investigate whether this phenomenon is due to senility or to the increase in temperature experienced as the plant grows old is the prime object of the following enquiry. With this end in view, the investigation was begun with a number of sowings made on different dates in two years in order to be able to compare material obtained from plants of varying ages under constant temperatures.

Materials and Methods. The data discussed in this paper were obtained from culture 539, a pure strain of Karunganni cotton (*G. indicum*), grown on the Cotton Breeding Station, Kovilpatti, Tinnevelly District during the two seasons 1927—28 and 1928—29. During 1927—28, the seed of this culture was sown in four adjacent plots in a fairly uniform field on (1) 31—10 27, (2) 15—11—27, (3) 9—12 27 and (4) 24—12—27 entirely under rainfed conditions. The earliest sowing made synchronized with the normal sowing of cotton on the station succeeding as usual the general sowing rains. During the season

* Paper which won the Ramasastrulu - Munagala prize in 1931. The paper was illustrated by graphs.

1928—29, sowings were done on six different days, namely (1) 1—9—28, (2) 1—10—28, (3) 18—10—28, (4) 8—11—28, (5) 23—11—28 and (6) 8—12—28, the last four being under rainfed conditions against the first two sown on artificially prepared seed beds. The sowing made on 18—10—28, though under rainfed conditions, was very much earlier than the normal sowings of cotton on the station during the year. Plants in all the plots during both the seasons were given a spacing of a foot and a half between rows and thinning was done when the plants were about six inches high leaving a stand of about nine inches from plant to plant in the row. The usual cultural operations ordinarily received by the normal crop were attended to.

Season (a) 1927—28. The annual rainfall recorded for the year was 36·4 inches, i. e., about 5 inches over and above the average for the preceding 23 years. The monsoon for sowing rains broke at the usual time and the sowings of cotton were done at normal period (end of October) and the germinations were good. About 4 inches of rainfall received during February 1928 brought about considerable shedding.

(b) **1928—29.** The total rainfall recorded during the year was 30.56 inches against an annual average of 31·63 inches. The north-east monsoon was delayed by a fortnight but gave the average rainfall in October and November. Continuous wet weather prevailed during December. This was followed in January by a most welcome dry spell. The unusual downpour in February was quite inopportune and caused a tremendous shedding of buds and bolls. On the whole, the season was unfavourable to cotton.

Characters Studied. The behaviour of the following economic characters with regard to the plants of different ages was studied for purposes of comparison, and discussion will be taken up character by character.

1. Position of first fruiting branch node.
2. Flowering activity (during 1927-28 only).
3. Boll production (do).
4. Lint length.
5. Kapas weight per seed.
6. Seed weight per seed.
7. Lint weight per seed.
8. Ginning percentage.

(i). *Position of first fruiting branch node.* It has, in general, been observed by many workers that the lower the node of the main stem from which the first sympodial or the fruiting branch arises, the earlier is the 'arrival of the crop' provided there is no shedding. The effect of the difference in the sowing dates on the position of the first fruiting branch node will be seen from Table 1. which gives the frequency arrays for each of the ten plots.

During both the seasons, the modes in the earliest sown plots are at the highest places and they systematically drop down in the succeeding plots. The frequency curves of the last sown plots during both the years, i.e., sown on 24-12-27 and 8-12-28, however, are complicated in that they show a bimodal nature. With the results of the first season, it was thought that the bimodal nature was, to a small extent, attributable to the fewer number of determinations. The repetition of the same phenomenon during the second year of the experiment with a large number of determinations negatived the assumption. The rainfall of nearly 3 inches on 5-2-28 and 7-2-28 during the first year and of nearly 5 inches from 2-2-29 to 8-2-29 during the second, at a time when the first fruiting branches were just emerging from out of their buds must have accelerated the general vegetative growth of the plants in these two last sown plots, and such of those as had not produced their first fruiting branches at the time must have formed them higher up the stem when drier conditions prevailed again. Kaserar (8) has suggested that the carbon dioxide of the soil must be at the disposal of the plants at the time of flower and fruit formation, that the production of this carbon dioxide is, in turn, dependent to a marked extent on temperature relationships among other factors, resulting in a fairly dry condition of the top layers of the soil and that conditions opposite to these will induce increased vegetative growth. No other cause is visible for the occurrence of two modes in these curves of the last sown plots.

To see if the observed differences in these modes of the different sowings were due to the seasonal factor or to errors in sampling, Karl Pearson's Test (7) of significance was adopted in the case of the first year's data and it is found, (Table 2), that each successive sowing has definitely a lower node from which arises the first fruiting branch.

(ii). *Flowering activity.* The data available in this connection (from results of 1927-28) persent features already observed by other workers. Balls and Holten (4) have dealt with this aspect, in detail, in the case of Egyptian cotton.

The data were procured from records of daily census of flowers taken on a certain number of plants marked out in each plot. Table 3 gives the total number of flowers produced per plant. Concurrent with the experiences of Buie (5) and Balls (3), it was seen that the intervals between the beginnings of the flowering phases of the successive sowings are in inverse ratio to the intervals between their sowing dates. The main flowering periods are in the order of their sowings, the earliest sown spreading over a period of two months and the second and the third plots over a period of a month each. The last sown plot is prominent from the beginning of April to the end of May—i. e., over a period of two months, and the latter part of it extends over the clearly defined summer period of the other three plots.

Further, the curve is multimodal, and when smoothened converges to two modes. A reference to the corresponding frequency curve of the first sympodial node already discussed and to the bolling curve (to be presented subsequently) will reveal its close identity with them except for the definite lag and earliness respectively, representing the time intervals required for the buds to develop into flowers and for the flowers to develop into bolls. Beyond temperature acting most probably as an indirect agent, no other marked factor seems to have caused this profuse flowering, which might have either been brought about by a comparatively greater bud production or by a greater bud retention. The space allowance for the plants of this plot was comparatively more than that for plants of the other plots, owing to poor germination. This is another possible causal factor resulting in profuse flower production.

The total number of flowers produced per plant in the various plots up to any required time shows that the rates of flower production increase according to the lateness of the sowing dates. The commencement of April appears to be a critical time so far as the environment of the preceding nine or ten months is concerned and plants which had not put forth their blooms by this time but which had attained the bare minimum age required to start the phase of flower production were apparently compelled to do so by the environment. Except in the case of the last plot, the differences in the total number of flowers produced per plant at the end of the season are not marked.

Buie (5) has also observed that delaying the planting for two weeks delayed the flowering activity by one week and that early plantings had produced by mid-season a much larger number of flowers. Ballard and Simpson (2) have also noted slightly larger number of flowers in late planted cotton.

(iii) *The Bolling curves*:- The data in this connection were obtained from the record of bolls picked on alternate days and once in three days during the two years 1927–28 and 1928–29 respectively. The bolling curve, representing as it does the net result of the effect of shedding on blooming should be identical with the flowering curve if all the flowers which opened were ripened into bolls, and this rarely happens. During the first year of the experiment, as in the case of the flowering curves, the main periods of boll production in the various plots are in the order of planting, i. e., 'the arrival of the crop' is earliest in the first sown plot and latest in the last sown. The curve of the last sown plot is prominent with two peaks as pointed out at an earlier stage and the bimodal nature of the first sympodial frequency curve seems to be the main cause for this as in the case of the corresponding flowering curve. The same observations hold good for the results of the second year also.

Table 4 gives the number of bolls per plant picked in the various plots by fortnightly intervals, and the totals in each case show that the bolls produced in the last plot during 1927–28 outnumber those of any other during the year though consisting of useless kapas. During 1928–29, the two sowings prior to the normal, i.e, the sowings made on 1–9–28 and 1–10–28 have yielded a considerably larger number of bolls than the rest.

(iv). *Lint length*:— Material for the study of lint length was collected at intervals of three days during both the years. Since four-locked bolls predominate in this selection 539, staple measurements were confined to bolls of this category. From the collection of every picking day, six representative seeds of third position as described in (1) *Agricultural Journal of India* Vol. XXV. Part I — were taken out for the determination of staple length, the method followed being the usual one adopted by Hilson (6).

The results obtained are summarised in Table 5 and shows the variations in the plots during both the seasons. During 1927–28, the differences in the lint lengths of the plots sown on (1) 31–10–27 and 15–11–27, (2) 31–10–27 and 9–12–27 and (3) 31–10–27 and 24–12–27 are found to be statistically significant. During 1928–29, significant differences are found in the following cases – (1) 1–9–28 and 1–10–28, (2) 1-9-28 and 18-10-28, (3) 1-10-28 and 8-11-28 and (4) 18-10-28 and 8-11-28. During the first year, differences are observed in lint lengths between the normal sown plots and the late sown ones, which exhibit no such differences among themselves. Similarly, during the second year also, the last three plots exhibit no differences, while differences are obtained among the first four plots, though the pair of sowings made on 1-10-28 and 18-10-28 is an exception. It must be mentioned at this stage that the normal sowings of cotton on the farm extended up to 29-10-28 so that the sowing on 18-10-28 is also to be treated as one made prior to the normal season. During both the years, the observations show that there is a general tendency in all the plots for the lint length to increase with the advance of the season and then shorten towards the end. As lint length is mostly influenced by soil moisture, the shortening towards the end is possibly due to the lack of proper moisture conditions in the soil at the time. The plot sown on 1-9-28 during 1928-29 exhibits the maximum length which must be attributed to its being far earlier than the normal time which probably has given it a chance for a good development as regards length.

(v). *Kapas, lint and seed weights and ginning percentage.* As in the case of staple length, material for the study of kapas, seed and lint weights was collected at intervals of three days during both the years, and the examination was confined only to the contents of four-locked bolls. From each picking, all the good locks were spread out, one hundred seeds (or as many as were available if less than one

hundred) representing all the locks and all the positions of seeds within a lock were picked out for purposes of the determinations of kapas, seed and lint weights and their respective averages per seed worked out after weighment. In all these cases, readings of the same picking dates of any two plots to be compared were taken to work out the standard deviation of the average difference of the pairs as per 'student's method'; in other words, the samples compared were from the pickings of the same periods in the season but they were from plants of different ages. The results obtained from a study of these characters are summarised in Table 6.

Kapas weight. In general, the earlier sown plots have given a higher kapas weight per seed. In the comparisons made during the first year, the results are always found to be statistically insignificant. During the second year, the last three sowings exhibit no differences, while five comparisons among the first four plantings exhibit significant differences. These are (1) 1—9—28 and 1—10—28, (2) 1—9—28 and 8—11—28, (3) 1—10—28 and 18—10—28, (4) 1—10—28 and 8—11—28 and (5) 18—10—28 and 8—11—28.

Seed weight. In the case of seed weight also, similar results are obtained except in the comparisons between seed weights of plants raised from plots sown 15—11—27 and 9—12—27, where the higher seed weight of 15—11—27 is found to be statistically significant. During the second year, differences which are significant are obtained in all the five comparisons found significant with reference to kapas weight (mentioned above under kapas weight) and in addition in the comparison between sowings on 1—9—28 and 18—10—28.

Lint weight. In general, lint weight seems to decrease as the season advances and during both the years age does not seem to affect lint weight except during the second year in the comparison between plot sown on 1—10—28 and 18—10—28. Lint weight presents greater uniformity than either seed or kapas weights.

With reference to all these three characters, during 1928—29 the general decrease in values with the advance of the season receives a reversal about the beginning of May, which is probably due to the effect of heavy shedding caused by the unusual downpour of February 1929. The rise in values about the beginning of May is to be attributed to the plant's struggle to reproduce its best in the face of a very bad season.

Ginning percentage. The results are shown in Table 7. During 1927—28, statistically significant difference is obtained in the comparison between plants sown on 31—10—27 and 15—11—27. During the second year, comparisons among the last three plots do not exhibit differences, while four cases among the first sown four plots, namely, differences, between (1) 1—9—28 and 1—10—28, (2) 1—9—28 and

18—10—28, (3) 1—10—28 and 8—11—28 and (4) 18—10—28 and 8—11—28 exhibit significant differences. It will be remembered that under lint length the same comparisons exhibited significant differences, and it looks as though when lint length increases, ginning percentage decreases. The general trend has been for the ginning percentage to decrease with the advance of the season irrespective of the age of the plant.

Resume. The foregoing observations fall into groups according to the results obtained in each case. In the first of these comprising the characters, first fruiting branch node, flowering and bolling, definite differences were observed between early and late sown plots. In the second of these groups, namely, lint weight, practically no difference is seen except in one case. In the last of these groups, we have the characters, lint length, kapas and seed weights and ginning percentage, where the differences are significant in certain cases and insignificant in certain others.

A perusal of Tables 5 and 6 shows that in all the four characters, lint length, kapas, seed and lint weights, the curves of the various plots, more or less, coincide in each case, a general rise or decrease in length and weights brought about by the seasonal factor affecting all the plots.

From the nature of the results obtained, the principal indications are that characters like (1) first sympodial node position, (2) flowering and (3) bolling are definitely influenced by the age of the plant in a marked degree, while boll characters, like lint length, kapas and seed weights, are affected by the age of the plants raised particularly very early in the season. With reference to lint weight even very early planting does not seem to influence it. After the normal sowing season, plants raised at successive intervals are mostly alike with regard to these characters. All aspects considered, from the point of view of the breeder of rainfed cottons, every endeavour should be made to sow seeds at the right period after the general rains and avoid for experimental purposes plants raised subsequently in blank holes.

Summary. The following principal indications are arrived at from a consideration of the comparisons made of some economic characters of cotton plants of different ages raised on the black soils of the Kovilpatti Cotton Breeding Station, during the two seasons 1927—28 and 1928—29, a favourable and a distinctly unfavourable season, respectively.

(1) The first fruiting branch is produced from a lower node on the stem by the late sown plants.

(2) The respective intervals between the beginnings of the flowering phases of the successive sowings are in inverse ratio to the intervals between their sowing dates.

(3) The active flowering periods of the successive sowings are seen to be delayed in inverse proportion to the lateness in the respective sowing dates.

(4) The early plantings produced by the middle of March a much larger number of flowers and by the first week of April all the plots were at the same level with regard to the number of flowers produced by them up to that time.

(5) The main periods of boll production in the various plots are in the order of their planting and sowings made earlier than the normal time have given a greater number of bolls per plant.

(6) Lint length, kapas and seed weights and ginning percentage seem to be affected by sowings made prior to the normal season, the late sown lots being more or less alike.

(7) Lint weight does not seem to be affected by the age of the plant even by making sowings earlier than during the normal season.

Note:--Items 2, 3 and 4 are conclusions from the results of 1927-28 only.

LITERATURE CITED

1. AYYAR V. R. AND RAO C. J. Variation in lint length in cotton. ***Agri Jou. of India*** Vol. XXV. Part I. 1930. Page 46.
2. BALLARD AND SIMPSON. Effect of time of planting on cotton plant (U. S. Dept. of Agr. Bull 1320. 1925) Extr. from ***Agr. Jou. of India*** Vol. XXII Part 2. March 1927.
3. BALLS W. L. Cotton Plant in Egypt. 1912.
4. BALLS AND HOLTEN. Part 2 Analysis of Agricultural yield. The sowing date expt. with Egypt. cotton 1913, ***Phil. Trans. Royal Soc. B.*** Vo. 206--1915.
5. BUIE. The fruiting habits of the cotton plant. Symposium on cotton. ***Jou. of Am. Soc. Agron.*** Vol. 20 No. 3 March 1928.
6. HILSON G. R. Methods of examination of certain characters in cotton. ***Pusa Agr. Res. Inst. Bull.*** No. 138.
7. KARL PEARSON. Tables for Statisticians.
8. KASERAR. The relation of soil and air temperatures in their influence on crop returns. Extract in the ***Int. Rev. of the Prin. & Prac: of Agr.*** No. 5 of 1918.

Table 1—Showing Frequencies of the First Fruiting Branch Node.

Class.	1927—'28 Sown. 31-10-27	1927—'28 Sown. 15-11-27	1927—'28 Sown. 9-12-27	1927—'28 Sown. 24-12-27	Class.	1928—'29 Sown. 1-9-28	1928—'29 Sown. 1-10-28	1928—'29 Sown. 18-10-28	1928—'29 Sown. 8-11-28	1928—'29 Sown. 23-11-28	1928—'29 Sown. 8-12-28
7	...	1	...	...	7	...	...	...	...	1	...
8	1	2	1	...	8	...	...	...	1	38	19
9	3	2	5	7	9	...	1	...	16	188	88
10	11	20	13	8	10	...	1	1	67	205	107
11	55	99	75	16	11	2	...	1	349	236	105
12	72	161	61	8	12	...	...	8	322	189	60
13	101	102	43	10	13	...	...	17	158	116	41
14	89	66	17	16	14	2	2	11	60	19	61
15	39	28	10	14	15	3	4	10	10	16	78
16	13	9	3	9	16	2	1	...	5	6	43
17	5	5	1	1	17	...	...	4	1	2	24
18	1	1	...	...	18	2	...	...	...	...	14
19	1	2	...	...	19	1	1	...	...	1	9
					20	...	...	...	...	...	5
					21	...	...	2	...	...	1
Total	391	493	229	89	Total	12	10	54	989	1017	655

Table 2—Showing the probability of the differences of the frequency arrays of the first fruiting branch nodes, 1927–28.

Comparison between plots.	N	X^2	P	Significant or not.
31-10-27 & 15-11-27	7	37·99	·0000	Significant.
15-11-27 & 9-12-27	5	21·70	·0001	do

Table 3—Showing the total number of flowers produced per plant, 1927—28.

Sown on	Total number of flowers per plant.
31-10-27	41
15-11-27	42
9-12-27	49
24-12-27	65

Table 4 Showing the No. of bolls per plant picked in the various plots by fortnightly intervals.

	1927—'28.					1928—'29.					
Total No. of bolls up to & including	Sown 31-10-27	Sown 15-11-27	Sown 9-12-27	Sown 24-12-27	Total No. of bolls up to & including	Sown 1-9-28	Sown 1-10-28	Sown 18-10-28	Sown 8-11-28	Sown 23-11-28	Sown 8-12-28
2-4-28	2·64	0·70	0·02	...	19-3-29	8·47	5·34	3·53	0·12	...	...
17-4-28	0·95	0·67	0·03	...	3-4-29	7·21	4·39	3·07	0·46	0·03	...
2-5-28	0 64	2·30	1·61	0·07	18-4-29	1.12	0·43	0·72	0·13	0·04	...
17-5-28	0·20	1·35	2·16	2·42	3-5-29	0·40	0·07	0·20	0·14	0·05	0·10
1-6-28	0·02	0·03	0.35	1·18	18-5-29	0·14	0·09	...	0·68	0·75	0·56
16-6-28	0·07	0·02	0.15	2·22	2-6-29	0·09	0·02	...	0·61	1·03	0·84
1-7-28	0·41	0·23	0·07	0.61	17-6-29	1·23	0·86	0·62	0·67	1·04	0·96
					2-7-29	1·33	1·25	1·05	0·59	0·70	1·02
					17-7-29	0·42	0·39	0·60	0·29	0·18	0·94
Total.	4.93	5·30	4·39	6·50	Total.	20·41	12·84	9·79	3·69	3·82	4·42

Table 5. Showing the difference in the lint lengths (per seed in mms.) of four-locked bolls of the various plots compared.

1927—28.

Comparison between plots sown on	N	Average 1.	Average 2.	Diffce. 1 – 2.	Stand. dev. of diffce.	Diffce. / σ diffce. Z	P.	Odds.	Signif. or not.
1 31 – 10 – 27 & 2. 15 – 11 – 27	22	23·76	23·245	0·514	1·1493	0·4481	·9716	38:1	Signif.
1. 31 – 10 – 27 & 2. 9 – 12 – 27	11	24·164	22·755	1·409	1·3565	1·0386	·9957	232:1	do.
1. 31 – 10 – 27 & 2. 24 – 12 – 27	6	23·85	21·95	1·90	1·6115	1·179	·9768	42:1	do.
1. 15 – 11 – 27 & 2. 9 – 12 – 27	11	23·155	22·755	0·4	1·3247	0·302	·8174	4:1	No.
1. 15 – 11 – 27 & 2 24 – 12 – 27	6	22·73	21·95	0·783	1·5585	0·50	·8428	5:1	No.
1. 9 – 12 – 27 & 2. 24 – 12 – 27	6	22·55	21·95	0·60	0·9039	0·6638	·8991	9:1	No.

Table 5 (contd). Showing the difference in the lint lengths (per seed in mms.) of four-locked bolls of the various plots compared.

1928—1929.

Comparison between plots sown on	N	Average 1.	Average 2.	Diffce. 1 – 2.	Stand dev. of diffce.	Diffce. / σ diffce. = Z	P.	Odds.	Signif, or not,
1. 1--9--28 & 2. 1--10--28	14	24·79	23·89	0·90	1·341	·6713	·9837	60:1	Signif.
1. 1--9--28 & 2. 18--10--28	18	24·92	23·88	1·04	1·605	·6506	·9914	115:1	do.
1. 1--9--28 & 2. 8--11--28	19	24·57	24·41	0·16	1·194	·1367	·7157	3:1	No.
1. 1--9--28 & 2. 23--11--28	9	23·86	23·73		1·035	·118	·6276	2:1	No.
1. 1--9--28 & 2. 8--12--28	7	23·87	23·91	-0·04	0·5729	·0748			No.
1. 1--10--28 & 2. 18--10--28	14	23·89	23·78	0·11	1·073	·0993	·638	2:1	No.

Table 5 (contd). Showing the difference in the lint lengths (per seed in mms.) of four-locked bolls of the various plots compared.

1928—29.

Comparison between plots sown on	N	Average 1.	Average 2.	Diffce. 1 – 2.	Stand. dev. of diffce.	Diffce. / σ diffce. = Z	P.	Odds.	Signif. or not.
1. 1--10--28 & 2. 8--11--28	11	23·82	24·48	-0·66	0·7216	·9196	·9920	124:1	Signif.
1. 18--10--28 & 2. 8--11--28	14	23·72	24·53	-0·81	0·9228	8748	·9959	243:1	do.
1. 8--11--28 & 2. 23--11--28	16	24·39	24·50	0·11	0·3372	·3151	·8804	7:1	No.
1. 8--11--28 & 2. 8--12--28	15	24·41	24·21	0·20	0·9274	·2156	·7854	4:1	No.
1. 23--11--28 & 2. 8--12--28	14	24·59	24·19	0·40	0·9817	·4075	·9174	11:1	No.

Table 6. Showing the differences in Kapas, seed and lint weights (per seed in mgms) of four-locked bolls of the various plots compared

1927—28

Comparison between plots sown on	Character	N	Average 1	Average 2	Diff. 1--2	Stand. dev. of diffce	Diff. / σ diff. Z	P	Odds	Signif. or not
1. 31-10-27 & 2. 15-11-27	Kapas wt.	18	78·31	78·16	0·156	5·2904	0·0295	·6575	2:1	No
1. 15-11-27 & 2. 9-12-27	do	7	74·27	71·30	2·97	4·043	0·735	·9393	15:1	No
1. 31-10-27 & 2. 15-11-27	Seed wt.	18	54·97	54·46	0·506	3·522	0·144	·7103	2:1	No
1. 15-11-27 & 2. 9-12-27	do	7	51·69	4·74	1·943	2·042	0·951	·9702	3:1	Signif.
1. 11-10-27 & 2. 15-11-27	Lint wt.	18	23·99	24·36	0·367	2·028	0·181	·7632	3:1	No
1. 15-11-27 & 2. 9-12-27	do	7	23·14	22·14	1·00	2·377	0·421	·8273	5:1	No

Table 6 (contd.)—Showing the differences in Kapas, Seed and lint weights (per seed in mgms) of four-locked bolls of the various plots compared

1928—29

Comparison between plots sown on.	Character	N	Average 1	Average 2	Diffce. 1 – 2	Stand. dev. of diffce.	diffce. / σ diffce. Z	P	Odds	Signif or not
1. 1--9-28 & 2. 1-10-28	Kapas wt.	11	75·18	69·64	5·55	2·903	1·910	·9999	Overwhelming.	Signif.
1. 1--9--28 & 2. 18-10-28	do.	14	74·93	73·07	1·86	4·147	·4541	·9331	14:1	No.
1. 1--9--28 & 2. 8-11-28	do.	13	72·0	74·92	– 2·92	5·540	·5277	·9529	20:1	Just Signif.
1. 1--9--28 & 2. 23-11-28	do.	5	68·0	69·40	– 1·40	4·715	·2969	·7096	2:1	No.
1. 1-10-28 & 2. 18-10-28	do	11	69·64	73·55	– 3·91	3·80	1·029	·9955	221:1	Signif.
1. 1-10-28 & 2. 8-11-28	do.	9	68·33	75·22	– 6·89	4·998	1·378	·9977	434:1	do.
1. 18-10-28 & 2. 8-11-28	do.	11	72·18	75·91	– 3·727	4·286	·8696	·9894	93:1	do.

Table 6 (contd). Showing the differences in Kapas, seed and lint weights (per seed in mgms) of four-locked bolls of the various plots compared

1928—29

Comparison between plots sown on	Character	N	Average 1	Average 2	Diff. 1--2	Stand. dev. of diffce	Diff. / σ diff. Z	P	Odds	Signif. or not
1. 8-11-28 & 2. 23-11-28	Kapas wt.	15	73·07	73·80	−0·73	2·909	·2521	·8033	4:1	No
1. 8-11-28 & 2. 8-12-28	do	15	71·93	73·07	−1·13	5·451	·2079	·7761	4:1	No
1. 8-11-28 & 2. 8-12-28	do	14	73·36	72·79	0·57	5·513	·1036	·638	2:1	No
1. 1-9-28 & 2, 1-10-28	Seed wt.	11	50·18	45·45	4·73	1·764	2·68	·9999	Overwhelming	Signif.
1. 1-9-28 & 2. 18-10-28	do	14	50·21	47·86	2·36	2·351	1·003	·9984	624:1	do
1. 1-9-28 & 2. 8-11-28	do	13	48·38	50·77	−2·39	4·359	·5471	·9578	23:1	do

Table 6 (contd). Showing the differences in Kapas, seed and lint weights (per seed in mms.) of four-locked bolls of the various plots compared.

1928—29.

Comparison between plots sown on	Character.	N	Average 1.	Average 2.	Diffce. 1 − 2.	Stand. dev. of diffce.	Diffce. / σ diffce. Z	P.	Odds.	Signif. or not
1. 1--9--28 & 2. 23--11--28	Seed wt.	5	47·20	47·80	−0·60	3·826	·1568	·617	2:1	Not Signif.
1. 1--10--28 & 2. 18--10--28	do	11	45·45	47·91	−2·46		·9815	·9877	80:1	Signif.
1. 1--10--28 & 2. 8--11--28	do.	9	44·78	50·78	−6·00	4·723	1·405	·9979	475:1	do.
1. 18--10--28 & 2. 8--11--28	do.	11	47·64	51·45	−3·82	3·010	1·269	·9988	832:1	do.
1. 8--11--28 & 2. 23--11--28	do.	15	49·33	50·27	−0·93	2·048	·4556	·940	16:1	No.
1. 8--11--28 & 2. 8--12--28	do.	15	48·60	49·93	−1·33	3·893	425	·8846	8:1	No.

Table 6 (contd). Showing the differences in Kapas, seed and lint weights (per seed in mms.) of four-locked bolls of the various plots compared.

1928—1929.

Comparison between plots sown on	Character.	N	Average 1.	Average 2.	Diffce. 1 – 2.	Stand. dev. of diffce.	Diffce. / σ diffce. = Z	P.	Odds.	Signif. or not.
1. 23--11--28 & 2. 8--12--28	Seed wt.	14	50·00	49·50	0·50	3·904	0·128	·6741	2:1	Not Signif.
1. 1--9--28 & 2. 1--10--28	Lint wt.	11	25·00	24·18	0·82	1·403	·5833	·9507	19:1	No
1. 1--9--28 & 2. 18--10--28	do.	14	24·71	25·21	– 0·50	2·027	·2467	·8044	4:1	No
1. 1--9--28 & 2. 8--11--28	do.	13	23·62	24·15	– 0.54	1·78	·3024	·8404	5:1	No
1. 1--9--28 & 2. 23--11--28	do.	5	20·80	21·60	– 0·80	1·166	·6861	·8799	7:1	No
1. 1--10--28 & 2. 18--10--28	do:	11	24·18	25·64	– 1·45	1·499	·9702	·9938	160:1	Signif.

Table 6 (contd). Showing the differences in Kapas, seed and lint weights (per seed in mms.) of four-locked bolls of the various plots compared.

1928—1929.

Comparison between plots sown on	Character.	N	Average 1.	Average 2.	Diffce. 1 – 2.	Stand. dev. of diffce.	Diffce. / σ diffce. = Z	P.	Odds.	Signif. or not.
1. 1--10--28 & 2. 8--11--28	Lint wt.	9	23·56	24·44	– 0·89	1·595	·5575	·9226	12:1	Not Signif.
1. 18--10--28 & 2. 8--11--28	do	11	24·55	24·45	0·09	1·929	·0471			No
1. 8--11--28 & 2. 23--11--28	do	15	23·73	23·53	0·20	1·376	·1453	·705	2:1	No
1. 8--11--28 & 2. 8--12--28	do	15	23·33	23·13	0·20	2·166	·0923			No
1. 23--11--28 & 2. 8--12--28	do	14	23·36	23·14	0·21	2·242	·0956	·638	2:1	No

Table 7. Showing the differences in the ginning percentages of seed cotton of four-locked bolls of the various plots compared.

1927—1928.

Comparison between plots sown on	N.	Average 1.	Average 2.	Diffce. 1 – 2.	Stand. dev. of diffce.	Diffce. / σ diffce. = Z	P.	Odds.	Significant or not.
1. 31--10--27 & 2. 15--11--27	18	30·24	30·80	-0·561	1·122	0·50	·9725	31:5	Significant
1. 15--11--27 & 2. 9--12--27	7	30·90	30·77	0·114	1·589	0.0717	·5928	1:1	Not Significant
1928—29.									
1. 1--9--28 & 2. 1--10--28	11	33·18	34·64	– 1·45	·9879	1.472	·9995	1999:1	Signicant
1. 1--9--28 & 2. 18--10--28	14	32·93	34·50	– 1·57	1·498	1·049	·9984	624:1	do.
1. 1--9--28 & 2. 8--11--28	13	32 69	32·15	0·54	1·811	·2973	·8404	5:1	Not
1. 1--9--28 & 2. 23--11--28	5	30·60	31·20	– 0·60	1·356	·4424	·7847	4;1	Not

Table 7. Showing the differences in the ginning percentages of seed cotton of four-locked bolls of the various plots compared.

1928—29

Comparison between plots sown on.	N	Average 1	Average 2	Diffce. 1 – 2	Stand. dev. of diffce.	diffce. / σ diffce. = Z	P	Odds	Signif or not
1. 11--10--28 & 2. 18--10--28	11	34·64	34·82	– 0·18	1·029	·1767	·697	2:1	Not Significant.
1. 1--10--28 & 2. 8--11--28	9	34·44	32·44	2·00	2·31	·8658	·9800	49:1	Significant
1. 18--10--28 & 2. 8--11--28	11	33·91	32 18	1·73	1·958	·882	·9901	100:1	do
1. 8--11--28 & 2. 23--11-28	15	32·33	31·93	0·40	1·083	·3693	·9031	9:1	Not
1. 8--11--28 & 2. 8--12--28	15	32·27	31·67	0·60	1·744	·3441	·8846	8:1	Not
1. 23--11-28 & 2. 8--12--28	14	31·86	31·79	0·07	1·667	·0428			Not

ECONOMIC IMPORTANCE OF ENTOMOPHAGOUS INSECTS *

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Over twenty years ago, when I entered the portals of the Science of Entomology as a raw recruit and started, apart from my official duties, the study of insects associated with other insects in various ways,—especially the bionomics of Hymenoptera as a side study, little did I feel that such a subject would loom so large before the entomological world of to-day. In fact, the study of insect associations and especially our knowledge of entomophagous insects have advanced with such rapid strides within the past ten or fifteen years that both from a purely scientific and an economic point of view this aspect of entomology to-day is in no way behind the subject of "Virus diseases" on which we had an interesting exposition just now. The abstract of this paper which, I believe, all of you have got, may have given you a brief idea of the main points on the subject I wish to deal with; and since the subject is a big one and as I may not be able to do full justice to all the different aspects of the theme in the short time I must not exceed, I am endeavouring to-day just to speak a little on the more salient points of the theme, which might give you some general ideas on this subject.

What are Entomophagous Insects ? From the point of view of food habits, insects, like all other animals, can be grouped into two main divisions, viz., those that feed on vegetable matter and those that need animal food, called respectively herbivorous and carnivorous insects. I am sure every one among us is familiar with many of the numerous insects feeding on plants and vegetable products of different kinds. Just as we are able to speak of paddy, fruit or cotton insects, it is possible for us to divide the carnivorous forms also into different groups. Examined in this way we find that among those that feed on animals there are some which depend for their food on members of their own group, viz., Insects. These carnivorous insects feeding on members of the same group are what are technically known as insect-feeding or entomophagus insects. Though in their numerical strength insect-feeding insects may be perhaps far fewer than those which take to vegetable diet, from the point of view of their biology and peculiar life habits, entomophagous insects exhibit numerous remarkable and unique features both as regards structural adaptations and in forms of behaviour. It is but rational that, unlike as in the case of insects whose food materials consist of plants and other substances which

*Summary of a lecture delivered before the meeting of the Association of Economic Biologists, Coimbatore on 3--11--1931.

are practically stationary and do not offer any active resistance to the individual feeding on them, every entomophagous insect has necessarily to adapt itself in many suitable ways in its shifts for life, especially in the securing of the most important source of its energy, its food supply, which in this case is an active moving object like itself! As such we find different categories of insect-feeding insects endowed with different habits and various types of behaviour adapted to their essential needs.

Different categories of Entomophagous Insects. This brings us to a consideration of the different categories of entomophagous insects. Considering the habits of these insects they can be conveniently divided into two main groups: Predators and Parasites. Predatory insects usually attack or hunt other insects, and kill and devour them, the main consideration being gratification of its craving for food. The prey is usually smaller and weaker than the predator and easily succumbs to the attacks of the aggressor. On the other hand, parasitism is a more subtle phenomenon. Parasitic insects are those which live on and get their food from other insects in quite a different manner from predators. The prey, which is called the host in this case, if it is to die, is not immediately killed but is compelled to supply food in the shape of its life blood to its guest, and only gradually succumbs. In this case the aggressor or the parasite is usually smaller than the host and the process generally is slow torture and sure death of the victim in most cases. In both these phenomena of predatism and parasitism prevailing among the insects we find different types. For instance we find that some attack particular kinds of insects and confine themselves to those; there are others which distribute their attention to more than one kind of prey or host, and there are still others which exhibit the predatory or parasitic habit only during certain stages in their life history. It is generally believed that in the evolution of animal habits prasitism gradually evolved out of predatism prevailing among carnivorous forms. We will now examine a few of the very familiar cases of predatory insects and their ways.

PREDATORS: Among predatory insects two distinct groups can be made out—one including those which are typically predatory and hunt their prey, kill the same and satisfy their hunger. These form the majority of predatory insects and representatives are found in most of the insect groups as may be seen from the rough list given below. In the habit of food hunting some of these predators are cosmopolitan and catch any insect which they are able to attack and eat; for instance, the common mantis will catch and eat all kinds of insects and even its own kind (*cannibalism*). So are some of the robber flies, dragon flies, assassin bugs, ant-lions, etc. There are some, however, which feed only on some special kinds of insects and refrain from tasting others. Common examples are the lady bird beetles, the green

chrysopa and some syrphid (Hover) flies which feed only on plant lice, scale insects and mealy bugs. The six spotted tiger beetle is known to feed on the rice bug in paddy fields.

The second group, on the other hand, includes those which attack the prey not for procuring their own food, but to provide nutrition for their developing young ones. We find this category of predators almost exclusively among some wasps, and even among them only the females exhibit this peculiar parental care for the off-spring. While a typical predator hunts the prey, kills it and devours the same as its food, a member of the latter group attacks the prey, but instead of killing and despatching it outright, it stings the victim by means of its powerful sting, paralyzes it without killing it and carries it home to its nest to serve as food for its offspring. Such predators are popularly known as '*Stinging predators*'. The varied activities and wonderful instincts displayed by many of these wasps are extremely remarkable and constitute some of the most marvellous phenomena exhibited in the world of insects. Among some of the famous naturalists who have made observations on the bionomics of these wonderful insects the French naturalist J. H. Fabre ranks very high, and some of his books on the subject form extremely interesting reading. Some of my early observations on a few Indian forms may be found incorporated in the chapters on Hymenoptera in Lefroy's *Indian Insects Life* published in 1909. In the following list are included some of the familiar predatory insects of both the above categories found in S. India.

ORDINARY PREDATORS

Insects	*Groups.*	*Nature of food or prey.*
The green mantis	Orthoptera	Grasshoppers, small bees, any others available, often feeds on its own kind (Cannibalism), spp. of Hierodula, Gongylus, etc.
Green locustid (Morismus Carinatus)	do.	Feeds on insects near lights.
Dragon flies	Odonata-species of *Pantala*, Orthetrum, *Trithemis*, *Crocothemis*, *etc*,	
Chrysopids	Neuroptera (*Chrysopa*)	Feed on miscellaneous insects. Larvae feed on plant lice chiefly.
Ant-lions	Neuroptera *(Palpares) Myrmeleo.*	The larvae trap small insects of sorts in their sandy tray pits.
Ground beetles	Carabids (Coleoptera) (sp. of Arthia, *Calosoma*, etc).	Feed on miscellaneous forms caterpillars, small grass-hoppers etc. A small redish beetle *Callida*, feeds on the coconut caterpillar Nephantis·

Insects	*Groups.*	*Nature of food or prey.*
Tiger beetles	Cicindelidae, (Coleoptera).	Feed on miscellaneous forms one sp. *Cicindela sixpunctata* feeds on Rice bug.
Lady bird beetles	Coccinellidae (Coleoptera)	Most of these confine themselves to plant lice, scale insects, mealy wings etc. in the larval and adult stages. sp. of *Chilomenes*, *Scymnus* and *Coccinella* are common in S. India. One group of this family-the Epilachna beetles are plant feeders and are pests on brinjal and cucurbitaceous plants.
Eublemma moth	Noctuid (Lepidoptera)	The caterpillars feed on scale insects of different kinds.
Phycita moth	Pyralid (do.)	*P. dentilinella* - caterpillars feed on the castor slug pupa.
Euzophera moth	Pyralid (Lepidoptera)	Caterpillars feed on the larvae of a scale insect *(Aspidoproctus xyliae, G)* on rain tree.
Blue butterfly	Lycaenid ,,	The caterpillar feeds on mealy bugs of different kinds, Phenacoccus, Psoudococcus, etc.
Hover flies	(Syrphidae--Diptera)	The larvae of many of these feed on Plant lice, the common form being the fly with gold banded abdomen (*Ischiodon*).
Robber flies	Asilidae ,,	Attack various kinds of small insects including, bees, small flies, beetles etc. (*Leptogaster* is a well known robber fly)
Predatory plant bugs	Pentatomidae (Rhynchota)	Some of these (species of *Canthecona Andrallus*, etc.) suck caterpillars, saw-flies, etc.
Assassin bugs	Reduvidae (Rhynchota)	Attack various insects - flies, caterpillars, leaf hoppers, etc. (chief genera are *Acanthaspis*, *Harpactor* and *Isyndus*).
Anthocorids	Anthocoridae ,,	Small bugs found in ear-heads and flowers and feeding on thrips, small leaf bugs, etc., etc. (*Triphleps* is the well-known genus in South India).

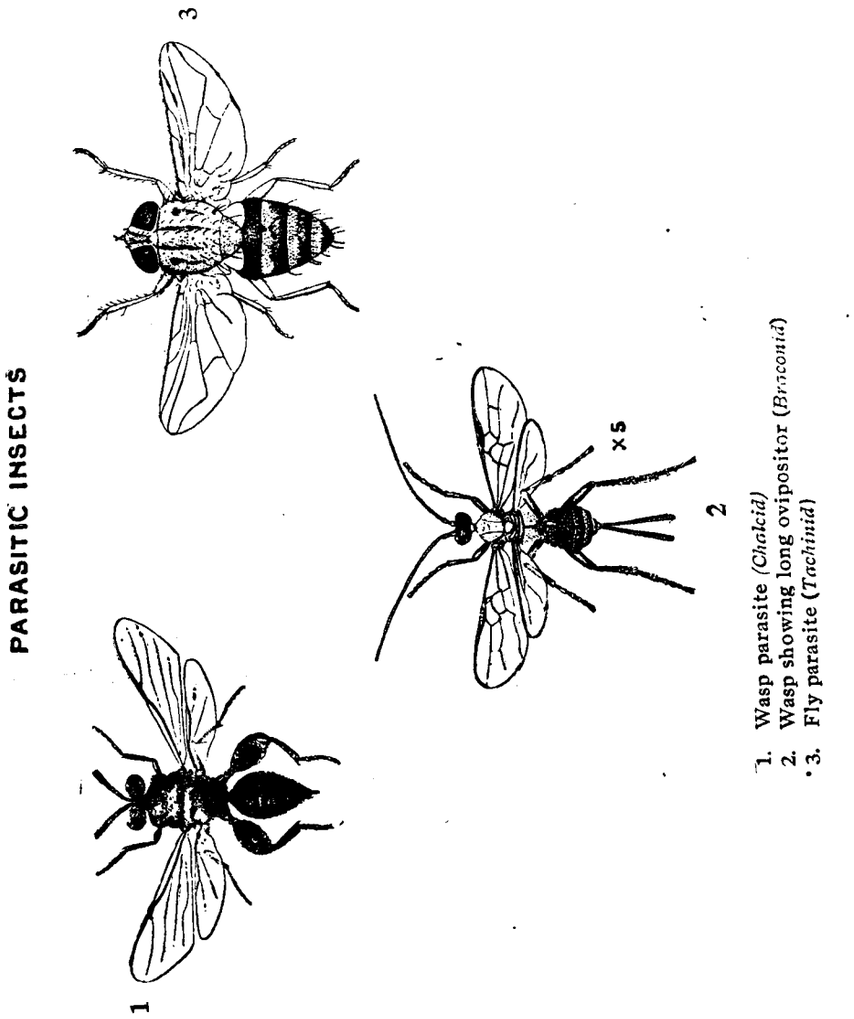
STINGING PREDATORS

As stated above, all these are wasps of different kinds, and it is the female that attacks the prey, paralyses it and carries it to the nest, where eggs are laid on these victims. The grub hatching out of the

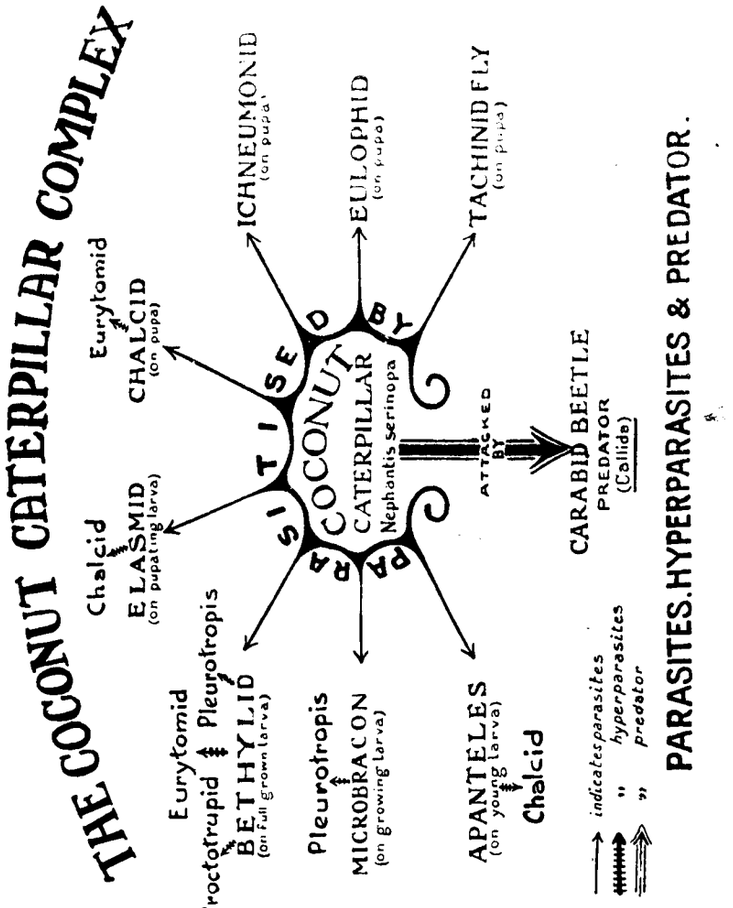
egg grows by feeding on the prey stored by the parent, pupates, and in course of time emerges as an adult wasp. Different kinds of wasps collect different kinds of insects as their prey ; the following are the more familiar ones in S. India.

Insect.	*Order.*	*Nature of food or prey.*
Scoliidae	Hymenoptera	Attack white gribs (larvae of cock-chafer beetles) (*Scolia*, *Elis* and *Tiphia* are common in S. India)
Sphegidae	...	These are the typical fossorial wasps - each different genus having its special insect food. Among these there are those that attack grasshoppers, crickets, cockroaches, etc., such as *Noto gonia*, *Liris*, *Sphex* and *Ampulex* those collecting caterpillars such as *Ammophila*, others collecting bugs, weevils and flies like *Gorytes*, *Cerceris* and *Bembex*. This family also includes the notorious bee-hunter *Philanthus P. Ramakrishnae, T)* discovered by me some years ago on the S. Indian hills.
Solitary wasps	Eumenidae	Include the potter or slender waisted wasps which store their mud cells with various kinds of caterpillars. Most of us, I believe, are familiar with this phenomenon of the wasp carrying the caterpillars to its nest. *Eumenes conica* is the common South Indian form. The smaller forms belong to the genus *Odynerus*
Social wasps	Hornets (Vespidae)	These are not typical stinging predators since they very often feed on other insects like ordinary predators - the common *Vispa cincta* is often seen sucking honey bees.

PARASITES: We now come to the second category of entomophagous insects known as parasites. Among parasitic insects there are those that live all through their lives as parasites on higher animals such as lice, ticks, fleas, bots, etc.; these are neither entomophagous, nor do they exhibit the features of typical entomophagous parasites, and it is not my intention to say anything on these parasites found on higher animals. The latter which are typically entomophagous are parasitic only during their larval stages, the adults being free living and very highly



1. Wasp parasite (*Chalcid*)
2. Wasp showing long ovipositor (*Braconid*)
3. Fly parasite (*Tachinid*)



organised. The commonest examples of these parasites are to be found chiefly in two or three families of Hymenoptera (Ichneumonidae, Braconidae, Chalcidae, Bethylidae) and in the Dipterous family Tachinidae.. The general life history of any of these parasites is briefly like this: the eggs which may be one or more are generally deposited by the mother insect on the body of the host which is usually a larva (a caterpillar, grub, maggot or nymph)—on hatching from the egg the parasitic larva feeds on the unimportant tissues of the host for some time and is careful not to kill it by attacking its important tissues until it has grown almost to maturity; at this stage the parasite quickly destroys the host by consuming its vital organs and gradually the host dies. Meanwhile the parasite reaches its full larval growth, pupates and emerges as the highly organised and active wasp or fly. Some of these parasites, especially the wasps, are provided with remarkable adaptations to carry on their life activities. For purposes of laying eggs on larvas boring inside plant tissues some of the Ichneumon flies are provided with long and conspicuous ovipositors (see fig.) by means of which the parasitic wasp is able to thrust its egg even through thick plant stems on to the body of an internal borer. It will be a very interesting sight to note how some of these wasps with long ovipositors cleverly detect by means of their marvellous and acute sense organs the presence of the borer inside and accurately thrust the ovipositor on the same through the plant stem. This is found in the case of a common reddish brown parasite (*Stenobracon deesae*) attacking the common sorghum borer *Chilo simplex*. Among these Hymenopterous and Tachinid parasites there are also some forms which attack their hosts in the egg and pupal stages also. Some lay single eggs, while there are others which deposit a hundred or more eggs on one host. Some spend their earlier stages inside the host's body and come out to pupate, while others are external parasites all their life. Numerous and remarkable varieties are found in the bionomics of the numerous species of Hymenoptera, a big group including extremely interesting insects, and scarcely a single order of insects is free from the attacks of these parasitic wasps. Thousands of species of this big wasp complex have been recorded all over the world, and numerous forms have also been noted from S. India and the host relations of many of these studied to some extent. I have recently published a few papers on the hymenopterous parasites so far known in S. India with annotations regarding their known food habits and those interested may refer to them. Tachinid flies chiefly parasitise caterpillars, and we know of some of these effectively controlling some of our crop pests. The most important genera of Tachinid flies found to be of economic importance in S. India are *Sturmia*, *Tachina* and *Cyphocera*. To the casual observer these flies would appear like large sized house flies, but they are really quite different from the latter, especially in the body, having an armature of numerous short bristles (see fig. 3.) Though these

flies do not display such remarkable variations in structure and habits, like the parasitic wasps, they are in their own way fairly numerous and their work as parasites equally telling. Most of the common caterpillars and grubs found on various plants are subject to the attacks of these hymenopterous and tachinid parasites, and a study of the bionomics of these creatures is a subject which will be found not only of absorbing interest to the biologist but also possesses great economic value as I shall presently explain.

Economic status of Entomophagous Insects. We now come to the more important aspect of the subject; an aspect with which our association is more directly concerned, namely, the economic importance of these predators and parasites. The importance of many of these forms to man consists in the fact that many of the insects, which constitute the food of these creatures as hosts, happen to be forms doing harm to cultivated crops and other belongings of man. Numerous caterpillars, beetles, etc., that are pests of various plants, like paddy, cotton, sugarcane, cholam, castor, fruit trees of sorts, vegetable and other economic plants are found subject to the attacks of these parasites and predators, and these latter help man considerably in keeping these pests under normal control in nature.

"Outbreaks of injurious insects" as stated by Howard, "are frequently stopped as if by magic by the work of insect enemies of pests". South India, similar to many other parts of the tropics, abounds in numerous parasitic wasps and flies carrying on their remarkable work of pest control often unknown and unnoticed by man. It is needless to add, therefore, what an important part these natural enemies play in influencing the spread or control of injurious forms. The work of natural enemies is as important as any of the other factors, such as food or climate, in influencing the regular balance of life in nature.

Utilisation of Entomophagous Insects. Now that we have realised the importance of the work of these entomophagous insects, we may proceed to consider the different methods that man has adopted and those he may adopt in future for taking the best advantage of the good work of these insects and utilise them in the most suitable and economic ways. For this purpose the essential prerequisites are a proper recognition, correct identification and a thorough study of the bionomics of the pest to be controlled and the natural enemy or enemies proposed to be utilised for such a control in all their aspects and inter-relations. Such studies are extremely important because it will be very often found, especially in the case of parasites, that in many cases what we consider a beneficial insect may not in fact be one in spite of its being a parasite. It may be a parasite on a parasite (a hyper-parasite), which means it is doing harm by destroying a beneficial parasite. "The first step towards vanquishing an

enemy," in the words of Curtis, "is to ascertain correctly its habits. The next is to be certain of its appearance so as not to mistake one party for another, and a third and no less important object is to be well acquainted with our friends and allies." As such these and other investigations on the different aspects of parasites and hosts are extremely important and necessary and thorough studies have to be made before any attempts are made in the way of utilisation. After such investigations are made the next thing is to afford all facilities to such of those natural enemies that are beneficial to do their good work effectively and successfully. This method of properly using the natural enemies to check insect pests is popularly known as the "Biological method of Insect-pest control". This method has now-a-days become very popular and in most of the countries where scientific agriculture has advanced, this method is being adopted to supplement the other time-honoured methods of pest control, such as cultural, mechanical and insecticidal. Some of the methods adopted are simple and quite practicable in most cases. Where plants are badly infested with pests, say caterpillars, or of different kinds of grubs, instead of the infested parts being removed and burnt or buried, as is at present done in most cases, they may be kept enclosed in cages with gauze netting to allow the natural enemies alone to emerge in due course; the mesh of the gauze should be of such dimensions that it will only allow the natural agent to fly out and not the adult of the pest, which in most cases is a moth or butterfly. This might be done not only in the case of various defoliating caterpillars, such as those attacking paddy, cholam, castor, groundnuts, palms, etc., but also with borers of sorts, such as the stem borers, and shoot and fruit borers of various valuable crops. For this purpose special cages or parasite boxes suited to each insect pest and its natural enemies could be devised; such boxes containing infested plants or portions of plants, which allow only the natural enemies to emerge, may be placed in the infested fields. Trials in this direction were made in the Punjab a few years ago for the cotton bollworms (*Erias sp.*) and on a small scale such a trial has also been made by the Madras Agricultural Department for the black-headed caterpillar (*Nephantis serinopa*) of coconut, a serious pest in some places along the West Coast. Similarly in the case of many pests of which the egg masses can be easily found and collected, as in the case of the paddy stem borer, the tobacco caterpillar, hairy caterpillars of sorts on cholam, castor, etc., and various others, where the eggs are laid in masses, these latter may also be kept to allow any of the egg parasites to emerge; egg masses may with advantage be kept exposed on a tray of water or in the middle of an ant pan so that the egg parasites might fly away and any minute larvae that might hatch out of unparasitised eggs might drown themselves if they attempt to crawl out. The stubble and debris of various borer-breeding plants, like cholam, paddy, wheat, cane and various vegetable crops after harvest,

may also be treated similarly to allow any natural enemies that might breed in them. In these simple ways, the existing parasites or predators in each tract might be helped to do their useful work more effectively; on the other hand, when the collected pests or the pruned branches containing pests are buried or burnt, as is usually done, the natural enemies also get destroyed. The adoption of such simple methods will substantially supplement the ordinary mechanical measures of control generally adopted at present. Generally there are three lines of procedure for the introduction of natural enemies; they are the introduction of (1) a parasite or predator of a particular pest into a place where they do not occur from a place where they are found, (2) of those which attack forms related to a particular pest in question in other tracts and (3) of the indigenous parasites of a pest occuring in adjacent districts into those where they are absent. The first method has received great attention and some remarkable results have been achieved in Biological control in that way in Hawaii, California, Fiji and other countries. This procedure is attended with marked success only in those countries where the conditions are very favourable to the introduced insects. The earliest and classical example of such pioneer attempts in the successful introduction of natural enemies of insect pests is the well known introduction of the famous lady-bird beetle (*Novius cardinalis*) in 1889 by Koeble from Australia into California to control the notorious fluted scale (*Icerya purchasi, M*). As a result of this early and successful introduction, numerous other attempts have since been made in different parts of the world and some measure of success has been achieved in many cases. Such introductions have been attempted in the United States of America, Italy, Australia and Fiji, but of all these the introductions have been more successful in the Hawaiian islands than in any other parts of the world. In the opinion of Howard;

> No part of the earth which does not have the very simple native fauna and flora of Hawaii, which does not have its equable tropical or sub-tropical climate and which does not consist of islands rather limited in size, can expect with any degree of certainty to achieve results at all closely approximating those in Hawaii.

The second procedure of introducing parasites of allied forms allied to a pest does not often prove successful, though in the case of the Fijian coconut pest, the introduction of a tachinid attacking an allied coconut pest in Malaya proved a remarkable success! The third method of transferring indigenous parasites of the same pest from districts they are found into those where they do not occur is one which is rather a difficult one and involves different principles. While in the case of the first two methods we try to help nature in effecting what may more or less be a natural balance of life as originally existed, in the latter case our attempts are directed to modify an equilibrium which has already been adjusted. Such a procedure is not only

difficult but is extremely hard to maintain permanently! Another important factor which has to be kept in mind in these attempts at biological control is the provision of sufficient food for the introduced parasite when the pest gradually gets destroyed and when we wish to keep a good supply of the natural enemy. Two interesting examples of how this difficulty is tried to be overcome are now known. One is the conservation of the mealy bug pest of California by breeding it in potato sprouts and allowing the predatory beetles to breed on these mealy bugs in captivity. I saw this interesting process in one of the Parasite laboratories in Southern California. The other is the quantitative breeding of the Chalcid parasite *Trichogramma minutum* found as a parasite on the common grain moth (*Sitotroga*) and using it against pests of different kinds (the insect is known to be a parasite of 50 diferent kinds of caterpillars). It appears that nearly 200,000 of these minute wasps can be reared per day and the life cycle is only 8 days. This work is only in its infancy and the success of such attempts can be judged only after repeated trials.

The history and progress of these trials in modern times is a very wide and interesting subject and can hardly be discussed thoroughly at present, but I shall close my talk with a few remarks on biological control in S. India. This method of control has so far been tried on an organised scale against two pests in this province; these two are the fluted scale (*Icerya*), a foreign insect which was introduced into the Nilgiris probably from Australia somewhere about 1927 - 28 and the other an indigenous pest, the coconut caterpillar (*Nephantis serinopa*). For the former, the well known insect enemy of the scale (the *Vedalia* beetle) was introduced and within the past two or three years the progress of the pest has been very considerably arrested by this predatory lady-bird beetle (*Novius cardinalis*), though it has not been completely exterminated. With regard to the coconut caterpillar considerable work has been done in the study of the bionomics, its parasites and predators and their inter-relationships. Some of the parasites have also been found to do some appreciable work in controlling the pest now and then. But as I said once before there is a regular complex of insects both beneficial and injurious passing their lives in relation to the coconut caterpillar (see fig. of coconut caterpillar complex). There are parasites, super-parasites and hyper-parasites competing with each other, and what with their activities and what with the other factors, such as climate and food, the Nephantis caterpillar is found to pass through regular waves of temporary increase or decrease in its population and activities. As I stated above, it is an indigenous pest, and all our trials in transferring its indigenous parasites from one district into another are only atttempts at the modification of a natural equilibrium already existing in a highly adjusted state, and this cannot be permanently kept on against nature's activities.

This is the reason why in the case of the coconut caterpillar such spectacular and appreciable results as in the case of the *Icerya-Vedalia* work on the Nilgiris are not evident. This work of the department in connection with this pest has however educated the coconut cultivators of the tract considerably and some facts on the subject of biological methods of control have also become known to the layman. But I may, however, be permitted to add that the biological method of pest control is not such an easy thing as many people often think and in most cases this method acts only as a supplement to ordinary cultural and mechanical methods of pest control. Nor is the procedure so easy considering the parasite complexes of many of these pests demanding a thorough study and elucidation of such factors and phenomena as hyper-parasitism, super-parasitism, multi-parasitism, host-parasite relations, the food of the adult parasites, influence of weather conditions on the pest and the parasite and a host of other points before anything definite can be achieved successfully. With some people the idea of this method has now become fashionable and is tending, in the words of Dr. Thompson, to degenerate into a kind of superstition and fad and unless proper ideas are inculcated on this subject this method can easily become quackery! But if carried along proper lines this method has a very bright future before it and is sure to help the cultivator remarkably in checking the ravages of injurious insects. Very valuable work has been done on this subject by eminent men like Howard, Thompson, Smith, Burgess, Jones, and others, and considerable amount of literature has accumulated on this new subject.

Gentlemen, I believe I have given you some idea of what entomophagous insects are, how some of them are of economic importance and how this habit of such insects can be utilised for our benefit. I am sure I have not been able to do full justice to a big subject like this but I hope I have perhaps given you some rough outlines on the subject.

The following papers have been published by the author on this subject:—

1. Habits of some wasps, in Lefroy's *Indian Insect Life* in Hymenoptera section, 1909. 2. Life history notes on *Eumenes conica*, *Bombay Natural History Journal* 1910. 3. Insect friends of the farmer, Departmental *Villagers' Calendar*, 1918-19. 4. A natural enemy of the mangohopper, *2nd Hundred notes on Indian insects*, Pusa bulletin No. 89, 1919. 5. On a musciphagous wasp (Bombex), *Report of third Entomological meeting, Pusa*, 1919. 6. An undescribed natural enemy of the castor semilooper, *Bombay Journal*, 1921. 7. A catalogue of Braconid wasps of India and Ceylon, *Report of 5th Entomological meeting Pusa*, 1923. 8. Life history notes on the hornet (*Vespa cincta*), *Report of 5th Entomological meeting*, 1923. 9. On the status of some parasitic hymenoptera in S. India. *Bombay Journal*, 1925. 10. A new lady-bird beetle of economic importance (*Scymnus*), *Bombay Journal*, 1925. 11. A check list of Indo-Ceylonese chalcid wasps *Spolia zeylanica* Ceylon,

12. Some biological methods of insect pest control, *Departmental Digest* for July 1925. 13. The braconid wasp "Aphrastobracon" with note on a new species, *Bulletin of Entomological Research*, London, 1926 14. A list of the parasite, hymenoptera of economic importance in S. India, *Bulletin of Entomological Research*, London, 1927 15. Some Indian Lepidoptera with abnormal habits. *Bombay Journal*, 1929. 16. A contribution to our knowledge of S. Indian Braconid wasps including descriptions and bionomics of numerous forms including new species, *Pusa Memoir*, 1928. 17. The economic aspect of insect associations, *Madras Agricultural Journal*, March, 1930.

A CHIMERA IN COTTON

BY P. GOPALARATNAM, L. Ag.

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At the Cotton Breeding Station, Coimbatore, a case of chimera in G. Herbacium selection No. H. 2919 was observed on 14th February 1930. The plant was growing in the non-experimental portion of the comparative trial plots of the rain-fed cottons in the red-soil area. It was a single plant and was as healthy as the other plants in the neighbourhood indicating that the soil was free from disease.

The plant was about three feet in height and the lowermost branch was completely normal green. The rest of the shoot was peculiarly affected in that it produced some branches, which were normal green, some patchy green and the rest completely creamy (Fig. No. 1). The patchy ones were mottled with cream colour and green in varying proportions while the rest were completely creamy (Fig. 2). The parts partially or completely affected included stem, stipules, petioles, leaves, bracts and pericarp of the boll. The different floral parts were complete though stunted in size. The deficiency in Chlorophyll was noticed even in the case of young vegetative buds. The flower and boll production was normal in all the cases though the number decreased with the intensity of the spread of the creamy colour.

Flowers were selfed in all the three groups. The bolls developed normally and seeds were carried forward for sowing in the next season.

Seeds from all the three groups were sown separately on the 11th November 1930. Out of 63 seeds from the green branches 60 germinated and developed normally. From the patchy branches, out of 21 seeds 20 germinated. Of these 6 had completely creamy cotyledons, but they withered and died 2 days after germination. The rest (14 seedlings) were green and normal. In the case of 13 seeds from the creamy branches 10 germinated. Every one of these had creamy cotyledons. They withered in 2 days.

The structure of the affected parts was in all cases normal but for the absence of chlorophyll. No trace of disease could be found.

The results obtained by sowing the seeds produced from the branches with mottled leaves suggest that the occurence of the creamy nature may be a case of non-mendelian inheritance.

So far as I am aware, there has been no mention of the occurrence of chimera in cotton of this nature.

Literature cited.

1. Anderson E. G. Maternal inheritance of Chlorophyll in Maize. *Bot. Gaz.* Vol. LXXVI. p. 411, 1923.

2. Correns. On Mirabilis jalapa-Reviewed in Miles Study of Albinism in Maize. *Jour. Gen.* Vol. IV. P. 193 1914 - 15,

3. Gregory R. P. Variegation in Primula. *Jour. Gen.* Vol. IV. P. 305.

4. Yoshitaka Imai. A consideration of variegation. *Gen.* Vol. XIII - P. 544. 1927.

UTILISATION OF WASTE LANDS IN PUDUKOTAH.

BY Mr. G. DURAISWAMI AYYANGAR, L. Ag.,

Agricultural Department, Pudukotah.

A perusal of the Agricultural Statistics for Pudokotah revealed that there were about thirty thousand acres of culturable land lying waste. It was a problem as to how this extent of land could be utilised to improve the financial position of the State ryots who could not at present make both ends meet since commercial crops like groundnut bring him insufficient returns. The commercial value of Tinnevelly Senna and the possibilities of its introduction into the State attracted the attention of the Durbar and an Agricultural Officer was deputed to Tinnevelly to investigate, under the guidance of the District Agricultural Officer, the cultivation and curing of this important crop. As the result of such investigation, the Durbar was pleased to sanction the opening of a farm at Pudukotah to study how the crop fares under local conditions so as to enable the Department to start propaganda for reclamation of the available wastes by planting senna and other crops.

The Senna Farm is located in a conspicuous place in the Town between the weekly market and the Railway line. This site was selected since the soil conditions approximated those of Senna soil of Tinnevelly. In order to test the suitability of senna both on dry and wet lands about 8 acres of dry and 8 acres of wet lands were selected for the farm. The dry area taken up had been overgrown with prickly pear (*Opuntia dilenni)* and *Erukkam* (*Calotropis Gigantia*) plants of several years' growth, thorns and shrubs. Hence their clearance was the first operation. Attention was next directed towards straightening the curves in field boundaries and levelling down mounds in order to widen the

view of the landscape. The work of sub-dividing this area into trial plots was then attended to, by forming necessary cross bunds, providing for cart tracks and foot-paths to convey manure. During the process of reclamation lots of pebbles and broken bricks that were lying scattered throughout were removed and were utilised for the approach road.

Then a ditch was opened all round to (1) carry superfluous water, (2) prevent root action of avenue trees and (3) provide earth for bunds to plant live fence upon.

In the preliminary cultivation that followed the state tractor was employed as (1) the land was handed over to the department very late (by 2nd week of October) and the preliminary operations had to be rushed through and (2) The cochineal insect reduced prickly pear into mere thorns and the land was not safely workable by human labour. The soil was first disced and exposed for weathering. The plots were then manured with farm yard manure at the rate of 15 cart loads per acre and covered with a country plough. Slight showers during the first week of December were taken advantage of to broadcast Senna at the rate of 4½ measures per acre on 5-12-1931 in about an acre of the dry red loam plot and the seeds covered with a country plough. In seven days the germination was complete.

One plot was uneven and not suitable to receive Senna this year. Hence this was sown to black gram and ragi in the season to get some return and also to render it fit for Senna next year. One corner which is alkaline measuring about an acre was sown with *samai*.

To make the farm remunerative and at the same time attract visitors maize, sorghum, cluster beans, sunnhemp and gogu were also sown in small lots. The wet land plots have been under cultivation for long They received paddy in this season to be followed by Senna during summer. Thus a start has been given and the results will be watched with interest.

Note: The pods and the leaves of Senna are of much commercial value. For cured leaves of senna the price ranges from Rs. 36 to 40; for Senna pods from Rs. 70 to 85, for Senna pod husks Rs. 40 to 50 (all per candy).

On an average an acre of Senna crop is reported to fetch a net income of Rs. 23 in dry lands and Rs. 75 in wet lands.

Cost of Cultivation (Tinnevelly figures).

DRY LAND.	Rs.	a	p.	WET LAND	Rs.	a	p
1. 4 ploughings	4	0	0	1. 5 ploughings	5	0	0
2. Penning sheep	4	0	0	2. Penning sheep	4	0	0
3. Seed 4 mm at 2 mm per rupee	2	0	0	3. Seed 6 mm	3	0	0
4. Weeding and hoeing	2	0	0	4. Weeding & hoeing	1	0	0
5. Removing flower buds.	1	0	0	5. Forming bunds	1	8	0
6. Picking leaflets	6	0	0	6. 2 irrigations	3	0	0
7. Drying charges	2	0	0	7 Removing flower buds.	2	0	0
9. Picking pods	3	0	0	8. Picking leaflets	9	0	0
10. Land assessment	0	4	0	9. Drying charges	2	8	0
				10. Picking pods	1	8	0
	24	4	0	11. Land assessment	3	8	0
					36	0	0

Yield. 2/3 baram cured leaflets and 1/3 baram of pods in Dry lands and 2 barams cured leaflets and 3/4 barams pods in wet, the value varying according to quality.

STUDIES IN RURAL ECONOMICS—II

BY P. V. SAMBASIVA RAO

Agricultural Demonstrator, Yellamanchili.

Name of Ryot:—G. N. *Taluq:*—Sarvasiddhi

Village:—Padmanabharajupet *District:*—Vizagapatam.

Year:—1930—31.

This ryot has a family consisting of twelve adults (6 men and 6 women) and five children ; all the adults work in the field. His holding consists of 7·75 acres of his own land (6 acres dry and 1·75 acres wet) with an assessment of Rs. 14—13—0, and 7·75 acres (6·75 acres wet and 1·00 acre dry) taken on lease for Rs. 248. The six acres of his own dry land is left as grazing ground, and the rest cultivated. He maintains 2 pairs of working cattle and 7 she buffaloes with 5 calves. The cropping adopted in 1930—31, the produce obtained, the quantity sold and the amount obtained are noted below:—

Crops	Area	Cash expenditure	Produce obtained: Grain	Produce obtained: Straw	Produce sold	Amount realised	Remarks
	Acres	Rs. (a)	lbs. Jaggery	lbs.	lbs.	Rs. (b)	
1. Sugarcane	1·09	53	4250	...	4000	267	38 cartloads of manure were obtained and used by him. besides 11,400 dung cakes of which 6000 were sold for Rs. 10. The rest were used by him, besides the palmyra and other fuel from his holding.
2. *Chodi* (Punasa)	1·50	...	480	...	...	...	
3. *Gante* ,,	2·50	...	1920	2250	...	...	
4. Onions (Tholakari)	0·50	...	1100	...	1000	20	
5. Cotton.	0·25	... (c)	150	...	...	...	
6. Paddy (Main crop)	7·50	17 (d)	10500	11200	...	...	
7. Gingelly (Paira)	4·75	5	1280	...	800	50	
8. Onions ,,	0·50	...	800	...	250	10	
9. Sweet pototoes (do)	0·50	...	2000	...	1600	4	
10. *Gante* (dry land)	1·00	...	700	1120	...	...	
11. Horsegram ,,	1·00	...	failed				
12. Tobacco ,,	0·25	...	103	...	...	...	
13. Palmyra trees.			3000 leaves		3000	15	
Assessment & lease amount...		245				366	
Total		320				46	
Balance							

(a) for oil cakes, bamboos and will hire; (b) Rs. 220 from Jaggery and Rs. 47 by sale of setts; (c) labour for planting; (d) for irrigation.

Besides the balance of Rs. 46 from the cash income from his crops, the ryot earned Rs. 50 by the sale of ghee, Rs. 10 by the sale of dung cakes, Rs. 25 by hire of carts and Rs. 20 by the sale of old bamboos in excess of his present requirements and these brought up his cash income to Rs. 151 after paying the assessment, lease amount and cultivation expenses. Of this he spent Rs. 97 for his weekly market expenses etc., Rs. 9 for getting clothes woven from the yarn, made by the members of his family from the cotton produced on his holding. He did not spend any thing during the year on the repairs to his house, marriages

or other cremonials. By thus living frugally, and obtaining most of his requirements from his land, he saved a small amount of Rs. 45. His previous savings amounting to Rs. 150 were given on loan to the owner of the dry land taken on lease, which he enjoys free of rent (Rs. 18).

EXTRACT

SOILS AND FERTILISERS

(Abridged from an article by Sir E. J. Russell, in "Agricultural Research in 1930" John Murray, London, 1931).

NITROGENOUS FERTILISERS: Renewed interest has been taken during the year in the question how much lime is removed from the soil by the action of sulphate of ammonia. The estimate usually given by experts in England until recently was that 100 parts of sulphate of ammonia used up 60 parts of calcium carbonate. This has experimental justification and it would be approximately correct if there were no loss of nitrate of lime from the soil. It is now realised, however, that this loss does occur. Continental and American authorities give a higher figure from 100 to 120 parts..... It seems safer to adopt a figure of about 110 for practical purposes, and where sulphate of ammonia is used, to give an equal amount plus 10% of calcium carbonate to the soil some time during the rotation.

PHOSPHATIC FERTILISERS: The use of mineral phosphate shows a tendency to increase; in some of the grass-land experiments it has recently given better results than were previously recorded; instead of being inferior to low soluble basic slag it has on occasions proved superior. The exact conditions under which this happens are not known with certainty: the present evidence is that the mineral phosphate acts best on permanent grass in moist districts with a long growing season: it is less effective on arable land and on grassland in drier regions. In view of its cheapness, however, a great deal of work has been done on it in this country, in Russia and the United States.

The experiments emphasise the wide difference between various crops in their powers of assimilating phosphorus from mineral phosphate. The groups are approximately:—(1) Considerable power—lucerne (best), lupin, mustard, hemp, cabbage, rape, swedes, turnips, buck-wheat and peas. (2) Less power—vetch, beans, winter rye. (3) Little or no power—wheat, oats, barley, rye, maize, carrot, tobacco, millet, clover, tomatoes, potatoes, phlox. There is much discussion as to the reasons for these differences; the amount of calcium in the plant, and the power of evolving carbon-dioxide from the roots, have both been regarded as important factors, but the problem is not yet solved .....

Phosphate starvation of plants is not so quickly recognised as nitrogen starvation. In extreme cases, swedes, turnips and mangolds fail altogether, the leaves of cereals become dull greyish green in colour, while those of apple trees are bronze coloured and are carried mainly at the tips of the shoots. Long before this stage is reached, however, the crop yields have suffered without apparent reason. By the time the phosphate starvation is detected, it may be too late to cure it for an annual crop. Wheat and barley take up their supplies of phosphate in the early days of their growth and gain nothing, indeed may lose, from phosphate supplied later. Scott Robertson finds that the most sensitive crops to phosphate starvation are swedes and turnips; next come potatoes, followed by oats, with hay as the least sensitive. At Saxmundham, mangolds and swedes suffer more than wheat and barley.

Crops vary considerably in their need for phosphate, or to be more precise, in the extent to which they will respond to further additions of phosphate. The most responsive are potatoes, then come swedes and turnips, then mangolds, barley and temporary hay, and lastly oats and wheat. Crops further vary in the ease with which they can obtain phosphorus from relatively insoluble compounds; swedes and turnips do this fairly easily but other crops respond only to soluble phosphates.

The experiments further show that crops utilise but little of the phosphate given to them. Of 100 parts of phosphate supplied, not more than 15% is recovered at Rothamsted in the first year and not more than 25% in the first four years; frequently the recovery is only about half of this at other centres. In the 1930 experiments the maximum recovery of phosphorus from super-phosphate was 12%, and the average 6%; from high-soluble basic slag, it was less than 3%, while from low-soluble slag and mineral phosphate it was still lower. The remainder lies in the soil, its value for soil fertility is not clearly known. The recovery of nitrogen is usually about 50%; hence the justification for the common practice of adding more phosphate than nitrogen.

As pointed in last year's Report, the phosphate taken up by the plant does not always cause an increase in growth; it may simply accumulate there. Recent experiments show that it remains largely in the inorganic forms as phosphates, it is not built up into complex organic substances. It is not known how far this affects the nutritive value. The experiments have further emphasised an important result already generally recognised. Super-phosphate, and to less extent high soluble slag, not only increased the yield, but markedly increased the proportion of nitrogen (protein) in the herbage. At one centre, super-phosphate actually doubled the amount of protein per acre, and the benefit from phosphate was therefore much greater than that suggested by the yield figure alone.

POTASSIC AND CALCIUM FERTILISERS. The Rothamsted experiments have shown that potassic fertilisers enabled potatoes to make better growth in a sunless season than would otherwise have been possible. This observation has been extended and confirmed by O. Lemmermann and H. Leisegang, who obtained evidence that potassium salts were more effective than other nutrients in enabling plants to utilise the diminished light under shaded conditions. More results have been obtained as to the time of application of potassic fertilisers. Faas found that 40% potash salt gave better results when applied a fortnight before sowing or even earlier than when applied with the seed.

It used to be thought that lime liberated potash from the soil and so did away with the necessity of supplying potassic fertiliser to hay land. This is not so on the heavy land at Rothamsted; lime increases yields only on the acid plots manured with sulphate of ammonia, not on the more nearly neutral plots receiving nitrate of soda; on the plots without nitrogen, it gives no increase unless potash also is supplied.

Notes and Comments

Economic depression and Agricultural Journalism.—From an announcement in the December number of the *Agricultural Journal of British Guiana*, we learn that the journal will suspend publication from 1932 as a result of financial stringency. Though established only four years ago as a quarterly publication the journal has been playing an important role in agricultural matters relating to British Guiana and its exit is a loss to the ranks of agricultural journalism. The economic depression which has swept over all parts of the globe has hit agricultural interests worst and we are not surprised that even a government organ like the AGRICULTURAL JOURNAL OF BRITISH GUIANA has been obliged to suspend publication. We are not ourselves free from the present depression and the cramped pages, small types and thin paper are but external manifestations of rigorous economy on all fronts. We trust that our numerous clients—themselves subscribers, advertisers and patrons—will bear with us and continue to steer us through the present crisis. Though our ambitious programme had perforce been curtailed we shall yet get through the ordeal with our heads above water.

Tennis Honours for Madras Agricultural Officer.—Mr. C. Ramaswami's march from victory to victory, in the several tournaments early this year attained its climax when as captain of the Madras team, he ably led his men to victory, in the recent inter-provincial tennis

contests held at Delhi. It is over a decade since Ramaswami won his Tennis 'blue' at Cambridge and since his return to India his official duties as District Agricultural Officer which compelled him to stay in mofussil towns and tour about in the rural areas precluded all facilities for maintaining his University form in tennis and cricket. We were therefore under the illusion that the hand that could with equal grace 'turn tennis balls into gun stones' or subtly 'wield the willow' had lost his cunning and that the time had arrived for "Ramu" to convert his tennis rackets into *insect* nets and cricket bats into *guntaka* handles. His recent performance has, however, belied our pet theories and we hasten to congratulate Mr. Ramaswami on the honour he brought his province and to the Madras Agricultural Department.

Another Loss in the Ranks of the Mysore Agricultural Department.— We regret very much to have to record the death of Dr. M. K. Venkata Rao M. A., Ph. D., Deputy Director of Agriculture, in the Mysore State, which took place recently. It was only very recently that we had to chronicle the loss of Dr. K. Kunhikannan, the Mysore Entomologist and we are pained to note the death of another very able and promising officer, of the state. The late Dr. Venkata Rao was a brilliant graduate of the Madras University and had special training as a Botanist and Mycologist in Great Britain and California from where he earned his doctor's degree. He was a very energetic and capable officer of the State Agricultural Department and was one of the best and up-to-date authorities on 'malnad' agriculture. In his loss the Mysore department has lost one of the best officers of the State and the small group of Indian botanists a very capable member.

More Honours to Dr. Sir C. V. Raman — Among those on whom the Madras University Senate resolved to confer honorary degrees is Dr. Sir C. V. Raman on whom the degree of Doctor of Science is to be conferred. It is needless to add that this honor to him has come rather too late from his own University and that the latter failed to honor itself earlier by conferring such a degree on this brilliant scientist and internationally famous as a nobel laureate!

Agricultural Exhibitions in March. — During the month three important agricultural exhibitions were held in the province. One was at Chodavaram in the Vizagapatam district, one at Nellore and another in Trichinopoly. At Chodavaram the show was opened by Rao Bahadur C. V. S. Narasimha Raju Garu, ex-President of the Legislative Council and a well-known and influential land-holder of the district The exhibition was held right in the middle of an agricultural holding and growing crops and other agricultural products were shown in their natural condition. Great credit is due to Mr. Jogi Raju, District Agricultural Officer, Vizagapatam, for the trouble he took in arranging a very good show of the local products. Mr. Edmonds, the Dy. Director also evinced considerable interest in the

function. At Nellore and Trichinopoly, S. V. Ramamurty Esq., I. C. S., Director of Agriculture was present in person and delivered interesting lectures on agricultural matters before large and educated audience. To bring home to the ryots and the educated land-lords there are no better methods of propaganda than such exhibitions and talks by officers of the department and others interested in matters agricultural. It will add to the value of such shows if the Government department can also arrange to display by means of cinema films the various activities in demonstration and research in the different agricultural stations and the Research institute at Coimbatore so that the lay man farmer can get an idea of what is going on in these places.

The Sir Subramanya Ayyar University Lecture. We are indebted to the University authorities for arranging to have this year's Sir Subramania Ayyar's lecture delivered by one of our distinguished officers. It was delivered by our ex-Principal, Rao Bahadur M. R. Ramaswami Sivan on the 21st instant in the Senate Hall of the University. The subject dealt with was "The problem of increasing crop yields — from the chemical standpoint". As a veteran Agriculturist of great experience with his wide knowledge of agricultural chemistry and as an agricultural teacher for many years Mr. Sivan was able to explain in a very interesting and popular manner the important needs of the province with regard to manure and other improvements of the soil so that the farmer may be able to raise better and more crops than what he has been able to do till now.

Sugar Industry in Mysore — The Government of Mysore are taking active steps for the early establishment of a sugar factory in the Irwin Canal area. The rotational system of irrigation contemplated under the Irwin Canal scheme will bring about 35,000 acres under cane cultivation in this area alone, while scattered in various parts of the State are some 40,000 acres under this crop, thus assuring a sufficient supply of cane for the factory.

Mr. Srivastava, the Sugar Technologist with the Government of India, who recently visited the State was very favourably impressed with the prospect of the sugar industry in Mysore. The Department of Agriculture is engaged in carrying out experiments for the production of a variety of cane, whose juice is specially well suited for the production of sugar. The variety now chiefly grown is better suited for jaggery making than for sugar. It is stated that a well-known Madras firm which has a large experience of the industry may be invited to work the factory.

The Lot of Cattle & Other Domestic Animals. Referring to several forms of cruelty practised upon animals Mr. N. C. Rangaswamy Iyengar of the Madras S. P. C. A. said that one of the most glaring forms of cruelty was the starvation of calves by milkmen. Prosecutions made them poorer still while education did not reach them. Cows were often kept in unclean and insanitary stalls. They feed on dried leaves and other rubbish strewn in the streets. With unclean hands milkmen milked cows in front of houses near rubbish heaps. The starting of a dairy farm in Madras might perhaps go a long way in solving the problem of starvation of calves. The views of the Heads of the Public Health and Agricultural Departments, Co-operative Societies, the Corporation, etc., have been ascertained and it was proposed to convene a conference. Bullocks with sores and tumours on their necks were used in oil mills. To escape detection, the mill owners enclosed the places with fences and walls and they also kept the gates locked while the mills were working. There were other types which were difficult of prosecution because of the difficulty in securing magisterial convictions. It is left to educated men and cultured farmers to attend to these things and improve the lot of these dumb animals.

ABSTRACTS

On the origin of the Uronic Acids in the Humus of Soil, Peat and Composts. Waksman S. A. and Renszer H. W. (*Soil Science*, vol. 38, pp. 135 - 151). Uronic acids are oxidation products of sugars and are found in gums, mucilages, pectins and similar complexes of plant materials and also in animal tissues and microbial cell wall substances. Their presence as such or as poly-uronides gives rise to inaccuracies in hemicellulose estimations by the usual methods. In this paper, a series of analyses are presented giving the abundance of pentosans, of total hemicelluloses and of uronic acid complexes in plant materials, in composts, in peats, forest soils and mineral soils. The results show that different plant materials vary in the relative concentration of the different hemicelluloses and in the relative rapidity with which these are decomposed by micro-organisms. The true pentosans are attacked more rapidly than the uronic acid complexes. The nature of the soil, its reaction, soil treatment and system of fertilization, modify not only the abundance of the total organic matter in the soil, but also its chemical composition. Addition of organic manures results in an increase of the pentosan content, whereas continued cultivation without manuring results in a rapid reduction of total soil humus and a corresponding relative increase in uronic acid complexes. (T. R. S)

Investigations into the feeding of Cotton Seed Meal to Cattle. Halverson J. O. and Sherwood F. W. (*Tech. Bull. No. 39 of the Agrl. Exptl. Stn. of the North Carolina State*) Experiments from 1920 to 1928 on "Cotton seed meal poisoning" symptoms: loss of appetite, staggering, impaired vision, spasms ending in death) show that it cannot be due to the gossypol content 0·0072% gossypol and 0·834% bound or D gossypol, on the meal, but is due to nutritive deficiencies in calcium and Vitamin A, and to a smaller extent in Vitamins B and D. These deficiencies can be removed by the use of pasture, leguminous roughage or good quality hay. Typical symptoms of cotton seed meal poisoning can also be produced on heifers receiving meals such as linseed, peanut or soybean, which contain only very small quantities of gossypol. The poisonous symptoms in all these cases can be removed by addition of alfalfa hay, green grass, brewer's yeast or

codliver oil, all rich in vitamin A. Biological analysis of the livers of both cows and calves affected by cotton seed meal poisoning, showed the absence of vitamin A. A ration consisting of 36·1% cotton seed meal with about 1/4 each of cotton seed hulls and Timothy hay, and 1/6 of corn silage, was unable to support milk production; reproduction, however, was good resulting in normal calves at birth. The addition of 1/7th of alfalfa hay (the Timothy hay being reduced by the same amount) aided materially in supplementing the above ration for healthy maintenance and milk production. (C. N.)

Studies in the Method of feeding Ducks:-- Cruz G. B. (*The Philippine Agriculturist* 1932, vol xx, No. 8). The paper records the results of experiments on rearing ducklings to maturity and feeding ducks for egg production. The birds were divided into three lots; lot I was given a supplement of dried shrimps, lot II a supplement of fishmeal and lot III a supplement of snails. Appreciable differences were observed in the rates of growth and the size and weight of birds, lot I being the best, lot II second and lot III last. Though the total cost of rearing the birds to maturity was highest in lot I, and next in lot II, there was lower mortality in lot I and highest egg production, so that among the three protein supplements tried, dried shrimps gave the highest returns over the cost of feeds consumed and hence found to be the most practical and economic supplement to be recommended. The studies disprove the popular belief that for economic egg production, duck-houses should be situated near a big source of fresh water where a regular supply of snails is available. (K. M. T.)

Root development as related to character of Growth and Fruitfulness of the Cotton Plant:-- Eaton F. M. (*Jour. Agr. Research*, 1931, vol. 43, pp. 875 - 883). An examination of the root systems of cotton plants grown in cans containing 110 Kgm. of soil, showed that root development was largely influenced by the character of the growth and the fruitfulness of the plants. Pima Egyptian and Acala upland cotton plants were grown 1. normally, i. e, with both branches and bolls, 2. with branches but no bolls, all floral buds being removed as they appeared, and 3. with neither branches nor bolls, the lateral buds of the main stalk being removed as they appeared. In the Pima series, the mean ratios of the weights of roots to tops were 0·22, 0·53 and 0·57 respectively for the treatments. In the Acala series, the corresponding ratios were 0·17, 0·44 and 0·62. The data showed that the boll development of fruiting plants was dominant over both root development and vegetative growth. When plants were grown without bolls, the weight of roots increased proportionately more than the weight of tops, but the increase in weight of roots was approximately proportional to the increase in weight of stalks and branches. The weights of the roots of plants grown without bolls were approximately triple those of control plants. (Author's Summary)

Tobacco Growing. VI. Bulking Down Mc Donald W. J. B. and Coghlan G. E. (*Jour. Agr. Victoria, 1932*, Vol. 30, pp. 15--17; *cf. M. A. J*, Vol. 20. p. 68). In the 6th article of this series the writers examine the optimum conditions necessary for the process of 'bulking down' or 'ageing', during which a mild fermentation takes place, improving the colour and imparting a pleasing aroma. Leaf may safely be bulked down with 10 to 12% moisture content; the leaves when crushed between the hands should crackle without breaking and rapidly regain its normal position when released. If too damp, there will be no crackling and the leaf will be inclined to remain in a limp state. When the midrib is doubled between the finger and thumb, it should crack two-thirds of the way up from the tip. A leaf containing too much moisture will show signs of bruising when rubbed between the thumb and forefinger. The writers give details for the building and rebuilding of bulks. (C. N.)

Tobacco Growing. VII. Preparation for Market --Mc. Donald, W. J. B. and Coghlan (*Jour. Agr. Victoria*, 1932, vol. 30. pp. 62--66.) In the present article, the writers deal with the factors of quality in Tobacco, on which depend the market value, e. g. colour, size and shape, texture, soundness and the proportion of leaf web to veins and ribs; and they suggest a tentative grading of leaves into the following classes based upon the colour of the cured leaf:--Lemon, Bright Mahogany, Mahogany, Dark Mahogany and Dark, the lemon coloured being the most valuable grade. Details are given for proper methods of grading, handing, bulking and baling of the leaves. (C. N.)

An instrument for determining the breaking strength of Straw, and a preliminary report on the relation between breaking strength and lodging. Salmon, S. C. (*Jour. Agr. Research 1931*, Vol. 43, PP. 73--82). The instrument, described and illustrated in the paper, was used from 1926 to 1930 to test the breaking strength of straw of different varieties of wheat grown at the Kansas Experimental Station. The straw of soft wheats, showing resistance to lodging, was found more difficult to break than that of hard wheats which lodge easily. The straw of varieties intermediate in tendency to lodge was intermediate also in breaking strength. Correlations between lodging in various seasons were not significant statistically, but those between breaking strength of straw in different seasons were both high and quite significant. This anamoly is attributed to the fact that the percentage of lodging is governed by weather conditions, growth stage and variations in individual estimates to a much greater extent than is breaking strength determinations. The instrument described may be of use in selecting new wheat varieties resistant to lodging by accurately measuring the breaking strengths of their straws. (C. N.)

The Relation between Iron, Humic Acid and Organic Matter in the Nutrition and Stimulation of Plant Growth:-- Burk D, Lineweaver H. Horner C. K. and Allison F. E. (*'Science'. 1931*. vol. 74, No. 1925. pp. 522-524), Natural humic acid prepared from the soil and synthetic humic acid prepared from glucose, containing various known amounts of iron, were compared in regard to their stimulatory action on the growth of the aerobic soil bacterium, *Azotobacter vinelandii*. It was noted that the beneficial action of humus was proportional to the content of iron; and the organic fraction as well as other inorganic impurities were substantially inactive. Comparison of samples of humic acid containing iron with applications of organic iron in the form of ferric citrate, tartarate or oxalate, and inorganic iron like ferric sulphate, metallic iron etc., and a statistical study of the data obtained show that a given amount of soluble iron gives the same order of stimulation independently of whether the iron is added in the form of natural humic acid or in any of the substitution products. It is therefore concluded that the stimulatory action of humus on plants is due primarily to the iron it contains. The superior beneficial action of humus is attributed to the fact that it contains iron in a much more soluble and available form, than other organic or inorganic salts of iron. Thus, inorganic iron is soluble in neutral media to the extent of only 0.01 to 0.05 p. p. m. which is considerably below the optimum concentration of about 0.5 p. p. m. necessary for active plant growth. Organic salts of iron, though more soluble, are slowly precipitated in neutral medium, while the iron in humus is not so preciptated. Moreover, the induction period necessary for the beginning of stimulatory action, is shortest in the case of humic acid (3 to 8 hours with Azotobacter), while for organic iron compounds it is 8 to 15 hours, and for inorganic iron 15 to 30 hours. (C. N.)

Manurial Experiments with Sugarcane.--Turner P. E. and Potter, J. A. (*Tropical Agriculture, 1932*, vol. 9 p. 44). In order to examine the economics of the local custom of manuring sugarcane in Trinidad with heavy doses of Pen (farmyard) manure up to 30 tons per acre, the authors carried out comparative experiments

in 1928 to compare the following systems of manuring :--(1) No manure *(2)* Complete inorganic manure (90 lbs. of nitrogen as sulphate of ammonia, 375 lbs. of total phosphoric acid as ground rock phosphate and 60 lbs. of potash as sulphate of potash, per acre); *(3)* 10 tons of Pen manure per acre (Farmyard manure containing approximately 0.44% Nitrogen, 0.20% phosphoric acid and 0.63% potash:) *(4)* 20 tons of Pen manure per acre; and *(5)*30 tons of Pen manure per acre. Statistical analyses of the data showed :-- 1. Maximum gain by the use of Pen manure alone was obtained by application of 10 to 12 tons per acre; above this range, the gain diminishes rapidly; beyond 23 tons a net loss was incurred. 2. The complete inorganic manure gave an increment in yield of plant and first ratoon canes of 14.6 tons (over 'no manure' crop of 40.4 tons). This is equal to the increment given by a dressing of 30 tons of Pen manure. 3. The net gain to the acre by the use of the inorganic manure was 19.82 dollars. The maximum net gain to which Pen manure could give rise was 4.35 dollars. The authors conclude that under the conditions of the experiment, sugarcane could be grown certainly without reduction in yield and with much greater profit, by the use of complete inorganic manure in place of Pen manure.

(C. N.)

Notes on Oil development in the seed of a growing plant. Eyer, J. V. *(Biochem. Jour.)*, 1931, Vol. 25, PP. 1902--1908. This paper reports a study of the changes which take place in the rate of formation and character of oil present in the seed of flax *(Linum Usitasimums)* and L. cribrosum, at different stages of development and ripening. The observations show that in oil formation, the acidic constituents are accumulated first. Whether glycerol is formed at the same time, only combining with the fatty acids at a later stage, or whether its formation itself is delayed, is not *clear*. There is rapid oil formation in the initial period of 15 days, during which a maximum of 30% of oil, calculated on the dry weight of the seeds is reached. After this, till 60 days, very little more oil is added. Changes in the nature of the oil continue after oil formation has ceased; its unsaturated character, as measured by its degree of iodine absorption, continues to increase. It is pointed out that this is apparently an entirely separate change independent of oil formation. During the early stages, a reducing system prevails for converting carbohydrates into acids, and later, an oxdidising system leads to the formation of unsaturated acids by removal of hydrogen. For the first 5 days, the capsules were white and translucent, and later the colour changed to green on account of accumulation of chlorophyll. After 20 days when the seeds were fully plump and well grown, the colour of seed slowly changed to yellow and brown. Rapid acid and oil formation take place in the initial stages when chlorophyll is present, and the oil is coloured green. Increase in iodine value and unsaturation is accompanied by a change in the colour of the oil to yellow and the author attributes the effect to the presence of carotene, which removes Hydrogen from the oil and is itself finally oxidised, rendering the oil colourless.

(C. N).

The Microbiology of Farmyard Manure Decomposition in Soil. III. Decomposition of the cells of Micro-organisms. Jensen, H L. *(Jour. of Agr. Science, 1932* Vol. 22. PP 1--25). In the first two papers of this series (*Jour. Agr. Sci. 1931*, Vol. 21, P, 38 and *Ibid.* Vol. 21, P. 81), the author has shown that the addition of manure to soil gives rise to rapid multiplication of bacteria, of actinomyces and sometimes of filamentous fungi, which last develop to an enormous extent in acid soils if the manure contains fresh straw. There is also an increase in cellulose decomposing organisms. Soon, however, the growth rate falls down, accompanied by the accumulation of ammonia and nitrification. In the present paper, the writer has examined the question of the difficulty with which the organic nitrogen of farmyard manure is utilised by plants, and the validity of the current explanation that the nitrogen is present in the form of bacterial and fungal cells which offer great resistance

to decomposition. Experiments were carried out to follow the rate of decomposition of dried cell substance of various micro-organisms -- nine fungi, one actinomycetes and two bacteria -- added to soil and sand. It was found that a certain fraction of the nitrogen of the microbial substance was readily nitrified and assimilated by the active soil micro-organisms, while the rest persisted in the soil as an almost unnitrifiable residue resembling A-humus. Based upon the present and previous experiments, the author arrives at the following conception of the decomposition of farmyard manure in the soil :---

"A considerable part of the organic nitrogen of the manure (18--25%) is present from the beginning in compounds corresponding to the A-humus of the soil, which are in themselves very resistant to decomposition. Another part of the manure nitrogen is used for the synthesis of cells of bacteria and other micro-organisms, which multiply vigorously immediately after the addition of the manure to the soil, utilizing the carbonaceous componds of the manure as sources of energy and sometimes reaching total numbers so high that their cell substance may account for 25% of the amount of nitrogen added in the manure. If the amount of nitrogen available to the bacteria is insufficient in proportion to the amount of available energy, nitrogen is assimilated from the soil, and the accumulation of nitrate decreases in comparison with unmanured soil. Some of the assimilated nitrogen may be converted into resistant A-humus like compounds through the activity of cellulose-decomposing fungi, especially if fresh straw has been present in the manure. In addition, the micro-organisms in general seem to contain other resistant nitrogenous compounds which must also be present in the farmyard manure, since it is very rich in living and dead micro-organisms. The remaining nitrogen of the manure, if any, is rapidly converted into ammonia and nitrate. Later, fresh inorganic nitrogen is released when the multiplication of the bacteria stops and their cells undergo nitrification. The resistant compounds which the micro-organisms have built up, tend to accumulate together with the A-humus and contribute to the soil humus. The carbon nitrogen ratio of the manure exerts a marked influence upon its nitrification. A widening of this ratio, i. e. an increased supply of energy in proportion to nitrogen, tends to bring about a larger development of micro-organisms and thus to increase both the amount of nitrogen temporarily locked up in microbial protoplasm and the amount of nitrogen converted into resistant compounds. In the case of farmyard manure, the resistant fraction is particularly large."

(*C. N.*)

Gleanings.

Spores travel in Upper Air. "Scouting trips with airplanes show that spores of certain plant diseases are often found at heights of 10,000 feet in the upper air. This is one explanation for the spread of such diseases as black stem rust of small grains", say specialists of the United States Department of Agriculture in a recent report. "Investigators working with white pine blister rust have found that spores of that disease falling in a perfectly still atmosphere from a height of one mile require 55 hours to reach the earth. Such experiments make it clear that plant disease spores may be blown for long distances unless brought down by rain or some other agency." (*Scientific American* January 1932.)

New Test for Pregnancy. "The fact that the pituitary gland empties an excessive amount of its hormone into the blood within a few days after conception is the basis for a test for pregnancy which has recently been proved to be accurate by the following investigators: Dr. M. H. Friedman of the University of Pennsylvania,

Dr. H. L. Reinhart and Dr. Ernest Scott of the Ohio State University; Dr. Schneider of the North Western University; and Dr. T. B. Magath and Dr. L. M. Randall of the Mayo Clinic. The test, known as the Aschhaim-Zondek test because it was devised by Dr. S. Aschheim and Dr. B. Zondek of Germany, is of extreme medical importance and may be a life-saving measure for the patient." ("Science Service", in *Scientific American*, January 1932).

The Silverfish as a pest of the household. "Silverfish are not difficult to control. By taking advantage of their natural craving for starchy food, they can be poisoned by using a powder consisting of a mixture of 12 parts of sodium fluoride powder to 100 parts of wheat flour or a thin paste made by mixing from one half to three-fourths of an ounce of white arsenic with one pint of wheat flour and adding enough water to make a thin paste by boiling. The paste should be poured on small pieces of flexible card-board or paper, which later can be rolled into cylinders with the paste on the inside. The powder or paste should be put in out-of-the-way places where silver-fish are found--on shelves, behind books, back of mantels, under washboards, and on the bottom of drawers and in storage boxes. As both are poisonous, they should be put where young children will not find them" (U. S. Dept. of Agriculture *Farmers' Bulletin* No. 1665. June 1931).

Origin of Vitamin C. "Three Scandinavian workers, Ottar Rygh, Aagot Rygh. and Per Laland, have obtained what appears to be conclusive evidence that narcotine, one of the less toxic alkaloids present in opium, is a, if not the, precursor of the antiscorbutic vitamin C. In the first issue of the *Zeitschrift fur physiologische Chemie* for 1932, these authors describe how they found the alkaloid in various unripe fruits and vegetables, but failed to detect its presence in the ripened materials. From 200 unripe oranges they prepared 600 mgm. of the alkaloid; and by extracting the concentrate, consisting of oil and crystals, from 15,000 oranges at various stages of ripeness, they were able to trace the gradual changes in antiscorbutic power as ripening proceeded. Pure, commercial narcotine was not antiscorbutic, but irradiation from a mercury vapour lamp activated it to some extent without appreciably altering its physical properties. Guinea pigs were fed on dieteries containing narcotine and irradiated narcotine; both groups died about the same time, but the former group developed strong signs of scurvy before dying and the latter none. Narcotine was found in unripe tomatoes (20 mgm. in 20 kgm.), white cabbage (40 mg. in 100 kgm.) and in potatoes (12 mgm, in 20 kgm.); qualitative indications of the presence of narcotine were found in milk, but none in red bilberries. Of various derivatives of narcotine, the orthodihydroxy derivative - methylnornarcotine - was found to be particularly anti-scorbutic. In presence of germinating seeds, known to produce vitamin C, narcotine became active; it disappeared and gave rise to phenols." (*Nature* Feb. 20, 1932).

Synthetic grass laid along city Boulevard. "Green all the year round, a strip of artificial grass has just been laid beside a New York city boulevard. If the 200-foot experimental plot proves of success, synthetic greens may become increasingly popular in cities. The man-made lawn is unaffected by the carbon monoxide fumes of auto-exhausts, never needs cutting, raking or watering, and does not turn brown in summer. Its appearance fools the eyes of passers-by, for it is said to look more real than genuine grass. This "grass" is a special composition of slate and asphalt on a cinder base." - (*Popular Science Monthly*, March 1932).

Lemon Juice is now reduced to powder. "Lemon juice in powdered form for making pies, icing and lemonade is a novelty that has appeared on the market. In its manufacture, practically all the water is removed from the juice of ripe lemons. Corn syrup is added to assist in the drying, but it is said not to affect the flavour in any way. According to the maker, the powder duplicates the taste of natural

emons, but the trouble and muss of squeezing them is avoided and the powder can always be kept handy in the pantry for instant use."--(*Popular Science Monthly*, March 1932).

Ensilage and high quality Milk. "In various regions producing hard cheeses, doubts have been expressed about the possibility of using green fodder ensilage as a feed for dairy cows, and in districts aiming at the production of first quality milk there is pronounced opposition to its use. These facts led to some careful tests being undertaken to determine the influence of ensilage on milk. The results of the experiments have just been published in *Die Futterkonservierung (Berlin 1931, Band III, Heft 2)*. It is found that by the use of well constructed silos and careful observation of the necessary precautions, young green fodder, rich in protein, can be converted by fermentation in the cold into a product containing lactic *but not butyric acid*. This form of ensilage may safely be used, as the experiments have shown, for dairy cows giving first quality milk." (*Jour. of Ministry of Agriculture*, Vol. 15, No. 1).

Smallpox Germ Discovered. "Demonstration that the germ of smallpox is probably a minute spherical body 1/125,000 of an inch in diameter, near the lower limit of microscopic visibility, has been announced by Prof. J. C. C. Ledingham, Director of the Lister Institute of London. This climaxes the medical war against smallpox, which began with Jenner's discovery of vaccination, long before Pasteur founded bacteriology. Although smallpox has been controlled for decades, its causative organism heretofore has been unknown. For a quarter of a century, minute spherical bodies have been found in certain virus diseases, such as smallpox and cowpox, but these have always been ignored. Their agglomerations constitute large inclusions which are striking features in the body cells and in the pox lesions of patients.

"Professor Ledingham made practically pure specimens of minute bodies from fowlpox and vaccinal lesions, and found that they reacted specifically with serum from animals that had recovered from attacks of fowlpox or vaccinia. He also demonstrated the presence of specific agglutenins in the blood serum of a rabbit inoculated with vaccinia. Agglutenins are substances of as yet unknown nature, the presence of which in the blood causes bacteria and other foreign bodies to gather together in clumps.....

"The cultivation of virus vaccinia in a medium containing no living cells was announced by Dr. G. Hardy Eagles of the Lister Institute. He used a medium composed of Extract of rabbit kidney, rabbit blood serum and salt solution. This first successful attempt to cultivate a virus in a cell free medium may eventually allow the production of vaccinia in the laboratory instead of in experimental animals. It is also important from a theoretical viewpoint."--- (*Scientific American*, Jan. 1932).

Top-working Mangoes. This, within two years, offers a ready means of transforming established and wild trees into fruit-bearers *in situ*. The method is now in regular practice in St. Lucia and has stimulated the demand for experienced propagators to work common trees on estates.

Any well-grown mango can be prepared for top-working by felling the tree carefully at about 4 to 6 feet above ground, leaving an intact, sloping surface, preferably facing north. Branches, if found low down, can also be prepared instead of the main trunk, the cut surface being painted with a suitable preservative such as solignam, tar, or paint. If no young shoots are present, suitable ones will arise within two months. Three to five of these should be selected, evenly spaced around the stump, and the remainder pruned off. The shoots are ready for budding as soon as they begin to suberise or form cork. This can be

detected by the change in colour of the shoots from green to brown, by the scabrous exterior, and frequently by the presence of a distinct eye (the bud) outlined by the brown cork layer.

The scion bud is selected from shoots of a similar degree of maturity, from a tree of the required variety, and can readily be removed by peeling off a piece of bark containing a bud, which should come away without any adhering pieces of wood or fibre.

For budding a suitable piece should be chosen low down on the young shoot for insertion of the bud. An inverted T shaped cut is made one and half inches long and half an inch wide, and the flaps of bark are carefully loosened up with the bone end of the budding knife. The strip of bark containing the scion bud is now lifted, trimmed to fit and immediately inserted and pushed well up into the "handle" of the cut. The upper edges of the incision will hold the bud, but the lower ones should be carefully carved away to allow the bud to rest in a ∧-shaped opening. This is in turn, firmly tied in with raffia, and the top of the shoot ringed half an inch wide so that the cell sap may concentrate around the bud. Within a week or so, budded trees should be examined, loosened, retied, and disbudded as necessary. In three months the buds make quite stout heads, which should be pruned back to encourage formation at the union, and so to prevent wind-blown heads.

A New Method of Pineapple Propagation. The following method of pineapple propagation was worked out by the author during the latter half of 1929, and up to the present has given excellent results. It promises to supersede the standard method of de-suckering lateral growths for making new material, as it produces a larger number of uniform plants of a given variety within a short time.

The pineapple plant, preferably before the formation of the fruit stem, is stripped of all leaves except the last or so which form the young shoot. The rizome and aerial stem, when freed from roots and scales, is then cut with a sharp knife into clean cross-sections not more than one fifth inch thick. Such sections, which will carry from three to four, more or less dormant, buds, should be put into a two to five per cent. solution of potassium permanganate for about ten minutes, after which they should be removed and allowed to drain. They are then planted in a flat position on a prepared bed of light soil or, if a solar frame is available, on a bed composed of chopped coconut fibre and granulated charcoal, covered with a thin layer of soil or fibre, and watered.

Germination of the dormant buds takes place within a week or a fortnight, according to the bed temperature maintained and the pineapple variety. When the buds have formed shoots, the section is lifted (care being taken to retain any embryo root system) and is served in three triangular portions, each with its own bud. The sections are then redipped in the permanganate solution, replanted in the germinal bed, and watered with a solution of ammonium sulphate. Within a short time the embryo pine-apple plants, with a good root system, can be transferred to an outside bed or further advanced in the green house in manured beds. Only moderate watering is necessary, but free use should be made of fibrous material (Chopped coir) and dressing of cotton-seed meal or similar complete manures. The stem end may also be dipped in permanganate solution and embedded in the chopped fibre, when it roots readily. The permanganate solution is used to prevent the growth of destructive organisms.

The object of using unfruited stems is to take full advantage of the food reserves present, of which each bud is allotted a share in sectioning. Furthermore, the buds, being stimulated by moist heat and by flooding with a nutrient solution, can develop a root system before decay sets in. Subsequently, the triangulate scrap of stem is almost completely reabsorbed, leaving only the fibrous remains of the vascular bundles intimate with the root system. It should be observed that water and gaseous exchange take place only with difficulty through a cork membrane; thus the passage of these substances must occur mainly through the cortex at the cut ends of the sections, and care should be taken not to bruise these areas when cutting sections for germination.

The development of flower heads in maturing pineapple plants required for propagation may be prevented by a drop of weak sulphuric acid tubed into the centre of the expanding bud.

From mature stems of one foot in length, from 80 to 100 plants may be obtained within six months, ready for setting out in nursery beds. Diligent manuring may be practised with the young plants which respond vigorously to dressings of cotton-seed meal. It is not expected that such plants will behave any differently from the side-shoots and suckers tardily developed in the normal flowering and fruiting plant, or that they will not carry satisfactory fruit characters. Also in view of the fact that the young buds are isolated from the parent before the pre-fruiting period of dormancy sets in, they should develop into fruit plants equal to, or better than, the parent forms. In propagation work of this kind, the main object is to induce the plant to redirect its energy wholly to the continuous production of meristamatic tissue. (*Tropical Agriculture Vol. ix, No. 2.*)

Correspondence

I Coat Colour in Kangayams at Hosur.

Mr. M. P. Kunhikutty writes from Hosur Cattle-Farm:---

Kangayams are a fine draught breed found in South India. They are strong active animals with compact barrels and short straight legs. The head is short and the horns are long and pointed having a backward curve. The prevailing colour is light grey in cows; but bulls are dark grey verging to black on head, hump and quarters. While the adults are uniformly grey in colour, the calves are, without exception, found to be brown at birth and the early stage of their growth. A change of colour from the young stock to the adult is an exception in other breeds but it is the rule in Kangayams. With a view to find out the time taken for, and the manner of, this change, two dozen Kangayam calves were kept under observation from their birth till they changed colour. This note is the result of such an observation.

The numbers of the calves selected for study were 201 to 224. All of them except No. 210 had the following features at birth:---

General colour brown, belly white; the inner sides of the legs completely or partly white; tail switch black; black spots near fetlock joints of all the limbs. No. 210 had white star and patches, in addition. This calf did not appear to be a pure Kangayam, but lookd 'Ongolish'.

At first, they were watched once a week, but the period was found too short to show any change in them and consequently the interval was extended to a fortnight. For the first month there appeared scarcely any change, but by the end of the second month, a slight fading of brown coat was clearly noticeable. From the third to the seventh month, a mixture of light brown and light grey coat was

found gradually spreading up the flanks, thighs and necks. During the seventh month, the calves changed nearly into light grey with the exception of face, poll, back and the lower parts of the legs which remained still light brown. These latter portions, however, gradually turned into light grey in the course of the 8th month, by the end of which the calves were found completely in light grey. The changes described above were common for half the number of calves, Nos. 201 to 203, 205, 208 and 220 to 223, while the others excepting one showed the same change in a slightly longer or shorter period, the manner of change being identical in all. To change the brown coat into light grey, calves Nos. 215 and 216 took 10 months; Nos. 218 and 219, 9 months, Nos. 204, 206, 207 and 214, 7 months and calves Nos. 212, 213 and 224, 6 months. The calf No. 217 was the only exception in that it did not change into light grey even after 10 months. The calf retained light red and grey coat. That the light grey coat appears after the shedding of the brown is evident from the fact that very young calves affected with ringworm got a coat of light grey hairs wherever original hairs had fallen off. Calves Nos. 207, 210 to 216, 218 and 219 had an attack of ringworm at the age of 1 to 3 months. Again the change in healthy calves took place quickest where there was the greatest chance of shedding the original coat. The flanks that rubbed against the floor were the first to show the change. The back, poll and face that had the least chance of coming in contact with the floor or wall were the last to change from brown to light grey.

After 10 months, the light grey colour of bull calves were found gradually changing into dark grey which finally turned to black on hump, head and quarters by the time they attained the age of 2 to 3 years. A cow on the other hand is uniformly light grey throughout her life. A mature bull when castrated reverts to light grey similar to that of a cow. Curiously enough Kangayam cows Nos. 13, 25, 36, 71, 76 and 124, as the result of a bad attack of "Foot and Mouth" disease in the year 1929, had developed a rough coat of dark grey colour and they have been found retaining the same coat ever since.

With the object of improving the rough coat of those cows, Potassium Iodide was added to their food but to no effect.

To summarise the result, Kangayam calves are brown at birth; they change their coat into light grey after 8 months and retain the same colour in case of cows. But in bulls the colour changes to dark grey on head, hump and quarters, which again reverts to light grey when the animals are castrated.

II A small suggestion for those that prepare bordeaux mixture with casein as adhesive.

Mr. P. S. Suryanarayana Ayyar, Sub-Assistant in Mycology, Lalgudi writes:–

It is a well known fact that in the preparation of Bordeaux mixture, the proportion of lime and copper sulphate plays an important part if the physical value of the mixture is to be preserved For instance, if the copper sulphate is in excess the foliage of the plants will be scorched, though the fungicidal value is not at all impaired. But on the other hand if the lime is increased, the efficiency of the mixture is affected. The usual knife test to see if the Bordeaux mixture is correctly prepared will only show the excess of copper sulphate in the mixture. As yet no test is usually adopted to find out the increase in lime which necessarily reduces the copper content and indirectly affects efficiency of the fungicide. This is perhaps due to the fact that excess of lime does not injure the foliage of plants sprayed on.

The following relevant extract from "Insecticides and Fungicides, Spraying and dusting equipments---A laboratory manual with supplementary text" by Anderson and Roth will show clearly the meaning of the above statement.

"The value of Bordeaux mixture is determined by the *amount of copper present*, its ability to cover the surface of the plant and its adhesiveness..... The copper is the active ingredient which controls the fungus diseases. The lime causes the formation of a compound which does not injure the foliage and which spreads and adheres well. When copper sulphate and lime are brought together a series of basic copper sulphates are precipitated. When properly mixed the precipitate remains in suspension for several hours, otherwise it settles rapidly."

The addition of more lime reduces the copper content bulk for bulk in a given quantity of the mixture, showing thereby that it affects the fungicidal property which depends on the copper.

Generally, one pound of casein is added as adhesive to 50 gallons of Bordeaux mixture (any per cent). This quantity of casein is first of all dissolved in one pound of lime (quick) and only this solution is added on to the whole fungicide.

The addition of this extra one pound of lime will have its effect on the whole mixture, especially it it is of a weak strength such as 0·5 per cent and below. For the preparation of the latter we add only 2 1/2th of quick lime to make up 50 gallons and the one pound necessary to dissolve the casein will make up the total lime come up to 3 1/2th (nearly 40 per cent more than is actually necessary). In this way it will be seen that in 1 per cent and 2 per cent mixture the lime content is increased by 20 per cent and 10 per cent respectively by the addition of the extra pound of lime used in dissolving the casein.

From the recent (January to February 1932) spraying campaigns at Konalai-Kalpalayam villages in Lalgudi Taluk, against grape vine mil dew, I find the use of this additional lime unnecessary. The casein is first of all dissolved in a pound of lime taken from the quantity intended for the Bordeaux mixture. This solution is added on to the total mixture of lime solution (or milk of lime) before finally mixing it with copper sulphate. After the process of mixing and when tested with a clean knife, the blade remains perfectly untarnished, showing thereby that there is no excess of copper.

This method, apart from the increase of copper content (as compared with the usual method), so essential in the control of fungus diseases, is also cheaper as we need not pay for the extra lime; the cheapness will become apparent when thousands of gallons of Bordeaux mixture is prepared for huge campaigns.

Thus I have suggested a slight departure from the usual routine, which if accepted will be a decided improvement. Finally, I request those, who like myself have to handle Bordeaux mixture and casein, kindly to test it for themselves and offer criticisms from their standpoint.

III When Experts Disagree.

Rudolph D. Anstead, M.A., C. I. E, (Retired Director of Agriculture Madras) writes from Bournemouth:---

In summing up the symposium on Sorghum at the Agricultural Conference in connection with College Day, the President remarked that "as usual the experts disagreed". The fact that "experts" frequently disagree is no reproach.

Sinclair Lewis in one of his books says: "It's taken the human race about 500,000 years to get where it is, and presumably it will take quite a few thousand more to become scientific, or even to "understand the need of scientific conduct of everything. I am not at all sure that there is any higher wisdom than doing a day's work. Living in a world that's raw and crude all you can do is to be honest." At least experts are honest in showing that they disagree.

In the search for ultimate truth, which is the aim and object of science, there can be no finality. The conclusions of science are based on ascertained facts and can never be final. Each new fact, or group of facts, discovered enables the scientists to review their former conclusions and modify them, or alter them accordingly. As the sum total of knowledge increases so do the conclusions to be drawn from it more and more approximate to what must be the real and absolute truth, at present hidden from the mind of man.

To the impatient layman this may prove disappointing. He wants a cut and dried opinion and immediate help, but this cannot always be given. There will always be certain areas, so to speak, in dispute. Never-the-less there are many things which science has brought to the help of the layman, in this case the farmer, which are not in dispute: the improvement of crops by means of selected seed and improved strains, the introduction and use of green dressings, for example, while the science of engineering has planned and executed great irrigation schemes, like the Sukkar Barrage and the Mettur Dam, which will make the desert blossom like the rose.

And be it noted that when nations disagree they resort to war with all its attendant horrors; when religious factions disagree they burn one another at the stake; when politicians disagree, -- well, *circumspice*! When scientists disagree they may express themselves in hard-flung words, but they then turn back to their laboratories and institute still more experiments in order to decide their disagreements and settle the points in dispute by marshalling still more facts in support of one side or the other. Thus while experts disagree and will continue to do so about many things, they press forward as a body to the common goal of them all--knowledge and ultimate and absolute Truth.

The layman has no cause to distrust science in India, and can well afford to be patient even if experts do occasionally disagree at Agricultural Conferences.

College News and Notes.

Students' Club: Tennis Tournament: The finals for the Cecil Wood Cup and the doubles handicap tournament came off on the 12th. In the singles finals students, D. T. Danapandian and U. Ananda met. Ananda put up a good fight in the first set but eventually lost the match to Danapandian. The masterly game of the latter player, particularly his forehand drives, prevailed. The scores were 8-6, 6-2 and 6-2. In the doubles tournament, K. Vedantachari and U. Ananda met D. T. Danapandian and O. K. Narayanan, and the former pair won the match by a margin of 4 games, the total number of games to the credit of the winners being 160 as against 156 obtained by the runners up. At the conclusion of the games Mrs. M. C. Cherian kindly gave away the cups and prizes to the several winners.

Award of Colours: It was by oversight we forgot to mention in the last issue of the journal the name of student T. R. Subbarayan of Class III amongst the list of students who had been awarded colours during the year. Subbarayan was the only student to obtain colours in Football.

University Meetings: There was a Senate meeting during the month and Mr. C. Tadulingam, Rao Sahib T. V. Rajagopala Acharlar and Dr. T. V. Ramakrishna Ayyar attended the same. Mr. Tadulingam attended a Senate meeting of the Andhra University also at Vizagapatam. Rao Bahadur M. R. Ramaswami Sivan

retired Principal of the Agricultural College, delivered in Madras The Sir Subramanya Ayyar lecture on "The problem of increasing crop yields from the chemical standpoint." We understand that he would be requested to repeat his lecture at Coimbatore for the benefit of the students of the College.

Retrenchment: We understand that as a means of retrenchment Government have decided to reduce the number of scholarships available at the Agricultural College and also to reduce the amount of each scholarship from Rs. 25 to Rs. 15 The posts of three assistant lecturers, one in Agriculture, one in Dairying and one in Agricultural Engineering are also being abolished.

Radha Kalyanam: The celebrations were done with great eclat as usual on the 25th March.

M. A. S. U. Parliament: A meeting of the M. A. S. U. Parliament was held on Wednesday 30th March in the Freeman Hall, when Mr. D. G. Munro, B.Sc., Deputy Director of Agriculture, VIII circle, moved that "This House welcomes under the present conditions, the Agricultural Marketing Bill and the Cotton Control Bill, as necessary measures." Mr. V. Duraiswamy Ayyangar, L. M. T. (Hons.), Manager, Rathakrishna Mills, Peelamedu opposed the motion. Mr. C. V. Venkataramana Ayyangar, B.A, B.L., Coimbatore, was Speaker. There was a very lively discussion and by consent of the House, the motion was divided into parts, and the voting showed that the house was for the Marketing Bill and against the Cotton Control Bill. Full details of the debate will be published in a later issue.

Visitors: Dr. Likhite, Dy. Director of Agriculture, Baroda State, was in our midst for a week to study the work on Cotton going on at Coimbatore. Mr. B. C. Burt, Agricultural Expert to the Imperial Council of Agricultural Research, visited Coimbatore in company with Rao Bahadur D. Ananda Rao, Headquarters Dy. Director of Agriculture, Madras towards the close of the month. They visited the Imperial Sugarcane Station, Cotton and Millets breeding stations and left for Chittor on 1st April.

Review.

Mr. M. V. Gadkari, Rice Specialist, Karjat, has published an interesting article in the February issue of the *Poona Agricultural College Magazine* entitled "Manuring of Rice in the present Slump." In these days of general depression and low prices for the agricultural products any demonstration that enhances the net return from the land should be very welcome. The article reviewed attempts to show how a rice cultivator of Konkan can increase the yield of his rice crop by following the work of the Rice Research Station at Karjat. The present low average yield per acre (1440 lbs.) of Konkan is, according to the author, due to insufficient supply of Nitrogen to the crop, and the article gives the results of an experiment where the application of an artificial manure like Ammonium Sulphate has increased the out-turn. Three doses of ammonium sulphate, namely, 150 lbs., 200 lbs. and 300 lbs to the acre, have been tried and the percentage increase of grain out-turn over the no manure plot have been 17, 32·5 and 44 respectively The economics of manuring have been worked out showing the net profits obtained after taking into consideration the present low prices of both the produce and the manure. After deducting the cost of the manure it is seen that profits ranging from Rs 9 to 28 per acre have been obtained. (K. R.)

Weather Review (MARCH 1932)

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	0	−0·5	1.4	South	Madura	0	−0·4	0·2
	Calingapatam	0	−0·4	0·6		Negapatam	2·9	+2·6	3·0
	Vizagapatam	0	−0·5	1·6		Pamban	0·1	−0·4	0·2
	Anakapalli*	0	...	2·6		Koilpatti*	0·8	...	4·4
	Samalkota*	0	−0·4	1·0		Palamkottah	0	−1·3	2·2
	Cocanada	0	−0 3	0·5					
	Masulipatam	0	−0·4	2·9					
Ceded Dists.	Kurnool	0	−0·3	0·8	West Coast	Trivandrum	1·2	−0·3	2·5
	Nandyal	0	−0·4	0·2		Cochin	0·3	−1·7	1·3
	Bellary	0	−0 2	0		Calicut	0	−0·3	0
	Hagari	0	0	0·06		Taliparamba*	...	...	...
	Cuddapah	0	−0·2	0·1		Kasargode*	...	...	...
						Mangalore	0	−0·1	0
Carnatic	Nellore	0	−0·2	0·9	Mysore and Coorg Hills.	Bangaloor	0·1	−0·5	3·6
	Madras	0	−0·3	0 7		Mysore	0·1	−0·3	0·1
	Cuddalore	0	−0·2	0·6		Mercara	1·5	−0·7	1.5
	Palur*	0	−0·1	0·2					
						Kodaikanal	0·8	−2·1	2·6
Central	Vellore	0	−0·2	0·6		Coonoor	0·1	−2·4	0·6
	Salem	0	−0·5	2.3		Kalaar *	0	−4·8	2·3
	Hosur*	0·1	0	1·8		Nanjanad*	0	−0·7	0 7
	Coimbatore Town	0	−0 5	2·7		Ootakamund*	...	...	...
	Coimbatore Res. Inst.*	0	−0·8	2 3					
	Trichinopoly	1·0	+0·7	1·1					

N. B. * Meteorological Stations of the Agricultural Dept.

General summary of weather conditions. --- The weather during the month was dry, except for a few days at the beginning when a few falls of rain occured in the southeast of the Presidency, when a "Low" shifted northwards from the Bay to the vicinity of the Palk straits.

Temperature was generally below normal throughout the month with the exception of Mysore and the Ceded Districts where at the end of the month temperature was above normal, Cuddapah reporting a maximum of 106o on the 31st.

Rainfall was below normal except locally in the south-east and Coorg, the defect being most marked in the Hills.

Weather R port for Research Institute Observatory. ---

Report No. 3 of 32.

Absolute Maximum in shade	...	...	...	97·0
Absolute Minimum in shade	...	...	...	62·0
Mean Maximum in shade	...	...	...	93·1
Mean Minimum in shade	...	...	...	69 4
Total Rainfall in month	...	...	...	nil
Mean rainfall for March	...	...	...	0·79 inches
Departure from normal	...	...	...	- 0·79 ,,

Mean daily wind velocity	...	..	...	1 4 M.P.H
Mean 8 h wind velocity	...	...	...	1·7 M.P.H
Mean humidity at 8 hours	...	...	...	70·7 %
Total hours of bright sunshine	...	...	...	284·7
Mean daily hours of bright sunshine	...	...	...	9·2

Summary of weather conditions. --- The weather was fine and dry with lower temperatures than usual and there was no rainfall. Towards the end of the month weather was slightly unstable owing to rising day temperatures and the setting in of the indraught from the South-west. Lightning was recorded on seven days. The month was characterised by the absence of the usual thunderstorms.

(P.V.R and P.K M)

Departmental Notifications.

Gazette Notifications.--Mr. C. Narayana Aiyar, Deputy Director of Agriculture, on special duty in the Co-operative Department, on reversion to the Agricultural Department is to be Deputy Director of Agriculture, VI Circle, Madura. Mr. B. Ramayya, Deputy Director of Agriculture, Vi Circle, Madura, on relief by **Mr. C. Narayana Aiyar, is posted to the I Circle, Vizagapatam, vice Mr. A. C. Edmunds granted leave. Mr. P. Subramanyan, Officiating District Agricultural Officer, Salem, in relief by the permanent District Agricultural Officer, is to officiate as District Agricultural Officer, Vizagapatam, vice Mr. G. Jogi Raju granted leave.** Mr. K. T. Bhandary, Agricultural Demonstrator, II grade, is to officiate as District Agricultural Officer, VII Circle, Tellicherry, vice Mr. M. Mangesh Rao granted leave, preparatory to retirement. Mr. A. C. Edmunds, Deputy Director of Agriculture, I Circle, is granted leave out of India for eight months from the 5th proximo or date of relief. Mr. G. Jogi Raju, District Agricultural **Office, Vizagapatam, is granted leave for three months from the 11th proximo, or** date of relief.

I Circle.-- K. Suryanarayanan, A. A. D., Anakapalle, Extension of l. a. p. by 1 day in continuation of 2 months l. a. p. already granted. D. Bappayya, A. D. extension of l. a. p. by 2 months on m. c. from 27--2--32. V. Achutharamayya, A. D. Chatrapur, l. a. p. for 9 days from 7--3--32. U. Vittal Rao, F. M. A. R. S., Samalkota, l. a. p. for 2 months from 18--4--32. V. Tirumala Rao, Asst. to the G. E., Berhampore, transferred to A. R. S., Anakapalli, vice V. Margabandhu, Asst. to the G. E. Anakapalli. B. P. Papiah, A. A. D., Bobbilli, l. a. p for 2 months from 25--4--32. **III Circle** :-- K. S. Ramanna Rai, A. D., Mangalore, l. a. p. for one month with effect from or after 15--4--32. **IV Circle** :-- P. Janakiramier, A. D. on special duty, l. a. p. for 9 days from 30--3--32 with permission to prefix the Easter holidays. V. Suryanarayanan, F. M, Kalahasti, l. a. p. for one month from 4--4--32. P. Janakiramier, A. D. on Van duty to be on Special duty, Cuddalore. M. K Swaminatha Iyer, A. D, Walajah, transferred to Tirukoilur. M. A. Balakrishna Iyer, A D., Gudiyatham, transferred to Walajah. S. Muthuswami Iyer will be in charge of Gudiyatham. **V Circle** :-- P. S. Suryanarayana Iyer, A. A. D., l. a. p. for one month from 15--3--32. **VI Circle** :-- V. G. Dhanakoti Raju, A. D., Ambasamudram, l. a. p. from 4--3--32 to 19--3--32. **VII Circle** :-- P. Kesavanunni Nambiar, A. D, Calicut, l. a. p, for 5 days from 19--3--32 to 23--3--32 with permission to affix the Easter holidays. **VIII Circle** :-- T. S. Sundaram, A. D. on probation, l. a. p for one month from 18--2--32. **G E.'s Section**:-- P. N. Krishnasami Offg. Asst. transferred to Cotton

Section from 7--3--32. T. S. Alwar Iyengar, Senior Artist l. a. p. for one month from 1--4--32. **G. A. C's Section**:-- G. Ganapathy Iyer, Asst l. a. p. for 24 days from 18--2--32 **P. S.'s Section**:-- T. K. Balaji Rao, Asst A. R. S Aduturai. l. a p. for one month from 21--3--32 with permission to avail Easter. A. Chidambaram Pillai, F. M. l. a. p. for 8 days from 16--3--32 with permission to suffix Easter. P. Uthaman, Asst, l. a. p. from 3--3--32. **G. M's Section**:-- K. M. Thomas, Asst, l a. p. for one month from 30--3--32 with permission to prefix the Easter holidays. **Curator's Section**-: P. Abisheganathan, F. M. to be F. M. Pomological Station, Coonoor. K. Krishnan Hedge, A F. M. Pomological Station, Coonor to be A. F. M. Govt. Botanical gardens, Ootacamund. S. Madhava Rao, Offg. F. M. l. a. p. for 17 days from 7th April 1932. P. Govindankutty Kurup, to be F. M Government Botanical gardens, Ootacamund. P. Abisheganatham Pillai, F. M. Pomological Station, Coonoor, to be in charge of the Kallar and the Burliar Gardens in addition to his own duties at Coonoor. **D. A's Office Orders**:-- Consequent on the abolition of two posts of Asst. Lecturers at the Agrl. College, the following appointments of Upper Subordinates are ordered K. Achutha Nayar, A. D. Salem to officiate with effect from 1--3--32, vice K. Avidanayakam Pillai on foreign service. D. Shanmugasundaram, F. M. Agrl. College Dairy, Coimbatore to officiate from 1--3--32, vice P. Subramanyan, A. D. viii circle. M. Sanyasi Raju, Bacteriology Asst., Research Institute, Coimbatore, extension of extraordinary leave out of India without allowance for one year 2--12--32. D. Sitharamaswami, fieldman, P. B. S. Maruteu, reinstated as Sub-assistant, V Grade and posted to P. B. S. Coimbatore. A. R. Krishnamurthi Iyer, Instructor, Borstal Institute, Tanjore, reinstated as a lower Subordinate V Grade.

Latest Notifications -- P. Subramanyan, Offg. D. A. O., Salem, to continue to officiate as D. A. O., Salem, *vice* M. U. Vellodi, on leave K. T. Bhandary, A. D. II grade to officiate as D. A. O., Vizagapatam with effect from 11--4--'32 *vice* G. Jogi Raju granted leave. K. W Chakrapani Marar, F. M. Kasargode, to officiate as D. A. O., Tellicherry with effect from 11--4--'32 *vice* M. Mangesha Rao granted leave preparatory to retirement. The transfer of P. Subramanyan to Vizagapatam and posting of K. T. Bhandary as D. A. O., Tellicherry are cancelled. K. Venkatarama Ayyar, Supt., A R. S. Pattambi, is granted leave for 3 months and 12 days from 11--4--'32 with permission to prefix the 10th and affix the holidays on the 23rd and 24th July. M. Viraraghava Rao, D. A. O, Kurnool, is granted leave for 2 months from 15th April or date of relief. C. V. Seshacharya, F. M. I grade is selected for admission to the M. A. S., and is posted as D. A. O., Kurnool from 15--4--'32. **I Circle**.-- M. V. Kondala Rao, A. A D., Rajahmundry, l a. p. for one month from 12th April. **II Circle** -- V. Ratnaji Rao, A. D. l. a. p. for 25 days from 21--4--32. L. Narasimhacharya, F. M, l. a. p. for 2 months from 18--4--32. -- **III Circle** -- S. N. Venkatrama Ayyar, F. M, Nandyal, l. a. p. for 3 weeks from 7--4--32. **IV Circle**.-- N. Krishna Pillai, A. D, Tiruvettipuram, l. a. p. for one month from 8--4--32. M. A. Balakrishna Ayyar, A D. Wallajah will be in additional charge of the sub-circle. **IV Circle**.-- Transfers-- A. Ramadas, to be A. D. Melur. G. J. Balraj, A. A. D., Melur, to be A. F. M., A. R. S., Koilpatti. N. C. Thirumalacharya, F. M., A. R. S, Koilpatti to be A. D. Aruppukottai. R. Kalimuthu, A. D., Aruppukottai, posted for training at A. R. S., Koilpatti. **VII Circle**-- P. Kesavanuuni Nambiar, A, D., Calicut, l, a. p. for 5 days from 19--3--32. **VIII Circle**:-- N. Srinivasa Rao, to be A. D., Erode. A. K. Ramasubba Ayyar to be A. D., Bhavani. **Paddy Section**-- S. Ramanujam, Asst., l. a. p. for 19 days from 4--4--32, with permission to prefix the 3rd and suffix the 23rd. V. K. Ramunui Kidavu, F. M., A. R. S., Pattambi, l. a. p. for one month from 8--4--32 T. K. Balaji Rao, Asst. A. R. S., Aduturai extension of leave for 10 days from 21--4--32. **Millet Section**--K. Kunhikrishna Nambiyar, Asst, l. a. p. for one month from 9--4--32. N. S. Rajagopala Ayyar, F. M., l. a. p. for one month from 11--4--32.

Oil-seed Section-- T. Gopalan Nair, transferred from C. F. is posted as F. M. Kasargode. **D. A's. Office Orders**-- A. Muhammad Ali, B. Sc. Ag., is selected as an Upper Subordinate with effect from the date of joining and posted as probationer to A. R. S., Palur. The following Upper Subordinates are reinstated and the period of their absence treated as leave:-- M. K. Padbanabhan posted as Asst. in the Paddy Section; K. Thomas Benjamin posted to live-stock Research Station, Hosur. He will be considered as having been confirmed from 19--4--31. T. Krishna Reddy posted to the III Circle. He will be considered as having been confirmed from 16--7--31.

ADDITIONS TO THE LIBRARY DURING JANUARY 1932

A. Books.

(1) Hopkins (J. C. F) 1931, *Diseases of Tobacco in Southern Rhodesia;* (2) Murari, T. 1931 *Methods of Livestock Improvement;* (3) Metcalf L. & Eddy H. P. (1916) *American Sewerage Practice,* Vol. III, *Disposal of Sewage;* (4) American Bacteriological Society (1931) *Manual of Methods of Pure Culture Study in Bacteria;* (5) Gray, J. (1931) *A Text-book of Experimental Cytology;* (6) Coulter J. M. & others, (1930) *A Text-book of Botany,* Vol. I *Morphology* and (7) Vol. II *Physiology;* (8) 1931. *Manual of Research and Reports;* (9) Provincial series 1931, *The Madras Services Manual,* Vol. I; (10) *The Madras Stationery Manual,* 5th Edition, Vol. II Part 1, 1931.

B. Annual Reports and Publications.

1. Report of the Subordinate officers of the Madras Agricultural Department 1930--31; 2. Administration Report of the Agricultural Chemist, Entomologist, Mycologist and Systematic Botanist of the Madras Agricultural Department for 1930--31; 3. Annual Report of the Bengal Agricultural Department for 1930--31; 4. St. Sett & F. M. S. Agricultural Department Technical Reports 1930; 5. St. Sett. & F. M S. Reports of the Agricultural Field Officers, 1930; 6. Philippine Islands Bureau of Science Annual Report 1930; 7. Annual Report of the Agricultural Department Zanzibar Protectorate for 1930; 8. The Annual Report of the Agricultural station, Florida 1930; 9. Annual Report of Wisconsin; A year's service of Research 1930; 10. Annual Report of the Agricultural Experiment station, Illinois 1929--1930; A year's progress of solving Farm problems; 11. Annual Report of the Agricultural Exprimental station, Virginia polytechnic Institute 1927--1931; 12. Annual Report of the Cyprus Agricultural Department 1930; 13. Statistical statements relating to co-operative movement in India 1929--30; 14. Monthly Rainfall of India 1928; 15 The Villagers' Calendar. English Edition. Madras Agricultural Department for 1932.

C. Bulletins, Memoirs, etc.

I C. C. Tech. Bull. No. 18. Technological Report on standard Indian cottons 1931; Imp. Bur. of Soil Science, Tech. Com. 22, Green Manuring with Bibliography; S. S & F. M. S. Agri. Dep. Sci. Ser. 8. Control and Economic Importance of the greater coconut spike moth; Mauritius Agri. Dept. Scientific series Bull. No. 14. Growth of sugarcane under Mauritius conditions as described by the Logistic curve and as expressed in terms of Temperature and Soil moisture.

Cornell A. E. S. Publications. Bulletins. No. 516 Dry skim milk in Ice cream; 517 Colery production on the Muck soils of New York; 518 A statistical study of milk production from the New York Market; 519 Studies of Genus Delphenium; 520 Fertiliser tests of several soil types; 521 Cultivation experiments with certain vegetable crops on Long Island; 523 The Sociology of a village and the surrounding territory; 525 A survey of some public produce markets in up state New York; Memoir No. 135 A Gene in Maize for supernumerary cell divisions following meiosis; Technical Bulletin No. 146 Factors affecting the quality of commercial canning peas.

California A. E. S. Publications. Bulletins. No. 501. Marketing California apples; 502 Wheat series of California crops and prices; 503 St. Johnswodt in Range Islands of California; 504 Economic problems of California Agriculture; 505 The Snowey Tree cricket and other insects injurious to Raspberries; 506 Fruit Spoilege diseases of figs; 507 Centalouse Powdery Mildew in Imperial Valley; 508 The swelling of canned purnes; 509 The Biological control of mealy bugs attacking citrus; 510 Olives series of California crops and prices; 511 Diseases of grain and their control; 512 Barley series in California crops and prices; 513 An Economic Survey of the Los Angeles milk markets.

Michigan A. E. S. Publications. (a) Technical Bulletins. No. 112 Residual effects of fruit thinning with the Lumbard plum; 114. Fertilisers and soils in relation to concord grapes in south-western Michigan; 116. The fruit habit of the peach as influenced by pruning practices; 117 Experiments with the Luber index method of controling virus diseases of potatoes.

(*b*) *Special Bulletins.* 211. A composition of Alfalfa strains and seed sources of Michigan; (c) Circular Bulletin No. 136. Hardy perennials; 137. Pests of apples and pear in Michigan.

Wisconsin A. E. S. Publications - -Research Bulletins. No. 105. The relation of Nitrate Nitrogen and Nitrification to the growth of Tobacco following Timothy; 106 The effectiveness of Rhizobia as influenced by passage through host plant; 107. Resistance to fusarium wilt in Garden canning and field peas; 108 Standardisation of milk for the manufacture of American cheese 109 Logging slesh and forest protection.

Florida A. E. S. Publications -- Bulletins. 607. Angular leaf spot and fruit rot of cucumbers; 208. Cucumber diseases in Florida; 209. Lawns in Florida; 210. Corn diseases in Florida: 211 A study of the root system of some important sod forming grasses; 212 Diseases of sweet potatoes in Florida; 213 Potash in relation to cotton wilt; 214 Cotton diseases in Florida; 215 Effects of Irrigation with sewage effluent on the yields and establishment of Napier grass and Japanese cane; 216 A Nutritional study of the white school children in five representative countries of Florida; 217 A study of the cost of transportation of Florida citrus fruits with comparative costs from other producing areas; 218 Fertiliser experiments with truck crops. (Celery Lettuce, Tomatoes); 219 Growth behaviour and maintenance of organic foods in Behia grasses; 220 Effect of seed potato treatment in yield and Rhizectonesis in Florida from 1924--1929; 221 The Tung Oil Tree; 222 Potato spraying and dusting; 223 Miscellaneous Tropical and sub-tropical Florida fruits; 225 Diseases of water melons in Florida; 227 Citrus Propagatioa.

Illinois A. E. S. Publicatcns--Bulletins. No. 360 Fertilising Tomatoes, sweet corn and musk melons in three year rotation; 365 Prices of Illinois Farm products in 1930; 366 Effect of soy beans and soy bean oil meal on quality of pork; 367 A technical study of the growth of white leghorn chickens; 368 Effect of carbonation on Bacterial content and keeping quality of Dairy products; 369 Vitamin-B and Vitamin G content of cereals; 370 Crop yields from Illinois soil Experimental fields.

U. S Dept. of Agri. Publications - (a) Farmers' Bull. 784 Anthrax or Charbon; 801 Mites and lice on Poultry; 1254 Important cultivated grasses; 1673 The Farm Garden; 1676 Lubricating oil sprays for use on dormant fruit trees. *(b) Technical Bulletins.* No 263 The leaf hoppers attacking apple in the Ozarks; 270 The Chemistropic responses of the house fly, [illegible] green bottle flies and black blow fly.

Jamaica Agri. Dept. Publications. [illegible] of Jamaican Buprestldiae; and Cerambycidie Circular [illegible] The Reauscitation of decadent citrus; 10 Citrus cultivation; 12 Insecticides and fingicides; 5[illegible]ts, pests ol sweet potato and of cassava in Jamaica.

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