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Madras Agricultural Journal

Vol. 26 No. 1

Jan 1938

Regd. No. 1155.

THE MADRAS AGRICULTURAL JOURNAL

Vol. XXVI. January, 1938. No. 1.

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Published by

THE MADRAS AGRICULTURAL STUDENTS' UNION,

Agricultural College and Research Institute,

Coimbatore, S. India.

Annual Subscription Inland Rs. 4-0. Single Copy.
" " Foreign Rs. 4-8. As. 6.

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The Madras Agricultural Journal

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The Madras Agricultural Journal.

(ORGAN OF THE M. A. S. UNION)

Vol. XXVI] JANUARY 1938. [No 1.

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Editorial.

1937. A Retrospect. To the future historian, the year 1937 should be one of more than passing interest. The political firmament in India as well as outside has been, throughout the whole of last year, foggy and extremely unsettled. The abdication of sovereigns, the overthrow of one party in power after another, secret pacts and open hostilities, unending talks of peace on the one hand and the manufacture of huge stocks of war materials, strengthening of naval bases and training people against gas warfare, on the other, have all contributed not a little to the above mentioned state of affairs. The horizon is still hazy and the proverbial 'silver lining' is nowhere visible. None the less we sincerely hope that the present unsettled state may prove to be only a passing cloud and that the year that has just dawned may prove happier and more prosperous than its predecessor to the world at large and more particularly to our readers and to the members of the "Madras Agricultural Students' Union".

The most important political event of 1937, so far as we in India are concerned was the introduction of Provincial Autonomy in all the provinces, In seven or eight of them the Congress is in power and in spite of the reluctance with which the Congress members accepted office it must be admitted that if the Congress Governments could not achieve more than what they have already done it was certainly not because of the much feared for interference from the provincial satraps. So far so good. In Madras, the most laudable achievement—or shall we say experiment—is the introduction of total prohibition in the district of Salem. There can be no two opinions regarding the usefulness of the measure if it will ultimately prove successful. Experience in the past both in and outside India of compelling people to become "tee-totallers" by legislation is however not of much help as the reports of such attempts do not take into account the changed conditions that exist at present. We hope that the experiment will succeed not only in the particular district where it has been started first but also in the rest of India in the not very distant future.

The Salary question. Our readers will remember the appeal we made in our last January issue to the members of the new Govt. regarding the threatened cut in the salary of civil servants. We are very glad indeed that our appeal has not fallen on deaf ears, as evidenced from the recent official announcements.

The Agriculturists' debt relief bill. *This bill has aroused considerable controversy, both in its original form as a moratorium measure as well as in its present form. In this matter again nobody questions the necessity for affording relief to the indebted agriculturists. But some of the provisions in the bill more especially those relating to the arrears of debts and rents can certainly be made more acceptable to the creditors and the landlords without at the same time reducing the benefits to the indebted. We hope the bill when it emerges as law will satisfy the more reasonable among both classes of people.*

Retrenchment. We are sorry to hear that our sister institution "The Madras Forest College" is to be closed down as a measure of retrenchment. We dare say the Government would not have decided on this drastic step unless they have been convinced of its necessity. Rumours are rife regarding the various steps which Government propose to adopt for economising expenditure in other departments as well, including ours. Nobody will deny the necessity for cutting out superfluous items of expenditure or to lessen actual waste to the minimum possible. To cry 'halt' however, in a developing department, besides being detrimental to all future progress must in itself occasion waste of considerable amount of time and expenditure already expended. But if the order is also to be "as you were" the result would be disastrous. We hope that the changes foreshadowed will be preceded by as thorough an enquiry as possible as to the necessity or otherwise of the same before final orders are passed.

NATURAL CROSS-POLLINATION IN LINSEED

By B. S. KADAM

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and

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Introduction. Linseed is cultivated entirely as an oil-seed crop in India, unlike Europe and America, where it is grown mainly for fibre. Next to Argentine, India is the largest linseed producing and exporting country. The area under linseed in India is about 34,000,00 acres, most of it being in the Central Provinces and Berar (9,70,000), United Provinces (8,60,000) and Bihar and Orissa (5,90,000)*. During 1934—35 the yield of linseed was estimated to be about 400 thousand tons. Next to these provinces come Bengal and Bombay which each grow over 100,000 acres annually.

Although Bombay Presidency is not a large producer of linseed, locally the crop is important. Most of the area is concentrated in the Karnatak and the Deccan, the important linseed growing districts in these two tracts being Bijapur and Nasik respectively. Gujrat and Konkan grow hardly any linseed.

In the Presidency, linseed is cultivated as a cold-season crop, like wheat, on deep black soils. It is sown in the beginning of October and harvested in February. In Bijapur, linseed is a row crop in rabi jowar or wheat; in the Nasik district it is grown as a main crop and sometimes sown around the wheat fields.

Since linseed is an important secondary crop in the Nasik district, it was decided to undertake its genetic improvement at the Cereal Breeding Station which is situated in the centre of the district. In order to handle the crop properly, one of the first requirements was to obtain evidence on the extent of vicinism under local conditions, so that proper methods of maintaining purity of the experimental material and eventually of pure strains could be adopted. The results of our observations are briefly reported in this Paper.

Review of Literature. As linseed (flax) is an important crop in many countries, considerable information is available on the magnitude of vicinism in this crop plant under various climes. The extent of natural crossing varies in different localities. The consensus of opinion is that protection of plants is necessary to ensure purity of a strain. A brief review of observations made in various countries is given below.

India:— Howard et al (1910) were the first to publish evidence of natural crossing in linseed. They observed hybrid plants in European

* These two provinces are now separate. The Director of Agriculture, Bihar, estimates 550,300 acres in 1936—37 under linseed in Bihar. (personal communication).

fibre-yielding types grown at Pusa but did not state the extent of contamination. In a further publication (1919) these authors present more definite evidence. During the years 1916, 1917 and 1918 they found 6, 1 and nil cases of segregation out of 340, 233 and 232 bagged plants respectively. This gives 1·8, 0·43 and 0 per cent of contamination during the three years. On the basis of total plants, 805, the natural crossing is 0·87 per cent.

In the Central Provinces, Graham and Roy (1924) observed 9 cases of segregation out of 212 line-cultures in three years or a little over 4 per cent of crossing.

Europe:— In 1911 Tammes observed natural crossing in Holland and concluded that plants should be protected to maintain purity. Bateson (1916) and Eyre and Smith (1916) in England found flax to be mostly autogamous. The latter detected natural hybridization in *L. humile* also. Fruwirth (1922) also mentions possibility of spontaneous contamination of flax in Germany. Davin and Searle (1925) also mention cases of intercrossing in Ireland and advocate protection of plants. In the publication, "Plant Breeding in the Soviet Union" issued by the Imperial Bureau of plant Genetics, Cambridge, England, (1933), it is stated that flax is subject to cross-pollination to the extent of 40 per cent in Russia. In this connexion it is interesting to note that Eyre and Smith (1916) state that in some countries flax is considered unstable and give as an example that in certain parts of Central Russia it is considered that besides changes in habit, the colour of the flower also changes.

U. S. America:— In the United States, Bolley (1927) mentions that he has observed no morphological variations in flax varieties although grown side by side for a number of years in North Dakota. He, however, does not present any figures. In a reply to Bolley (1927) Robinson (1928) states that under Michigan conditions vicinism in flax varies from zero to 3 per cent. Very recently Robinson (1937) has presented extensive figures on natural pollination in flax under Michigan and Oregan conditions. He found blue-flowered varieties were contaminated more than white-blossom varieties. In Michigan 5 to 6 per cent of crossing was found as against 1 to 2 per cent in Oregon. Robinson considers that spacing has some influence on the extent of crossing, but the figures he has given are somewhat erratic. The most systematic investigation is reported by Henry and Tu (1928) from St. Paul, Minnesota. They found 1·25 to 1·71 per cent vicinism in rows 1 foot apart. The percentage in crossing decreases from 1·26 at 1 foot to 0·33 per cent at 5 feet spacing. These workers found thrips the main pollinating agents.

Material and Methods. The investigation reported in this paper was conducted at the Cereal Breeding Station, Kundewadi, taluka Niphad, district Nasik.

In 1933 a number of bulk samples were collected for sowing in the *rabi* season. In the same season a large number of bulk samples were also

received from the Economic Botanist, as he had no facilities for growing them at Poona. The material was grown for him and selection supplied to him by us to carry on the work from the next season at Poona. The material for the study of natural crossing was obtained mostly from these samples.

The seed of various samples was dibbled at a distance of 4 inches in rows 18 inches apart. In each hole two to three seeds were sown and after a month the crop was thinned to one plant per hill. Thus a uniform stand was obtained for purposes of selection of outstanding plants for further breeding.

Experimental Data. 1933—34. During the course of the examination of various crops of linseed during the season of 1933—34 a number of plants with pale-blue or white flowers were observed among the mass of blue-flowered plants which constitute the predominating type. There were 33 such off-types of plants. These plants were allowed to set seed openly and at the end of the season each of the plants was harvested separately to determine the extent of natural crossing next season.

As the pale-blue or white flower colour is recessive to full blue, any contamination in such plants would show up in their progeny by the appearance of blue-flowered plants.

1934 - 35. During the season a progeny line from each of the 33 pale-blue and white-flowered plants was raised. The season, however, proved to be so abnormal that hardly any plants were left in the field. In the seedling stage there was a very severe attack by insects and a further reducion of the population resulted by injury from frost in mid-January, 1935. Out of the 33 lines 24 were completely wiped out. Even in the remaining lines, there were only very few survivals in each. In view of this, it was decided to discard the material and to grow again the remaining seed of the 1933—34 plants. There were, however, some blue-flowered plants among the surviving families and it was decided to harvest them individually with a view to ascertain whether or not they were natural hybrids or mere mechanical mixtures. Altogether only 13 such plants were available.

1935 - 36. Seed of only 23 pale-blue and white-flowered plants out of the original 33 was available for growing during the season. All the available seed of each plant was used and the crop was not thinned. The crop grew well and from the beginning up to the end of flowering, it was examined for off types of plants. In table I are given the number of blue-flowered plants that occurred in each progeny line, together with other necessary information.

It will thus be seen that the amount of contamination varies from 0 to 6·75 per cent. On the basis of the total plants the incidence is 3·08 per cent. In three of the families Nasik IV-2, Belapur 1-1 and Bijapur 1-3, showing no infection, there were some blue-flowered plants in 1934—35. Thus, a very large proportion of the individual plants gets contaminated under field conditions.

Table I

Extent of natural crossing in various families of linseed grown at the Cereal Breeding Station, Kundewadi, Niphad during the season 1935-36.

S. No.	Culture No.	Flower colour of the parental plant of the culture	Total No. of plants	No. of plants with blue flower	Percentage of natural crossing	Remarks.
1	K. L. 2	Pale blue	121	0	0 00	
2	Nasik I-2	Pale-blue	57	2	3·50	
3	Nasik I-3	White	51	1	1·96	
4	Nasik I-4	White	75	3	4 00	
5	Nasik I-5	Pale-blue	69	2	2 89	
6	Nasik II-1	Pale-blue	56	0	0 00	
7	Nasik II-2	White	55	0	0·00	
8	Nasik II-3	White	64	1	1·56	
9	Nasik III-1	White	62	4	6·45	
10	Nasik IV-1	White	89	4	4 49	
11	Nasik IV-2	White	77	0	0·00	2 Blue-flowered plants in 1934—35
12	Nasik IV-3	Pale-blue	60	2	3·33	
13	Malegaon I-1	White	76	4	5 26	
14	Malegaon I-152	White	74	5	6·75	
15	Malegaon II-1	White	99	5	5 05	
16	Malegaon II-3	White	46	0	0 00	
17	Belapur I-1	Pale-blue	30	0	0·00	2 Blue-flowered plants in 1934—35
18	Sholapur I-1	White	35	2	5 71	
19	Bijapur I-1	White	83	2	2·41	
20	Bijapur I-3	Pale-blue	73	0	0 00	1 Blue-flowered plant in 1934—35
21	Bijapur I-4	White	104	7	6·73	
22	Belgaum II-2	White	24	1	4 16	
23	Belgaum II-3	White	45	2	4·44	
	Total.		1525	47	3·08 Average.	

The behaviour of the blue-flowered plants isolated in 1934—35. It has been stated above that the crop from pale-blue and white-flowered plants in 1934—35 was a failure, and that from the surviving lines 13 blue-flowered plants were obtained. These were presumed to be due to cross-pollination. In order to test this, they were grown in 1935—36. All the seed of each plant was sown and no thinning was done. Due to crowding, some plants remained stunted and produced no flowers. The behaviour of each plant is indicated in table II.

It will be observed that all of the 13 plants segregate in blue and pale-blue or white-flowered plants indicating that all were hybrids, being the result of fortuitous crossing. Except Nasik IV-1-1, all show monogenic segregation, indicating that pale-blue and white colours are recessive to blue. In the exceptional case the white-flowered plants are in excess. The cause or causes of this are not traceable.

Agents of cross-pollination. Under Niphad conditions blooming takes place between 9 a. m. and 11 a. m. During this period bees and various types of butterflies are busy collecting nectar from the linseed flowers.

Undoubtedly these creatures affect cross-pollination by carrying pollen on the underside of their bodies. Howard *et al* (1919) observed bees visiting linseed flowers. Eyre and Smith (1916) and Fruwirth (1922) mention insects visiting the crop in bloom. Henry and Tu (1928) observed thrips in and around flax flowers and consider these as pollinaters.

Table II.

Behaviour of 13 blue-flowered plants isolated in 1934-35 from the surviving progenies of nine pale-blue and white-flowered plants.

S. No.	Culture No.	Total plants	No of blue-flowered plants.	No. of pale-blue flowered plants.	No. of white-flowered plants.	No. of plants which did not flower.
1	Naik I—2—1	60	43	12	0	5
2	Nasik IV—1—1	90	29	0	49	12
3	Nasik IV—2—1	88	66	0	14	8
4	Nasik IV—2—2	95	62	0	24	9
5	Nasik IV—3—1	86	51	22	0	13
6	Malegaon I—1	61	45	0	12	4
7	Malegaon II—1	94	72	0	15	7
8	Malegaon II—2	52	35	0	16	1
9	Belapur I—1	99	68	26	0	5
10	Belapur I—2	50	25	12	0	13
11	Bijapur I—2—1	56	30	16	0	10
12	Bijapur I—2—2	37	10	11	0	16
13	Bijapur I—3—1	87	64	12	0	11

Discussion. From the foregoing experimental evidence it is clear that under Niphad conditions vicinism in linseed is sufficiently extensive to warrant protection of plants. A large proportion of the plants, chosen to study the amount of fortuitous crossing, was affected; the infection ranging from zero to as high as 6·75 per cent. The average amount of natural hybridization was slightly over 3 per cent.

The review of the observations of other workers also shows more or less similar situations. Bolley (1927) is the only exception. He, however, does not present any facts, but makes a definite statement that he has observed no morphological variations in flax varieties grown side by side for a number of years in North Dakota. The reflections and the general attitude of Bolley (1927) appear to be so widely divergent from the generally accepted conceptions of modern genetics that one is not constrained to accept wholly his conclusions.

The amount of vicinism varies under different climates, and Robinson (1937) has presented definite evidence that it is more in Michigan than in Oregon, U. S. America. The amount of contamination in the Central Provinces, India, (Graham and Roy, 1924), is almost similar to our results, whereas under Bihar conditions it appears to be lower, (Howard *et al*, 1910, 1919). Thus, in Peninsular India natural-hybridization in linseed appears to be more than in the Gangetic alluvial tract.

Besides regional influences, varietal differences may also affect the amount of natural-pollination. Robinson (1937) mentions that blue-flowered plants are more affected than white. He does not ascribe any definite cause for such differential behaviour, but it is very probable that insects are attracted more by blue colour than by white.

The mode of pollination in linseed is such as to ensure self-fertilization very largely, but the long range of flowering period of about a month exposes every plant to the danger of cross-pollination by insects. Protection of plants, therefore becomes a necessity to maintain genetic purity. For plant breeding purposes it would be necessary to protect individual plants. For this purpose muslin bags stretched over galvanised rings of suitable diameter have proved to be more convenient and efficient than butter-paper bags which present a number of undesirable features, the most serious being very low seed-setting in them.

For the production of seed for multiplication of an improved strain it would be necessary to adopt larger scale methods. Muslin cages of convenient size and suitably constructed would cover a number of plants. By employing a few of such cages it would be easy to produce a fairly large initial stock of pure seed. The further multiplication of such seed will have to be done at an isolated place, preferably under controlled conditions, since raising of a crop from the selfed-seed on or around the breeding plot is fraught with the danger of contamination as a collection of various varieties would most likely be grown on the experimental site. The seed of the M_2 (second multiplication) generation may be supplied to the Propaganda Staff for further multiplication on Government Farms or to the I class Registered-seed-growers. Under such conditions the crop should be rogued at the time of blooming or before, if possible. Such operations can be greatly facilitated if the improved variety differs conspicuously in some morphological character, such as flower-colour, from the local variety.

Henry and Tu (1928) advocate growing of linseed varieties or strains at a distance of 5 feet, the intervening space being grown under a tall crop, like oats, as a barrage. This may work well where thrips are the pollinating agents, as found by these workers; but it is extremely doubtful if this plan would be feasible where insects such as bees play a prominent part.

Summary.

1. Under Niphad conditions, vicinism in linseed varied from zero to 6·75 per cent in pale-blue and white-flowered plants. The average was slightly over 3 per cent.

2. In Peninsular India there appears to be more natural-pollination than in the Gangetic alluvial area.

3. The amount of contamination is sufficiently large to make it obligatory to protect the plants. For this purpose muslin bags are better than paper bags to cover individual plants.

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* Original not seen.

What is good Farming ? Good farming demands the recognition of three basic principles: Judicious economy in time, in labour, and in money. The farmer who can direct these successfully will eventually win through. Good farming makes management in every branch of farm production return a profit, and it also leaves a farm at the end of fifty years in a state of productivity as high as, if not higher than, at the beginning—W. Waston, General President, Agricultural Bureau of New South Wales. (*Queensland Agricultural Journal*, Vol. XLVIII, October 1937).

THE STORY OF POTATO

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The Importance of Potato. Potato has been described by a writer as the world's greatest plant. In the western countries it is one of the most widely cultivated crops. It is used for food and for industrial purposes such as the manufacture of starch and industrial alcohol. About one-quarter of the food of people in Europe and European settlers outside Europe is comprised of potato. It is also a valuable food for animals. As a food plant it is only rivalled by wheat and rice, which are the most widely used food crops in the world. Potato leads the other crops in the world's total production of food crops. It is grown in all the continents, although about 90% of the world's crop is grown in the European countries. Germany and Russia are the largest producers being responsible for more than one-half of the world's production. The others in order of importance are Austria, France, the United Kingdom, the Netherlands and Italy. The cultivation of potatoes in the United States and Canada is increasing in importance. Potatoes are grown in Japan, India and Burma in Asia, in South and East Africa and in Australia to an appreciably large extent.

One remarkable feature of potato is that it can be grown in almost any kind of soil. In Ireland, some of the soils on which potato is grown are said to be so sandy that straw and seaweed have to be used to keep the soil from being blown off the sets. Potato, no doubt, thrives best in well-drained friable soils, but, even clay soils and peaty soils can, by proper cultivation, be made to grow potatoes. It is said that there is scarcely an acre of barren waste free from stagnant water which cannot be made to grow potatoes.

Another feature of the potato plant is that it grows very quickly and comes to maturity in a few weeks. After the plant has made its first six inches of growth there is "a rapid rush into full leaf and stature—a process so swift that the gladdened cultivator may well tell himself sometimes that he can see the plants grow".

A further remarkable feature of potato crop is that a much greater weight of crop can be produced per acre than any other food crop. The yield of potatoes per acre is between 5 and 10 tons whereas the average yield of wheat, for example might be only one ton.

Potato, however, is unfortunately very susceptible to disease. It undergoes a process of degeneration and in course of time it loses its productiveness and vigour. This was for a long time considered to be due to natural causes, but in recent years it has been proved to be due to the cumulative effect of infection by virus diseases. The plant is tender and not hardy.

It is also easily affected by climate and rainfall. Mr. Walter P. Wright, the founder of the National Potato Society of Great Britain says:

"With all its weaknesses the Potato remains a vegetable of great value and vast importance to us. If one season, the crop is light, the next is heavy; if last year there were severe losses through disease, this year there are few, so that a useful average is struck. It is in this philosophical spirit that we must pursue our culture, but at the same time, we must take care to study methods of reducing our losses from disease."

Discovery of Potato:—A writer says,

"Amidst the numerous remarkable productions ushered into the Old Continent from the New World, there are two which stand pre-eminently conspicuous from their general adoption. Unlike in their nature, both have been received as extensive blessings—the one by its nutritive powers tend to support, the other by its narcotic virtues to soothe and comfort the human frame—the potato and tobacco".

Potato is a native of South America. It was first discovered by the Spaniards in the neighbourhood of Quito in Ecuador, where it was under cultivation early in the sixteenth century. It was also found in Peru and Mexico. The inhabitants of Peru called it "papas". Potatoes were used in these countries as food, usually cooked, but also dried in the sun and made into flour. The potato plant was found growing wild or cultivated in comparatively high altitudes and in a dry climate but never in the neighbourhood of sea-coast.

Introduction into Europe. The potato was carried to Spain by the explorers about 1535 at the time of the conquest of Peru. It is said that Hieronymus Cardan, a monk, was the first to introduce it from Peru into Spain. From Spain it passed quickly into the other countries of the Continent but it did not come into general cultivation for a very long time. It began to be cherished as a valuable product only after over a century passed away since its discovery.

Regarding its introduction into England, admirers of Sir John Hawkins claim that he introduced it as early as 1563, while admirers of Sir Francis Drake claim that he introduced it in 1586. It is said that a statue to Drake as the introducer of the Potato was erected at Offenburg, in Baden, in 1853. However, there is no doubt that Sir Walter Raleigh was the first to grow potatoes in England; he planted it on his estate at Hayes, in Devonshire and also in his estates at Youghal, near Cork, in Ireland in 1586.

Bauhin, in 1596, was the first to describe the plant and to give it the Latin name, ***Solanum tuberosum esculentum.*** In 1601 Clusius had described the plant with figures in his ***Rariorum Plantarum Historia.*** In 1597, John Gerard, who had obtained some tubers of the potato from Virginia and planted them in his garden, gave a description of the plant in his publication ***Herbal*** and he called it ***Batatas Virginiana.***

Naming of the Potato. The naming of the potato was a result of a confusion with another plant of a totally different character, ***Batatas edulis (Ipomoea batatas)*** the sweet potato. Sweet potatoes were also discovered

by the Spaniards in Brazil and was introduced into Spain in 1519. It was called by the natives of Brazil, ***Batatas***. This was corrupted to 'Potato'. The cultivation of sweet potatoes was carried on in Spain and Portugal and in the time of Queen Elizabeth, sweet potatoes were imported into England from Spain and Portugal. The potatoes mentioned by Shakespeare and other writers of the period were really sweet potatoes. Thus, in the "Merry Wives of Windsor" it is not the real potato but the sweet potato that is referred to in Falstaff's exhortation :

"Let the sky rain potatoes and kissing comfits"

The real potatoes were called later on as potatoes of Virginia. In course of time, ***Solanum tuberosum*** was called Potato and ***Batatas edulis*** as sweet potatoes.

Cultivation of Potatoes in Europe. The cultivation of potatoes in England made little progress for many years. During the reign of James I they were rare and cost two shillings a pound. Potato was then an article of luxury. By 1663 its usefulness as an article of food was so generally known that the Royal Society took measures to encourage its cultivation and its introduction into Ireland, especially as a safeguard against famine.

Potato was very slow to come into general use. In the seventeenth century it was believed that it might become useful for feeding swine and cattle. There was also a belief that it caused leprosy. During the seventeenth century it was merely a botanical curiosity cultivated by collectors of new plants. It was only in the eighteenth century that it became a cultivated crop. By 1760 it became established as a field crop in England and some 25 years later as a field crop in Scotland.

By 1772 the cultivation of potatoes had become common in Germany but the quality of the crop was poor and it was generally used for feeding domestic animals. It was used as human food only in times of failure of grain crops. Frederick the Great encouraged its cultivation in Prussia and by about 1785 it began to be grown extensively in Saxony. By the end of the eighteenth century it was firmly established throughout Germany and it became a great staple crop of the country.

France adopted the potato more slowly. In 1769 the grain crops of France were a failure, threatening a national famine. Auguste Parmentier, an apothecary in the French army, recommended the use of potatoes as food to take the place of grain. He had been a member of the medical staff of the French army in 1758, during the war in Hanover and had been taken prisoner. During his five years in prison his principal food consisted of potatoes. He wrote a book called a ***Treatise on Certain Vegetables that in Times of Necessity can be substituted for Ordinary Food.*** This book was received with ridicule even though it received a certain amount of support from the Paris Agricultural Society. By persistent efforts, he was able to interest Louis XVI in the crop sufficiently to induce the king to grant him 50 acres of land on which to experiment with potatoes. It is said that the

King ordered the plot to be guarded by a cordon of troops which excited the curiosity of the people. On the King's fete day, Parmentier presented the king with a basket of tubers and a boquet of the blossoms. These were worn by the king and queen who also ate the cooked tubers. They were found to be very palatable and soon the French people took an interest in potato.

By the latter half of the eighteenth century, potato was extensively cultivated and recognized as one of the regular crops throughout the temperate regions of Europe and America, so that Henry Phillips (1822) who published a detailed account of the potato and its culture, was able to cite a single grower who planted 300 acres annually.

In Ireland, potatoes were used very extensively as human food. By 1840, potatoes had largely replaced the cereals because the yield of potatoes exceeded by 20 to 30 times the yield of wheat, barley or oats on an equal area of land. Dependence on a single crop for food led to disaster when the potato blight devastated the Irish crops in 1846 and caused a widespread famine. It is said that 600,000 died during the two years, 1846 and 1847, for want of food or from diseases caused by a meagre diet of unhealthy and unnutritious food. By 1848 the plague had subsided.

Potatoes in India Potatoes seem to have been introduced into India early in the seventeenth century. It is mentioned in Terry's account of the banquet given by Asaf Khan to Sir Thomas Roe in 1615. By 1675 its cultivation had assumed some importance as Fryer has described the gardens of Surat and Karnatak as containing among other vegetables, potatoes. Potatoes are now grown in many provinces. In Bengal, the chief potato growing districts are Hugli, Burdwan, Rangapur, Jaipalguri and Darjeeling. Potatoes are extensively grown in the hilly tracts of Assam such as Khasia, Jaintia, Garo and Lushai Hills. In the United Provinces it flourishes well at Naini tal, Almora, Mussoorie etc. In the Bombay Presidency it is grown on a large scale in Poona district and to a smaller extent in other districts particularly, Surat. It is also grown in the Punjab in the hilly tracts round Simla. Potato is cultivated in the Bangalore district of Mysore State. In the Madras Presidency the most important potato growing area is the Nilgiris district. The story of its development on the Nilgiris is interesting.

Potato Growing on the Nilgiris. Potato growing on the Nilgiris is over a century old. The first introduction of potatoes to the Nilgiris must have been by Mr. Sullivan. In 1822 he had procured a professional gardener "with a view to making experiments in horticulture and agriculture under his superintendence". It was also his idea that "the experiment may eventually prove useful to the public, and the expense of making them will be my own". Mr. Sullivan applied to the Government for permission to enclose about 1900 acres of waste land for this purpose. This was granted. It was the valley to the south of Stonehouse hill. The gardener was Johnstone and he had an assistant, an African, named Jones. In 1824 it is

recorded that a potato weighing 5 lbs. was grown that year in Mr. Sullivan's garden.

In April 1830, the then Governor, Mr. S. R. Lushington, established an experimental farm at Kaity, "taking up Badaga lands for the purpose in a high-handed manner, which, after his departure, was the subject of a severe censure from the Court of Directors, who ordered the lands to be restored and ample compensation to be given to the landholders for loss of profits whilst their lands were improperly appropriated". Major Crewe was in charge of the experiments. The land "was broken up in the English style of farming with ploughs of the English shape and by means of cattle trained for the purpose". Some of the fields were planted with potatoes while others with wheat, barley, oats etc. The farm showed the possibility of potato culture as an occupation whereby one could earn one's livelihood. But in a few years the farm was abandoned owing to the above attitude of the Court of Directors.

In his book on the "Nilgheries", first edition of which was published in 1834, Dr. Baikie mentions, speaking of Jakathala (Wellington), that three and even four crops of potatoes might be raised in twelve months and that all other European vegetables were luxuriant and were produced all the year round. He says "Fruits and an immense variety of vegetables have been introduced by the European visitants. And almost every description of esculent vegetable, to be found in Europe, is now cultivated on the Hills in abundance. The list extends to potatoes in great quantity and first rate quality; cabbage, cauliflower, Savoys, French beans, spinach, peas, lettuces, beet-root, radishes, celery, turnips, carrots, sea-kale, asparagus and tomatoes".

In 1847, Major Ouchterlony mentions in a report that Ceylon offered a very favourable market for the Nilgiri potatoes. In that year there were 186 acres under potatoes, the total output being estimated at 29,400 maunds or 6,562 cwts. The average selling price was 6 as. per maund or Rs. 1-11-0 per cwt. An acre of potatoes produced up to 600 mds. and the ratio of return of crop to seed was 15 : 1. This is an extraordinarily good yield considering the present-day figures.

In 1848 the Government Botanical Garden was established and for some years cultivation of potatoes was one of its chief features. New varieties were tried. The ryots were shown how to cultivate potatoes and other vegetables.

The cultivation of potatoes was increasing in extent and in 1876 there were 754 acres under potatoes. Potato was grown on a small scale by the European settlers and on an increasing scale by the ryots. Major-General Morgan says "There is no doubt that the Badaga country is especially suitable for the growth of potatoes, which delight in a dry soil, of a reddish brown colour and warm sun and moderate rainfall. With much rain they lose their starch and become watery. Kalhatti, Bellikal, Ketti, Cocnoor andK [illegible] are well suited for the growth of the pototo. The Kalhatti

valley has for years produced the best potatoes on the hills; the soil is reddish brown loam, the climate moderately moist, and frosts occur only in January." The yield per acre, in 1847, was 600 mds. as mentioned above but that in 1876 was given as 40 cwts. That is to say, the yield per acre had declined from over 6 tons to about 2 tons in the course of three decades. There was a serious falling off in the size and quality of potatoes. This was due to the following reasons, according to Mr. Jamieson, the Superintendent of the Botanical Gardens, who in 1877 wrote an article on potatoes. The principal causes of degneration were (1) planting on swampy undrained land, (2) the continued use of the same seed, (3) over manuring and (4) the planting of the same land year after year with potatoes.

In the seventies, great interest was taken by the Government and individuals in improving the quality of the potatoes grown on the Nilgiri hills. Good varieties were imported from England and Australia and tried. Good seed was supplied to the public. In spite of these the ryots were taking very little care either in the selection of seed or in its preservation. They were doing nothing to combat potato diseases. The potato crop became one of more risk. Prices varied. At one time it was as low as Rs. 20 per ton and at times went up to Rs. 100. Sometimes disease might smite the crop and the return would hardly pay for the seed. Seasons also varied exceedingly. Late April rains meant a short potato crop; early frost was death to the second crop.

In the first decade of this century Nilgiri potatoes were being exported to Ceylon, Burma and Straits Settlements and potato had become a paying crop. Mr. W. Francis, a Collector of the District, evinced very keen interest in improving the quality of the potatoes produced on the Nilgiris and in 1909 he was able to get a grant from the Government to import two tons of good seed from Australia. This was taken by Mr. George Oakes, an enthusiastic potato grower for the growing of seed. In an address on Potatoes delivered by Mr. Oakes under the auspices of the Nilgiri Agri-Horticultural Society on the 30th September 1910 he refers to this. From the seed he obtained he planted a crop in May 1910 for which he used

6 cwts. Brownell's Beauty	and lifted	80 cwts.
1¼ cwts. Satisfaction	,,	5½ cwts.
1¼ cwts. Cambridge Kidney	,,	9 cwts.

Mr. George Oakes applied ½ ton of Parry's Potato Fertiliser for the above crop.

New varieties were tried in the Government Botanical Gardens. In 1910 there were 1½ acres and in 1914 about 2½ acres under potato. Seed produced here was supplied to the public and it is said that the average annual supply of seed to the public during the period was over 350 mds. In 1915 and 1916 the question of expansion of seed production was under discussion and in 1917 the Government decided on establishing an experimental station at Nanjanad where new varieties were tried and manurial experiments were also undertaken.

Since 1910 the area under potatoes has been increasing owing to demands from Colombo, Bombay, Calcutta etc. The use of fertilisers has also been increasing. From the beginning of the Great War in 1914 there was a marked increase in area. The area under potatoes in 1914 was about 4000 acres and it increased to about 8000 by 1920. Since then and up to 1931 the increase was not so marked. In 1931 it was only about 9000. Since then owing to increasing unemployment due to depression and to the increasing activities of fertiliser firms the area under potatoes has been increasing and at the present time it is not less than 12,000 acres.

The pre-war price of potatoes was between Rs. 6 and 9 per bag of 190 lbs. During the war prices went up to even Rs. 23 per bag. From 1930 the prices have been declining and in 1932 it went down to as low as Rs. 3 per bag. During the past five years prices have been ranging from Rs. 3 to 9 per bag. The low prices are due to increased production on the Nilgiris and in the potato growing areas in other parts of India and to the increased imports from Italy, Cyprus, East and South Africa, Australia, Japan and Burma.

The consumption of potatoes has also been increasing throughout the country and so long as the price of potatoes to the consumer is reasonably low the consumption will increase.

Palm Oil as a Motor Fuel. It is reported that research in the Belgian Congo has shown that motors designed for the use of gas oil fuel can also be driven satisfactorily with locally obtained palm oil as fuel, the combustion of the palm oil in the motor cylinder being as good as that of gas oil. The exhaust gases are colourless and contain no carbon monoxide At the normal temperatures of the Congo, the palm oil is sufficiently fluid as to require no pre-heating before being injected into the motor cylinder, and the starting up of the motor with this fuel is satisfactory. The acid content of the oil is not sufficient to attack the motor parts with which it is brought in contact. The heating value of the fuel is 9,200—9,600 calories per litre and the average water content 0·4 per cent. Experiments with the palm oil fuel in power works showed the consumption per kilowatt hour, with a 400 kw. unit, to be 0·292 kg. which compares favourably with the consumption of gas oil fuel in the same unit. (*Industrial India*, November 1937, Page 264).

CLIMATIC CONDITIONS AND BEE BEHAVIOUR

BY R. RATNAM, B. A.

Introduction. Demuth (1919) states that there are four factors which combine to make up the honey crop that a bee-keeper hopes to get, namely, (1) a surplus population of adult bees ready for field work, (2) a pronounced storing instinct and a minimum of swarming impulse, both of which depend upon the race of bees handled, (3) a good pasturage and (4) suitable weather conditions which would not impediment flight of bees on the one hand, and which would on the other hand stimulate secretion of nectar in plants. Root (1929) adds that "some advances have been made within recent years in a study of climatic factors on a few plants, but there still remains much to be done, and bee-keeping will not be a safe business until far more is known about these effects". Ramakrishna Ayyar and Ramachandran (1934) observe that the most important factors which contribute to the general health and prosperity of the bees are "(1) availability in the vicinity of sufficient pasturage for gathering honey and pollen, (2) the climatic conditions prevailing and (3) the absence of enemies like the wax moth". They point out also that "we have hardly any previous records on these points with regard to South Indian conditions".

The present investigation was undertaken to find out the relationship that exists between climatic conditions, chiefly temperature and relative humidity, and bee behaviour as indicated in the activity of the bees and the change of weight of a hive. Hambleton (1925) has studied in U. S. A. the effect of weather upon such changes in weight during the honey flow. The practical bee-keeper is concerned about the net gain per day per colony which to him represents a surplus of honey available for extraction during the honey flow season. The importance of determining the various climatic conditions which influence his honey crop cannot, therefore, be over estimated.

Pasturage conditions. That the availability of adequate pasturage is the chief determining factor for a good honey crop can be easily admitted. But with the present information, it is hard to state whether given the same pasturage conditions, bee-keeping will be successful in all localities. The question is closely related to the relationship that exists between temperature and relative humidity to nectar secretion in flowers. Again different plants may possibly react differently to identical climatic conditions. It is, therefore, necessary to indicate at the outset the plants that formed the chief source of nectar in the locality which was studied in the present investigation.

The apiary is situated about three miles from Coimbatore town, and the study was undertaken in April—May 1937. Tamarind (*Tamarindus indica*) flowers were available in very great profusion close at hand and this was the chief source of nectar. To a smaller extent the second crop of flowers in cotton formed pasturage of minor importance, but they were available

only about 500 yards away from the location of the apiary. Of lesser importance were flowers of guava (*Psidium Guajava*), the cactus (*Pachycereus marginatus*), coconut (*Cocos nucifera*) and *Antigonon leptopus*. These plants were useful either for pollen or nectar or for both. Particular mention should be made of the cactus which blossomed before 5-30 a. m. and numerous bees were seen inside the flowers which formed the chief source of pollen between 6 and 7-30 a. m. Till about 8-30 a. m. incoming bees were seen to bring full loads of pollen. But during midday and the afternoon incoming bees were seen to be least possessed of pollen and it was, therefore, concluded that they came chiefly with nectar, for bees rarely make flights when either nectar or pollen is not available. It has also been observed by experience that the period during which the present study was conducted falls almost in the middle of the main honey flow season in that locality.

Materials and Methods. Two bee colonies of *Apis indica* (hereafter referred to as hive *A* and hive *B*) of average strength with full set combs in one super were mounted on a Salter's family weighing scale and hourly reading of weight from 5 a. m. to 7 p. m. were taken. The hours from 5 a. m. to 7 p. m. were, by observation, found to be the period during which bees were seen at outdoor work. Readings were taken correct to half an ounce (1 oz. = 28·35 gms.). Simultaneously temperature in shade was noted by means of a wet and dry bulb thermometer and the relative humidity was then read off from the appropriate tables. Pearson's co-efficient of correlation was worked out wherever possible.

Discussion.

Changes of weight. (I) *General.* The variation in the weight of a hive is due to the following causes:—

(1) Loss of weight on account of evaporation of moisture from the contents of the combs.
(2) Loss of weight on account of metabolism in the body of the bees.
(3) Gain in weight on account of the loads of pollen and nectar gathered by the bees.
(4) Changes in weight due to the weights of incoming and outgoing bees during the day time.
(5) Changes in the numbers of bees in the hive by reproduction, destruction etc.

Of these five factors that contribute to the change of weight items (1), (2) and (5) happen throughout the day and night. The rate of loss on account of evaporation depends chiefly on the temperature and relative humidity, while loss due to metabolism is considerably increased if bees do more work. The gain in weight of a colony is due to incoming loads of pollen and nectar brought by bees. Since it is found that the outdoor activity of the bees, during the course of the present study, has been confined to the "diurnal hours" from 5 a. m. to 7 p. m. and since almost all

the population of the colony is within the hive at 5 a. m. and 7 p. m., the differences in weight-readings taken at these hours are not likely to be caused by the weights of bees remaining outside the hive. Increase or decrease in the population of the hive, variation in weight on account of death of bees, if any, or loss of population due to other causes has been taken as negligible and therefore disregarded. Over a small period of time, changes of weight due to these causes will be relatively very small. The hive is made of wood which will absorb varying amounts of atmospheric moisture depending upon the climatic conditions, but these changes have been ignored since they would be slight in view of the fact that hives have been in use for over five years.

Since Root (1929) has pointed out that unless the storage of honey in the supers found in the honey flow season (which is spread over a long period) is removed, bees get lazy and tend to crowd in the hive itself, honey from the super was removed, after recording the weights, for six days continuously, to make them work sufficiently fast. An interval of three days was allowed for the above mentioned operations and readings were again taken for another period of six days continuously. This procedure was followed throughout the study. Both hives *A* and *B* were also under observation for a period of four days continuously. Hourly readings of weight were recorded in all cases.

(ii) *Net gain of weight.* In table I the frequency distribution of hourly changes of weight for hive *A* alone for 21 days is given. The difference of weights between the readings taken at 5 a. m. and 7 p. m. which represents the net gain or loss for the day, shows that out of the 21 readings available, on two days there have been net losses of weight of 2 oz. and 0 5 oz. respectively, on three days there was no change of weight, and in all other cases a gain of weight has been recorded. The average gain in weight for the 21 days amounts to 1·8 oz. per day and there is a net gain of even 4 oz. per day.

It is not possible to easily obviate the loss due to evaporation and metabolism. Losses due to evaporation should be considerable, and but for this, there should be a much larger gain in weight.

(iii) *Midday increase.* While a comparison of the readings taken at 5 a. m. and 7 p. m. would obviate the error due to the loss of weight on account of the bees being engaged in field work, the hourly readings taken between these hours introduce this error also. If we imagine for a moment that there is no evaporation and that between 5 a. m. and 7 p. m. the bees are engaged in outdoor work, then the weight recorded at any time between these hours should be less than the reading taken at 7 p. m., for the reason that a smaller or larger number of bees are outside the hive. But there have been very few cases when the readings taken earlier than 7 p. m. and later than 11 a. m. were less than the weight recorded at 7 p. m. This increase is due to the honey and pollen collected during the day by the bees.

Table I.

Frequency distribution of changes of weight of hive A with 5 A. M. weight as the base (Observations on 21 days.)

Changes of weight in oz.	Time in hours from midnight.													
	6	7	8	9	10	11	12	13	14	15	16	17	18	19
-2·9			1		1	1	1							1
-1·5	1		1	2	1									
-1·0	1	1	1	1	1			1	1				1	
-0·5	4	2	1	1	1	1							1	1
0	15	12	10	3	2	2	2					2	1	3
0·5		4	1	7	4	2				1	1		1	1
1·0			1		3	4	3	4	3	3	1	3	2	1
1·5		1	2	3	2	4	2	1	2	2	2	2	2	3
2·0		1	3	2		1	2	2	3	1	5	2	2	2
2·5				1	2	2	2	1					1	1
3·0				1	2		1	1	1	2			5	4
3·5							2	2	1	1	2	6		1
4·0						1	1	1	1	2	1	2	4	3
4·5					2			2	1	1	3	2	1	
5·0						2	1	2	2	2	4			
5·5							2	1		1				
6·0							1	1	3					
6·5							1	2	2	3	23	2		
7·0						1				2				
Mean oz.	-0·2	0·2	0·3	0·6	1·1	1·7	2·6	3·3	3·5	3·1	3·4	2·9	2·2	1·8

The maximum weight was recorded between 1 p. m. and 4 p. m.; and during these hours the average gain in weight was between 3 oz. and 3·5 oz. As much as 6·5 oz. or 7 oz. have been added to the weight of the hive before these hours.

(iv) *General trends.* Hambleton (1925) has observed in U. S. A. that the "diurnal hours" from 6 a. m. to 7 p. m. is divided into four stages during the spring honey flow. The one from about 6 a. m. to about 10 a. m. is the period when the hive loses weight. He has explained this morning loss as due to the bees leaving in flight. During the second stage which immediately follows upto about midday, the hive steadily gains in weight after which (the third stage) for about an hour between 1 p. m. and 2 p. m. the rate of gain slackens. Hambleton explains this by stating that "until further investigations are made Bonnier's observations of decreased nectar secretion and the resulting effect on bee behaviour must be accepted as the most logical explanation of this phenomenon, although the reasons which he gives for these changes on the part of the plants and the bees do not seem entirely satisfactory". After about 2 p. m. which is the fourth stage, the hive gains in weight till about 7 p. m.

In the present study, ordinarily the hive was found to undergo no change of weight between 5 a. m. and 6 a. m. Out of the 21 readings available for hive A, 15 readings show that there has been no change of weight and 6 readings show a loss (Table I). After 6 a. m. the hive began

to gain weight and this increase continued till about 2 p. m. after which hour the weight began falling. On some days as on May 9, 1937, there was a depression between 11 a. m. and 1 p. m. and on other days this fall was totally absent. On April 11, 1937 it was found that losses of weight were recorded between 8 a. m. and 2 p. m., and on April 12, 29 and 30 between 8 a. m. and 11 a. m.

The large fall of weight occurring between 2 p. m. and 7 p. m. may be due to two causes working simultaneously. While on the one hand, as Hambleton has stated, there may be a decreased nectar secretion, and so less honey gathering by bees, the rate of evaporation on the other hand should also be greater since the temperature is very high and relative humidity low at about 2 p. m. As much as 3 oz. have been lost on some days during the afternoon for a net weight of about 9 lb. (very approximate and only estimated) of the combs (exclusive of the weight of the wooden frames and hive). There was an average loss of about 1·7 oz. during the afternoons for the readings taken on 21 days.

In graph I the changes of weight of colonies *A* and *B* as on May 9, 1937 are shown, and in graph II the tendencies in change of weight for hive *A* alone, for each of the three periods of six days and for a period of three days during which the hive was continuously on scale is indicated.

(v) *Two hives compared for change of weight.* It will be evident from graph I that hives **A** and *B* show similar tendencies for change of weight. In fact this has been the case on all the four days during which both the hives were compared. Table II furnishes the changes of weight of each of the hives at various hours.

Table II.

Trend of changes of weight of two hives A and B with 5 a. m. weight as the base (in oz)

Date of observation.		7 a.m.	9 a.m.	11 a.m.	1 p.m.	3 p.m.	5 p.m.	7 p.m.
May 9, 1937	A	0·5	3·0	7·0	6·5	7·0	3·5	3·0
	B	-1·0	0·5	3·0	2·0	4·0	0·5	-0·5
May 10, 1937	A	2·0	2·5	5·0	4·5	5·5	3·5	2·0
	B	1·0	4·5	5·5	5·0	4·5	2·5	0·5
May 11, 1937	A	-2·0	1·0	3·0	4·5	3·0	Not available for hours from	
	B	1·0	3·0	3·5	5·5	2·5	5 p. m. to 7 p. m.	
May 12, 1937	A	0	2·5	4·5	5·0	3·5	-0·5	-0·5
	B	0	2·0	5·0	4·0	3·5	-2·0	-2·0

The similarity probably indicates that given identical environmental conditions bees work to their maximum. Else the trends of change of weight would not have been so alike. Of course, the amount of gain in weight should always depend on the force of field workers available for collecting pollen and nectar. Favourable environmental conditions for

collecting nectar help the working of bees in different colonies in the same manner. The two colonies were caught at two different places in different years and they have shown similar responses to environmental conditions. How sharply bees of each colony respond to environmental conditions is a different question and that will be dealt with later in this contribution.

The results now obtained are in general agreement with Hambleton's views.

(vi) *Nocturnal loss.* There is also loss of weight during nights which may be due to evaporation from the honey and metabolism in bees. In Table III the frequency distribution of loss by night is indicated.

Table III.

Frequency distribution of Nocturnal loss of weight.

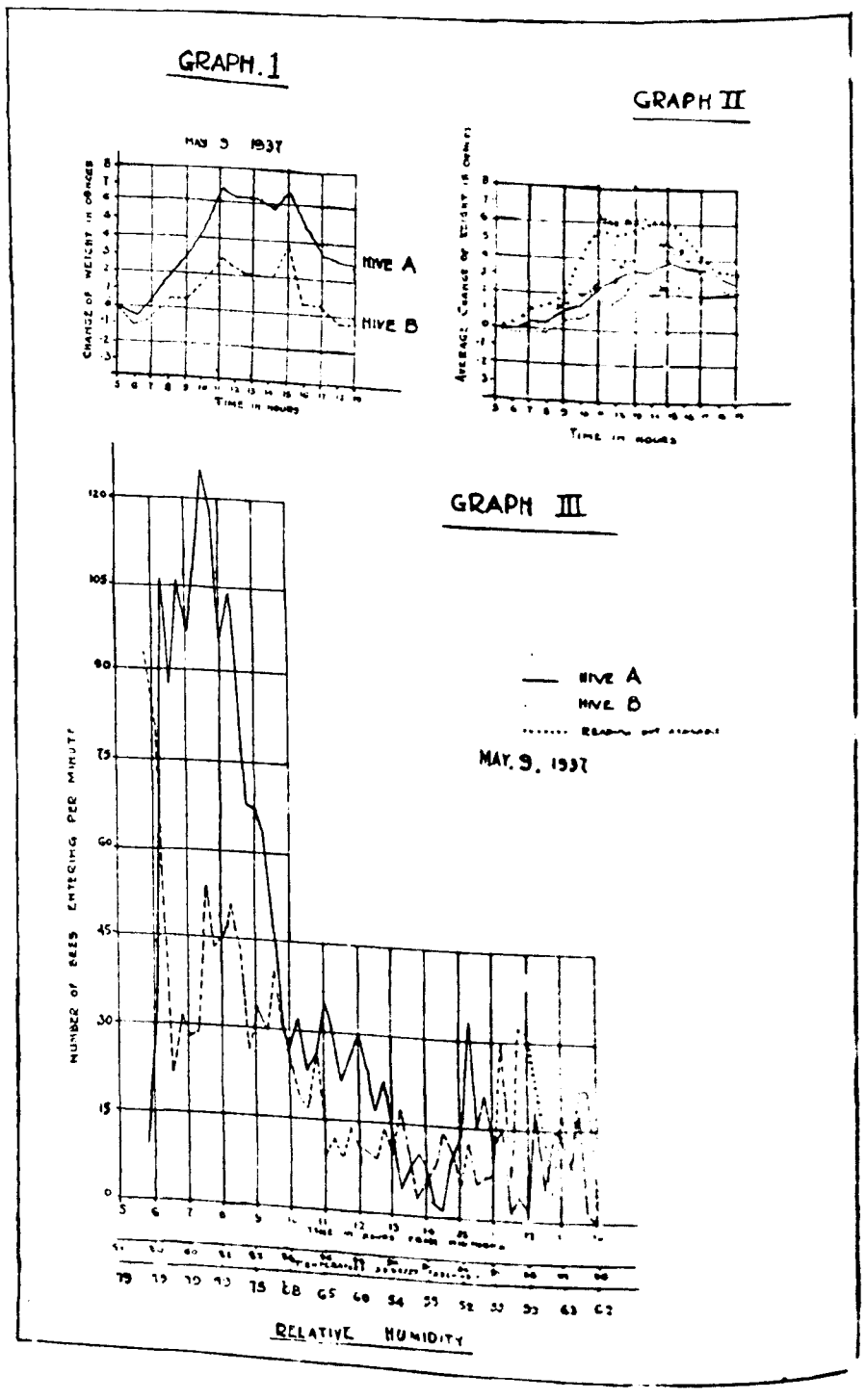
	Loss of weight in oz.					Total
	0	0·5	1·0	1·5	2·0	
No. of days	6	5	3	...	2	16

Only 16 readings are available and the mean loss for these readings is about 0·6 oz. per night. This is very small when compared with the loss due to evaporatton in the afternoons. It is, therefore, likely that the loss during the night is largely due to metabolism, and evaporation may be insignificant as the relative humidity is higher and temperature lower during the nights. The six zero readings indicate that losses due to metabolism are balanced by absorption of moisture during the nights when the humidity is high and temperature is low.

Flight of Bees. Three factors usually operate on the number of bees entering a hive in a given interval of time. Firstly if pasturage is available close at hand, each bee can perform a greater number of trips in a given interval of time. Secondly even if pasturage is available nearby, unless nectar secretion is profuse or pollen is available in abundance, bees would not be in a position to collect the optimum load quickly, that is, they will have to visit a larger number of flowers before they "think" of returning to the hive. This would naturally take a longer time and so the number of bees entering a hive in a definite period will be less. Thirdly the environmental conditions obtaining outside by way of temperature, velocity of wind, rain etc., should be such as would not impediment flight of bees.

In a particular locality the number of bees that enter a hive in a given interval of time should account for the increase in weight and unless the incoming bees bring sufficient loads, the hive should record a fall of weight due to loss on account of evaporation.

Rough counts of the number of bees in hives *A* and *B* entering in one minute were made from 5 a. m. to 7 p. m. at intervals of 15 minutes. It was not possible to record the number of bees, if any, entering between 5 a. m. and 5·45 a. m. as there was not sufficient light available. It was easier to record the number of bees alighting at the entrance to the hive,



rather than the bees that were leaving the hive. Moreover, it is only the number of bees that return to the hive that matters for the increase in the weight of the hive due to the incoming loads of pollen and nectar. The need for an automatic device for counting was not very keenly felt, since it was found very easy with some experience to count over 50 incoming bees per minute. The occasions when larger number of bees was to be counted were very few and even here much difficulty was not experienced.

Of the observations for four days recorded, those of 9th May are represented in graph III, the records for the other days being similar. It will indicate that bees are busy in the early hours of the morning rather than at midday or in the afternoon. It will also be seen that hive *B* has started work earlier than 5-45 a. m. and that is the reason why as many as 94 bees were seen to enter the hive in one minute at this hour. Hive *A*, however is seen to increase in activity as time advances and at 6-15 a. *m.* the count has increased to 106, while the graph for the hive *B* is already falling.

The trends of graphs I and III may now be examined. It will reveal that till about 9 a. m. the rate of increase of weight of the hives is very small although the number of incoming bees is very large. This is due to the fact that the loss of weight of the hive on account of bees leaving in flight has first to be compensated and this naturally takes a longer time.

The trends of both graphs I and III are alike after 11 a. m. The depression between 11 a. m. and 3 p. m. is repeated in graph III and the peaks at 3 p. m. followed by a fall occur in both the graphs. After 11 a. m. when the temperature rises bees do not go out for field work as is reflected in graph III. This fall in the activity of bees may be due to decreased nectar secretion in flowers. After 3 p. m., however, the activity is seen to have increased but the loads brought in by the field force is not sufficient to compensate the loss of weight of the hive on account of evaporation. During the afternoons as much as 3 oz. has been lost in the weight of the hive on some days, while the average is about 1·5 oz.

Ghosh (1936) has stated that "more nectar is secreted in the morning and evening than in the middle of the day" and the above observations of the number of bees entering the hive at specific intervals of the day appears to confirm this statement.

If it is assumed that the number of bees entering in one minute recorded at fifteen-minute intervals is fairly representative of the activity of the hive, then the total number of bees entering per minute say at 8 a. m., 8-15 a. m., 8-30 a. m., 8-45 a. m., added together furnishes an index of the aggregate activity of the hive between the hours 8 a. m. and 9 a. m., and the difference in weight of the colony recorded at these hours should bear some relationship to the above index. Of course, loss due to evaporation is always happening. The correlation between the number of bees entering in one minute recorded at intervals of fifteen minutes and the difference in weight of the hive recorded during two consecutive hours, shows a significant

correlation of $+0.5409 \pm 0.048$ for hive *A* and 0.5715 ± 0.0649 for hive *B*. But for the error introduced by varying rates of evaporation this correlation should be much higher. The conclusion that more frequent flight of bees should account for a larger increase in weight should, therefore, be correct.

Nectar Secretion, Climatic Conditions, and Flight. It has been shown that flight, i. e., the number of incoming bees, is an index of the changes in weight of the hive. It is, therefore, possible to utilise flight records in analysing the effect of climatic conditions on the colony. Relative humidity and temperature are the two factors that could be measured conveniently.

It is well known that it is possible to make the bees active even during dark hours by directing a beam of light from a torch to the entrance of the hive. Were the light to be switched off the bees would be lost, as they are unable to perceive during darkness. Sunlight is, therefore, necessary for visual perception. Strong wind and rain act as impediments and prevent flights. Within the normal limits of temperature and humidity which prevail at Coimbatore, the availability of pollen and nectar seems to be the only limiting factor for the activity of bees. That relatively high temperatures which prevail between 1 p. m. and 3 p. m. do not appear to affect the flights is very easily seen from the fact that if a cotton wool soaked in honey is placed at about 100 yards or more from the hive, the bees, in spite of the hot hours, gather around the soaked cotton wool. This is a very common observation at any part of the day when extraction of honey is going on. It is, therefore, clear that provided extremes of temperature and humidity are not met with, temperature and humidity affect the bees indirectly by either causing scarcity or profusion of nectar and pollen and by influencing blossoming. A study of the relationship between the flight of bees and these two climatic factors really, therefore, amounts to a study of nectar secretion in plants.

Temperature. Phillips (1926) observes that " any species of nectar-secreting plant is often rendered non-productive by unfavourable weather conditions. The smaller plants usually cease nectar secretion at once in dry weather, while the tree sources are less quickly affected". Root (1929) states that " for the majority of the plants there is a decrease in the amount of nectar until about the middle of the afternoon, when the amount is least, followed by some increase toward the close of the day. This change may be due to higher temperatures at midday, or may be due to lowered relative humidity when the temperatures are highest".

Hambleton (1925) has arrived at a correlation of $+0.7529 \pm 0.0473$ between net gain in weight of a hive and the average day temperature; it must be remembered that in U. S. A. temperatures are generally low, and, therefore, high temperatures in U. S. A., which would be comparable to our low temperatures, are beneficial. Since losses due to evaporation reduce the increase in weight of the hive, the flight activity of bees may be taken as a better index for ascertaining the effect of temperature on nectar secretion

than the change of weight. In the present study a significant correlation of -0.6084 ± 0.0658 was obtained between flight of bees and day temperature. This negative correlation indicates that as temperature increases the flight activity of the bees decreases indicating retarded nectar secretion. Since there is a positive correlation between flight of bees and change of weight, lower temperatures should account for a larger honey crop.

It may be concluded that given the same pasturage conditions, a larger honey crop can be obtained at lower temperatures. In the present study the temperature ranged from 77°F to 92°F between 5 a. m. and 7 p. m. with the average ranging from 82°F to 87°F. Oertel (1937) has studied in U. S. A. the data in respect of the honey crop obtained over twelve years in relation to the average temperature in each year, and concludes that larger honey crops are associated with temperature deviations below normal. This conclusion is also in conformity with the inference stated above.

Humidity. Relative humidity accounts for the large evaporation in hives. Effects of humidity are always co-existent with the effects of temperature while both temperature and humidity are related. It is, therefore, very difficult to assess the effects of humidity on bee behaviour exclusively. There is a very high negative correlation of -0.8802 ± 0.006 between temperature and humidity which indicates that as temperature rises humidity falls. Between flight and humidity a positive correlation of $+0.8484 \pm 0.027$ has been obtained and this shows that higher humidities are conducive to an increased flight activity of the bees which is an index of more profuse nectar secretion. Phillips's (1926) observations that lower relative humdities retard nectar secretion is confirmed.

In the forenoon, temperature is low and humidity is high and the nectar secretion is, therefore, greater in the early part of the day.

Summary and Conclusions. A study in the hourly change of weight of a bee hive is made, which shows that the hive gains till about 3 p. m. and then loses weight due to evaporation. An average net gain in weight per day of about 1·8 oz. is recorded, the afternoon loss alone being about the same, so that, but for the heavy loss of weight in the afternoons, a larger increase of weight should be recorded. There is relatively little loss of weight by nights, it being only about 0·6 oz. on an average. Two hives are also compared for change of weight and they are found to behave almost alike. When one gains in weight the other also gains in weight and so also when one loses weight.

The exact amount of gain in weight depends upon the field force. Observations of the number of bees entering the hive per minute on four days at fifteen minutes intervals have been made and a correlation of $+0.5409 \pm 0.048$ has been obtained between flight of bees and change of weight for hive A. A similar correlation of 0.5715 ± 0.0649 was obtained for hive B. It is also seen that bees are busier in the mornings than at midday or in the afternoons. In the matter of behaviour of the population in each hive, it is observed that one colony starts work earlier than the other.

Provided that extremes of temperature and impediments like darkness, high wind and rainfall are not met with, the activity of the bees is found to entirely depend upon the blossoming of flowers and availability of pollen and nectar. The necessity for studying the effect of temperature and humidity on nectar secretion and anthesis is, therefore, keenly felt. It has been shown that the flights indicate this floral activity, and utilizing flights as an index of the condition of the pasturage, it has been proved that nectar secretion is larger in the mornings than at midday or in the evenings, and that lower temperatures cause larger nectar secretion. It is therefore concluded that when the pasturage is identical a larger honey crop can be expected from the locality having lower temperature.

Acknowledgments. I am very grateful to Mr. M. Bhavani Shanker Rao for the valuable help he has rendered in scrutinising all calculations.

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ELEMENTARY EDUCATION AND AGRICULTURAL IMPROVEMENTS*

By Mr. K. UNNIKRISHNA MENON,

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I thank you very sincerely for the opportunity you have been pleased to give me for reading a paper on "Education and Agricultural Improvements." I prefer not to confine agriculture to elementary classes alone. I am aware of the fact that I am addressing a large gathering of educationists. The diffidence becomes greater as I am an old trained teacher myself. However, my claim to speak on the subject is that the man in the forest sees only trees while the one outside can see the forest as a whole. I therefore venture to place before you some of my observations and experiences quite as a lay man and allow you to form your own ideas about them.

2. Education has been defined in various terms and it is not for me on this occasion to go into the details of its definition. Suffice it to say that any education, if it be real, must enable the educated to live as independently and well, as possible. I should consider this as the practical purpose of education. If the educated man is also able to benefit his fellow beings around, he must be considered to be living a useful life. In the attempt to study many things or the most important and prominent things in this world a student becomes enamoured of them. The sky scrapers of America, the Niagara falls and the enormous electric energy they give out, the electric trams and trains in towns all remain vivid in his mind. He is prompted to go and see and enjoy those wonderful things in the towns, relegating his own surroundings to the background. As a result there is a rush of the educated man from the rural to the urban areas. Many an educated youth has asked me why we do not use engines and pumps for irrigation, tractors for ploughing and so on and spare our poor animals from hard work. I attribute all such questions to the utter ignorance of the poor educated youth of his own surroundings. We cannot afford that standard of life until we are able to increase our production.

3. The three important means of production are mining, fishing and agriculture including pastoral farming. Mining is confined to the areas particularly blessed with underground mineral wealth and fishing is confined to the seabord areas or banks of big rivers. Agriculture is the only productive industry that can be carried on anywhere man lives. It alone is able to produce the food requirements of man and raw products needed for most of the industrial undertakings. A general increase in production must evidently be through agriculture and that is more so in India of which over 70% of the population depends upon this industry. Any attempt at industrial

* A paper read at the Malabar District Educational Conference on 27—11—'37.

revival without increasing production through agriculture will be like the erection of a big building without adequate foundation.

4. The educated man, with his urban tastes, leaves this important industry into the hands of the uneducated and illiterate villager. This process has been going on long, with the result that Agriculture as an industry has nearly fallen into disrepute. This is particularly due to the fact that the illiterate farmer has been found devoid of the outlook needed to imbibe new ideas of improvement in farming and much more so to adopt them as he happens to be more a fatalist than a materialist. His economic position is consequently unsound and he is always found to be needy as he is quite unable to compete with the farmer of the civilized countries, all the world over, in point of production. He has now to sell his produce in the world market when the difficulties due to time and space have been mostly overcome by the advance made by science.

5. What is needed to improve the situation is to increase the productivity or in reality the wealth of our country. The income from Agriculture cannot be improved or production increased until farming as a business is at least partly taken out of the hands of the illiterate villager and handed over to the educated man, in whom a taste has to be created in village life. Many an educated man has now found it impossible to live in towns as he failed to secure a footing there. He is always on the alert to find out something in the town for himself and run away when possible. He is also unfit to become a farmer as he can have no abiding interest in the business.

6. The only remedy under these circumstances is that the boy as he gets educated must be made to develop a taste in farming and village life. In the early stages of his career as an infant the child must be helped to develop its natural love for flowers and later on in their production A teacher was once found to be taking great pains to draw a paddy plant with coloured chalks on the black-board when the school was situated in the midst of a paddy flat with crops all round. The idea must be different from this. The actual plant must be grown and shown to the child to satisfy the real inherent curiosity and make the child take part in the growing of it. The wonderful changes the seeds undergo when planted and the greater wonder evinced by plants as they grow and produce flowers and seeds of the same kind, must all be considered as practical lessons, one should get at the school. Their requirements of food and drink and ventilation as we require them must all be taught in an interesting manner ; so too animal life and their usefulness to man. There must be some field crops, fruit plants and vegetables grown in the school garden itself with the labour of the boys. Showy plants like crotons that now make the best school garden must be fewer and less prominent though I do not recommend to exclude them. The aesthetic aspect of the school garden or farm can very well be maintained by proper lay out given to growing crops. A chilly plant is as beautiful as any showy plant in a flower garden. The only defect with it is that it will bring in profits. So also a brinjal or a ladies' finger plant.

Amarantus of various hues can easily take the place of crotons. There are very many beautiful fruit plants which can form an avenue on the roadside in any school farm or a shade plant in the school premises. They are as the Begonias, Caesalpinias, Tecoma or Thevetia or the most poisonous Nerium (oleander) that now predominate in a school garden and are liable to endanger the life of the child. A grape wine or passiflora can make a bower as beautiful as any Aristolochia. The Moringa (Drum stick) plant grown along the margin can be a constant source of income while it beautifies the garden or serves as a wind break. Mango bushes, roseapple, jack trees, sapotas, pomegranates and guavas are but a few of the productive and harmless plants that can thrive well in a school garden or within the school compound. Pets like cows with calves, goats and kids, poultry, pigeons etc. may also be reared in a school where facilities can be provided for them. A few good fishes in the school well will be a useful adjunct to the garden ; so also honey bees or silk-worms. Cows or goats may be reared in larger number as a source of profit and to supply the necessary food of pure milk for children in the school. They will form great object lessons and serve to prove their worth as profitable and necessary side lines to the growing of crops. Their study should not be theoretical if they should appeal to the young minds. Therefore I am forced to recommend that most of it has to be practically shown to them in the school and done by boys themselves. One cannot have a taste for swimming if one is not allowed to enter water. So long as the study of the surroundings remains optional, it is likely to be neglected. I should like to place all the emphasis at my command when I say that these lessons must be made a compulsory part of the elementary education as much as the three R's.

7. The great need for making the children realise the dignity of labour cannot be exaggerated. They must also be able to have a liking for the many useful domestic animals. The failure of the boy to realise it and to know the usefulness of domestic animals may be the probable reason for the educated villager becoming unagricultural in his outlook. You can very often see a European going under his car and soiling his fingers when there is a need for it, while many an educated Indian awaits the arrival of the mechanic. This is obviously the result of the better opportunities the European had of realising the dignity of labour in his early life.

8. There have been misgivings in certain quarters where guardians began to grumble at their children being put to manual work in a school. This is the outcome of their ignorance or imperfect education. It seems necessary to enlighten the objectionist guardians in the great utility of their children realising dignity of labour. Then alone the future generation of guardians may be amenable to this great need of the country. It must also be got over by instilling interest in the minds of the pupils to do manual work. The teacher has to lead the boys by commencing to work himself and continuing to do so in a way till such classes are over. Once at the Agricultural College boys revolted against the cleaning of the cattle shed. This was

easily got over when the Principal himself commenced the work and all the boys joined him. Under the authority of an experienced officer of the Educational department I may add that the teacher's unwillingness to tuck up his sleeves and to enter the field with the boys militated against the popularity of field work in schools. The higher market value of manual labour as it is at present can be very well understood when we compare the presest day wages of a good labourer though illiterate he be, with that of a literate writer in an ordinary trader's shop. We can allow our boys to stand in the midday sun for hours together in the cricket field. Is it not a real sin to object to the boy exposing himself in the evening sun for a shorter period to put in labour of a productive kind ? Let the training given in schools help to make field labour as dignified or more so as the work in the cricket field.

9. In the higher classes the boys must have become fully conscious of the dignity of labour and must be able to do the very ordinary farm operations. An idea of the life of a farmer and his requirements must be made clearly understood by the boys. The great advantages of village life must be well impressed on the adolescent youth by showing him happy examples in local villages. Later on, the economics of farming, emphasising prevention of waste and the prospects of a good farmer to live a self-sufficient and contented life in the village, may be well impressed on his mind. Prevention of waste combined with sanitation can be very well demonstrated to the pupil by the way in which things thrown out from the school garden and the droppings of animals are composted together as harmless material. It can be used for manuring plants in the garden. The remnants of victuals thrown out or spilt grain etc. can all be fully made use of by poultry with advantage. The drainage from the school urinal may be turned to manure a clump of plantains or specimens of fodder crops. Once a Japanese lady was travelling with an Indian lady in a 3rd class compartment. Both of them purchased sugar canes for chewing on their way. The Indian lady threw off all the parings of the outer rind of the cane stem, while the Japanese lady kept them safe in the compartment. After she finished the chewing of the canes worth 3 pies, wove the rind pieces into two fancy baskets and sold them each for one anna. The Indian lady had half a mind to purchase one of them but felt ashamed to do so. Thus the idea of prevention of waste is possible in our everyday life.

10. The student must be trained to do certain items of work meant to occupy the spare time of a farmer. Spinning, weaving, basket making, carpentry or other items of manual training can be useful this way. They can be given only secondary importance and may be allowed to be taken up according to the taste of the boys. But the idea must be well impressed that spinning is possible only after producing cotton. Preparation of jams, fruit preservation and canning, converting the grain into flour or desiccating vegetables and fruits will naturally be the appropriate side lines of production in order to facilitate marketing of produce. They can be given greater prominence as items of manual training. Purely industrial training may be

suitable to the urban people but all education in rural areas must be organically connected with farming and devoid of the sense of unmaking a farmer.

11. In case there are facilities to obtain sufficient lands adjoining the school either as property of the school or on long term lease, gardening work or farming can be made a real source of profit to the school. If the reserve fund needed for the maintenance of a school is invested in lands a school farm is at once a practical proposition. A generous donor may place lands at the disposal of a poor school. Another may provide funds for equipment. Thus in a regular way a school farm may become a reality and may support the school if sufficient lands are available for cultivation. The strong controversy now going on in the newspapers as regard's Gandhiji's 7-year scheme of making a school financially self-sufficient with a school farm may be quite a practical idea worth a trial. If in a school, farming is taken up for its academic interest devoid of its economic aspects, improvement in the general trend of events can hardly ever take place. Many an educated youth has been found to criticise the improved methods of farming as costly. This is due to his ignorance as in reality it is only the other way about. It seems necessary to go a step further and assert that an economically run school farm is the only means to impress the business aspect of farming in the minds of the growing generation and the villagers in the locality. Farming which is the most important productive industry may thus be redeemed from the disrepute it has gained among educated people of this country.

12. The question of getting useful hands as teachers for such a course of study is the real problem. Of the two years' course in a secondary training school, one year is mostly spent in making the student up-to-date while the other year is devoted to train him as a teacher. If resourceful candidates with good education are selected for training they can be made to devote one year for the study of farming and village life and get trained in the next year. They will certainly be better fitted to become teachers.

13. The educated villager of the future with a real interest in farming should thus be able to stick to his own village, carry on farming most economically on improved lines and demonstrate a higher standard of life in the village. He must be able to give a lead to his unfortunate neighbours who were unable to obtain the benefits of education. This is the only way to introduce lasting improvements in the methods of farm-life so as to make the country wealthier or to make "the villages smile" to put it in the language of our esteemed Premier.

EXTRACTS

Relation between brix of juices from a cane stalk and that obtained in the mill, by M. Kenjo and T. Yoshida, in Rpt. *Govt. Sugar Expt. Str., Taiwan, Formosa,* No. 4 (1937)-pp. 145-162 (with English Summary).

The refractometer Brix of the juices obtained from each of the successive internodes of a cane stalk (16 months old) by means of a "punch" showed higher values than the Brix (both refractometer and hydrometer) of the juice obtained by crushing the stalk in a laboratory mill with an extraction of about 60 per cent. except from the few youngest internodes at the top of the stalk. In general, the average value of the Brix from each of the successive internodes was from 0·5° to 2·0° higher than the Brix of the mill juice.

To enquire into the causes of the above phenomena the authors made comparisons of the refractometer Brix of the juices obtained from inner, middle, and outer parts of the successive internodes; nodal and internodal parts, and the refractometer Brix of the juices obtained from one cane stalk by different pressures using a hydraulic press.

The difference in the Brix of the juices obtained from the inner, middle and outer parts of the internodes of a cane stalk was very small, and the Brix of the juice from the inner part was a little lower than that of the juices from the middle or outer parts of the internodes. There was little difference in the Brix of the juices from the middle and the outer parts of the internodes.

The refractometer Brix of the juices obtained from the nodal parts of a cane stalk was lower than that of the juice from the internodal parts of the same stalk when they were crushed separately in the mill.

The average value of the refractometer Brix of the juice obtained from each of the successive internodes of a cane stalk by a "punch" indicated still higher degrees than the Brix of the juice obtained by crushing only the internodal parts.

According to the pressure applied for crushing the stalk in a hydraulic press, considerable difference was observed in the Brix of the juices from the same cane stalk. The smaller the pressure in crushing stalk, the higher was the Brix of the juice obtained.

The difference between the average Brix of the juices obtained from each of the successive internodes by the "punch" and the Brix of the mill juice of the whole stalk may be due primarily to the difference in the pressure and the mechanism of juice extraction between the "punch" and the mill. In addition however, it is probably due to the fact that the Brix of the juice from the internodal parts of a cane stalk is by nature higher than that of the juice from the nodal parts.

The fact that the Brix of the juice estimated by a hand refractometer and a "punch" in the fields always shows higher value than that of the juices actually obtained from the canes by the factory mill may partly be explained by these considerations. (*Facts about Sugar*, December 1937)

The nutritive value of pasteurized milk. One of the statements most frequently made by opponents of pasteurization is that the nutritive value of milk is deleteriously affected as the result of treatment by heat. No satisfactory evidence in support of the contention has yet been brought forward. It is true that certain workers have carried out experiments the result of which have been regarded as favouring raw as opposed to pasteurized milk, but careful examination of their protocols has usually revealed some source of error that has

rendered their conclusions untrustworthy. On the other hand there have been a number of workers who have failed to find any significant difference between the nutritive value of raw and that of pasteurized milk. With the rapid increase in the extent of pasteurization that is occuring at present and the growing demand for powers of compulsory pasteurization by towns like Glasgow and Poole, whose experience of raw milk has been unfortunate, it is important that this question should receive a definite answer. Considerable progress towards this end is being made by a group of workers at the National Institute for Research in Dairying at Reading and the Rowett Research Institute at Aberdeen who are engaged under the auspices of the Milk Nutrition Committee of the Milk Marketing Boards in making careful observations on the comparative nutritive value of raw and pasteurized milk. The first report of this committee which has just been published mainly concerns experiments on rats.

Observation on the individual constituents of milk showed that, when subject to commercial pasteurization by the holder method (145°—150° F for thirty minutes) milk lost about one-fifth of its vitamin C content and a certain but unmeasured amount of its vitamin B complex. No change was observed in the vitamin A or carotene content of the milk, in the biological value of the proteins, or in the availability of the calcium or phosphorus.

Experiments on litter mates, carried out with whole milk given in a quantity of 70—80 c. m. daily, failed to show any difference between the nutritional value of raw and pasteurized milk as judged by such criteria as gain in weight, body-length, or the calcium and phosphorus content of the carcasses. (Extract from *The British Medical Journal* May 8, 1937.) (*Agriculture and Live-stock in India*, September 1937.)

Cowsheds Should be Sprayed. It was urged by Mr. D. Boyd (Berwick-on-Tweed), at the recent conference of the Sanitary Inspectors' Association at Brighton, that cowsheds should be sprayed with water just before milking. By this means, he said, producers could substantially reduce the bacterial count of their samples and prevent milk from souring.

He pointed out that the air in cowsheds contains a considerable quantity of invisible dust, which carries bacteria into the milking pails. The spraying of the atmosphere with a very fine spray of water would bring nearly all of this dust to the floor. It took but a couple of minutes to carry out the syraying, but it meant that the bacterial count would be reduced to a tenth of that obtained without spraying. (*The Implement and Machinery Review* October 1937.)

Foot-and-Mouth Disease. The task of investigating this important and damaging disease of live-stock has proved to be one of exceptional difficulty. As long ago as 1924 the British Foot-and-Mouth Disease Research Committee was formed "to initiate, direct and conduct investigations into foot-and-mouth disease, either in this country or elsewhere, with a view to discovering means whereby the invasions of the disease may be rendered less harmful to Agriculture".

That foot-and-mouth disease may be caused by several closely allied but serologically different viruses makes the difficulty of prevention by any type of vaccine almost insuperable and the failure to work out an effective method of inoculation represents the major disappointment of the investigation. Valuable information has, however, accumulated as to the resistance of the virus to physical and chemical influences. It has been shown, for instance, that the virus may resist cold-storage temperatures for prolonged periods and that it can be dried on fabrics and other materials and retain its virulence. These observations

have led the Ministry to introduce orders compelling the cooking of animal products before feeding them to livestock and make certain requirements as to wrapping materials. These regulations should eliminate some at least of the outbreaks. Important advances have also been made in the simplification and effectiveness of disinfection methods. Increasing reliance is now being placed both here and in Germany on alkalis, such as washing soda or dilute caustic soda, in disinfecting contaminated objects and premises. (Extract from *The Lancet*, May 29, 1937.) (*Agriculture and Live-Stock in India*, September 1937.)

Crop and Trade Reports

Paddy--1937-38—Second Forecast Report. 13th December 1937. The average of the areas under paddy in the Madras Presidency during the five years ending 1935-36 has represented 15·3 per cent of the total area under paddy in India.

2. The area sown with paddy up to 25th November 1937 is estimated at 8,595.000 acres. When compared with the area of 8,504,000 acres estimated for the corresponding period of the previous year, it reveals an increase of about 1·1 per cent.

3. The increase in area occurs in the Circars (Vizagapatam excepted) Cuddapah, the Carnatic districts, Chittoor, Trichinopoly, Tanjore and the Nilgiris. There has been a marked increase in Nellore (100,000 acres) and South Arcot (71,000 acres) and at the same time a large reduction in area in Vizagapatam (100,000 acres) and Tinnevelly (75,000 acres)

4. The first crop has been generally harvested throughout the presidency. Normal yields have been reported from Kistna, Kurnool, Cuddapah, Nellore, Salem, Coimbatore, Tanjore, Madura, South Kanara and the Nilgiris. The yield is expected to be below normal in the other districts. The crop has been affected by excessive rains in parts of Chingleput, South Arcot, North Arcot and Trichinopoly; in the other districts it has suffered to some extent from drought.

The seasonal factor for the Presidency works out at 95 per cent. of the average as against 98 per cent. in the corresponding period of the previous year.

Paddy--1937-38—Intermediate report. 11th January, 1938. The main crop of paddy has been or is being harvested in parts of the Circars, Kurnool, Bellary, Madura and the West Coast. The yield is reported to be normal in Kistna, Kurnool, Madura and South Kanara and below normal in the other districts.

2. In parts of the districts of Bellary and Anantapur the crop has been affected by drought. The condition of the crop is reported to be generally satisfactory in the other districts.

3. The wholesale price of paddy, second sort, per imperial maund of 82⅔ lbs. as reported from important markets on 3rd January 1938 was Rs. 2—15—0 in Madura, Rs. 2—12—0 in Chittoor, Rs. 2—11—0 in Trichinopoly and Tinnevelly, Rs. 2—9—0 in Virudhunagar Rs. 2—8—0 in Vizianagaram, Rs. 2—7—0 in Guntur, Rs. 2—6—0 in Hindupur and Kumbakonam, Rs. 2—5—0 in Ellore, Rs 2—4—0 in Masulipatam and Anantapur, Rs. 2—2—0 in Vellore, Rs 2—1—0 in Negapatam, Rs. 2—0—0 in Cuddalore and Mangalore, Rs. 1—15—0 in Cocanada, and Rajahmundry and Rs. 1—13—0 in Conjeeveram. When compared with the prices published in the last report, i. e., those which prevailed on 6th December 1937 these prices reveal a rise of 6 per cent in Anantapur 3 per cent in Guntur, 2 per cent in Trichinopoly and a fall of 23 per cent in Vellore, 15 per cent in Conjeeveram, 14 per cent in Rajahmundry, 12 per cent in Cocanada, 11 per cent in Cuddalore, 8 per cent in Masulipatam and 5 per cent in Hindupur, the prices remaining stationary in the other centres.

Sugarcane--1937--Third or final report. The average of the areas under sugarcane in the Madras Province during the five years ending 1935-36 has represented 3·4 per cent. of the total area under sugarcane in India.

The area planted with sugarcane up to 25th December 1937 is estimated at 97,510 acres. When compared with the area of 121,530 acres estimated for the corresponding period of last year, it reveals a decrease of 19·8 per cent. The estimate of the previous year was in excess of the final area of 119,650 acres by 1·6 per cent.

The present estimate of area exceeds the second forecast by 6,730 acres. The excess occurs mainly in East Godavari, Kistna, Chittoor, Salem and Coimbatore.

The decrease in area in comparison with the final forecast of 1936 occurs in all districts outside Kistna, Ramnad, Tinnevelly, Malabar and South Kanara.

The harvest has just commenced and yields below normal are expected in all districts outside West Godavari, Kurnool, Bellary, the Carnatic, Salem, Ramnad and South Kanara where the yield is expected to be normal. The seasonal factor for the Province is calculated at 95 per cent. of the average as against 97 per cent. in the previous year. On this basis, the yield is estimated at 266,630 tons of jaggery as against 338,790 tons estimated in January 1937, a decrease of 21·3 per cent. The final estimate for 1936-37 was 338,460 tons.

The wholesale price of jaggery per imperial maund of 82⅔ lbs. (equivalent to 3,200 tolas) as reported from important markets on 17th January 1938 was Rs. 5—8—0 in Adoni, Rs. 4—11—0 in Trichinopoly, Rs. 4—10—0 in Erode and Coimbatore, Rs. 4—7—0 in Mangalore, Rs. 4—2—0 in Salem, Rs. 3-10-0 in Vellore, Rs. 3—7—0 in Cuddalore, Rs. 3—5—0 in Rajahmundry, Rs. 3—0—0 in Chittoor, Rs. 2—13—0 in Cocanada, Rs. 2—12—0 in Vizagapatam and Vizianagaram and Rs. 2—3—0 in Bellary. When compared with the prices published in the last report, i. e., those which prevailed on 6th December 1937 these prices reveal a rise of 19 per cent in Vizianagaram, 14 per cent. in Trichinopoly, 12 per cent. in Coimbatore, 9 per cent. in Vellore and Mangalore, 7 per cent. in Cocanada and 1 per cent. in Erode and a fall of 7 per cent. in Cuddalore, 5 per cent. in Bellary and 2 per cent. in Rajahmundry, the prices remaining stationary in the other centres.

Cotton—1937-38—Third forecast report. 8th December 1937. The average of the areas under cotton in the Madras Province during the five years ending 1935-36 has represented 9·5 per cent. of the total area under cotton in India.

The area under cotton up to the 25th November 1937 is estimated at 2,118,600 acres When compared with the area of 1,982,100 acres estimated for the corresponding period of last year, it reveals an increase of 6·9 per cent.

The increase in area occurs in all the important districts outside Vizagapatam, East Godavari, Kistna, Kurnool, Nellore and Tinnevelly.

The area under irrigated cotton mainly cambodia is estimated at 227,400 acres as against 198,800 acres in the corresponding period of last year, an increase of 14·4 per cent.

Pickings of the *mungari* or early sown crop in parts of the Deccan are in progress and a yield below the normal is expected in the districts of Bellary and Anantapur; a marked reduction in yield is expected in Bellary where the crop has been affected by drought and by an attack of hairy catterpillar. The *hingari* or late sown crop in the above districts is suffering at present from the absence of rains and, if no rains are received in the near future, the whole crop may be affected very adversely.

Normal yields are expected in all the districts outside East Godavari, West Godavari, Bellary and Anantapur. The seasonal factor for the Presidency works out to 93 per cent. of the average as against 96 per cent. in the previous year.

On this basis, the total yield is estimated at 439,700 bales of 400 lb. lint as against 412,000 bales of last year, an increase of 6·7 per cent. The crop is young and it is too early to estimate the yield with any degree of accuracy.

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

Variety.	Area from 1st April to 25th November		Corresponding yield	
	1937	1936	1937	1936
1	Acs. 2	Acs. 3	Bales. 4	Bales. 5
Irrigated Cambodia	2,174	1,873	1,359	1,171
Dry Cambodia	2,452	2,275	532	494
Total Cambodia ...	4,626	4,148	1,891	1,665
Karunganni in Coimbatore ...	1,155	1,020	262	235
Uppam in the Central districts ...	270	290	49	47
Nadam and Bourbon	218	185	11	9
Total Salems ...	1,643	1,495	322	291
Tinnevellies*	3,260	3,110	839	801
Northerns and Westerns ...	10,410	9,610	1,117	1,111
Cocanadas	1,177	1,378	219	242
Others	70	80	9	10

* Includes Uppam, Karunganni and mixed country cotton in Madura, Ramnad and Tinnevelly.

The local cotton trade is not generally active at this time of the year. The average wholesale price of cotton lint per imperial maund of 82⅔ lb. as reported from important markets on 6th December 1937 was Rs. 18—15—0 for Cocanadas, Rs. 13—6—0 for Westerns (Mungari crop), Rs. 16—1—0 for Westerns, (Jowari crop), Rs. 22—15—0 for Cambodia, Rs. 24—1—0 for Coimbatore--Karunganni, and Rs. 18—10—0 for Nadam cotton. When compared with the prices published in the last report, i. e., those which prevailed on 8th November 1937, the prices reveal approximately, a fall of 12 per cent. in the case of Nadam cotton, 5 per cent. in the case of Coimbatore--Karunganni, three per cent. in the case of Westerns (Mungari crop) and one per cent. in the case of Westerns (Jowari crop) and a rise of approximately one per cent. in the case of Cambodia, the price of Cocanadas remaining stationary.

Figures of areas by varieties in the central districts and the south are given below:—

(Area in hundreds of acres, i. e., 00 being omitted.)

District.	Area under irrigated cotton mainly Cambodia.	Area under unirrigated cotton				
		Cambodia.	Uppam.	Nadam and Bourbon.	Tinnevellies.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Acs.	Acs.	Acs.	Acs.	Acs.	Acs.
Chingleput ...	Nil.	...	...	...	...	...
South Arcot ...	3	3,0	5,7	...	...	8,7
Chittoor ...	...	...	1	...	...	1
North Arcot ...	1	1,2	...	...	...	1,2
Salem ...	25,0	70,0	1,4	6	...	72,0
Coimbatore ...	(a) 144,0	66,0	(b) 110,8	21,2	...	198,0
Trichinopoly ...	13,0	20,0	14,0	...	...	34,0
Tanjore ...	Nil.	...	...	...	...	Nil.
Madura ...	24,0	69,0	...	...	73,0	142,0
Ramnad ...	12,0	9,0	...	...	129,0	138,0
Tinnevelly ...	9,0	7,0	...	...	124,0	131,0
Malabar ...	...	...	3	...	...	3
South Kanara ...	...	...	2	...	...	2
Total ...	227,4	245,2	132,5	21,8	326,0	725,5

(a) Includes 10,0 hundred acres of irrigated Karunganni.

(b) Includes 105,5 hundred acres of unirrigated Karunganni.

Cotton—1937—38—Intermediate Forecast Report—11th January 1938. Poor and insufficient rains during the North East monsoon period affected to some extent the Cocanadas cotton in parts of the Guntur district. Pickings of the mungari or early sown crop in parts of the Deccan are in progress and the yield is expected to be appreciably below normal owing to drought. The hingari or late sown cotton in the Deccan has also been affected by drought and the crop is reported to be withering or to have withered already in parts of the districts of Bellary and Anantapur. The condition of the crop is fairly satisfactory elsewhere in the province.

The wholesale price of cotton lint per imperial maund of 82⅔ lbs. as reported from important markets on 3rd January 1938 was Rs. 16—7—0 for cocanadas, Rs. 17--6—0 for white Northerns, Rs. 16-7-0 for red Northerns, Rs. 13—7—0 for Westerns (early crop), Rs. 15—13—0 for Westerns (Jowari crop), Rs. 21—9—0 for Cambodia, Rs. 24--1—0 for Coimbatore Karunganni, Rs. 19—7—0 for Tinnevelly Karunganni, Rs. 18 for Tinnevellies and Rs. 18—10—0 for Nadam cotton. When compared with the prices published in the last report, i. e., those which prevailed on 6th December 1937 these prices reveal a fall of about 13 per cent in the case of the Coconadas, 6% in the case of Cambodia, two per cent in the case of Westerns (late crop) and a rise of approximately one per cent in the case of Westerns (early crop), the prices of Coimbatore Karunganni and Nadam cotton remaining stationary.

Groundnut—1937—Fourth or final report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1935—36 has represented 47·7 per cent of the total area under groundnut in India.

The area sown with groundnut in the Presidency in 1937 is estimated at 4,564,800 acres. This is the highest area estimated so far. When compared with the corresponding estimate of 3,426,500 acres for the previous year and the actual area of 3,495,023 acres according to the season and crop report of the previous year, the present estimate reveals an increase of 33·2 per cent and 30·6 per cent respectively. The estimated area for this year exceeds the average area of 3,075,230 acres by 48·4 per cent. The areas reported in respect of the Circars, Cuddappah, Nellore, Chingleput, Chittoor, Salem, Madura, Ramnad, Tinnevelly and Malabar are the highest on record.

The increase in area is general. The area in the Deccan has increased from 1,203,000 acres in 1936 to 1,680,000 acres in 1937 i. e., by 39·7 per cent.

The harvesting of the summer and early crop of groundnut had concluded by the end of October. The harvesting of the winter or main crop is proceeding. The crop is expected to be normal in Tanjore and below normal in the other districts due mainly to drought, especially in Anantapur (64 per cent), Bellary (70 per cent), North Arcot (78 per cent) and Kurnool and Chittoor (80 per cent in

each). In Anantapur and North Arcot, the crop has also been affected by the attack of insect pests. The seasonal factor estimated for North Arcot is the lowest estimated in recent years. The seasonal factor for the Presidency works out to 83 per cent of the average as against 95 per cent in the previous year according to the season and crop report. On this basis, the yield is expected to be 1,902,300 tons of unshelled nuts as against 1,657,280 tons in the previous year, an increase of about 14·8 per cent. The yield in an average year is estimated at 1,540,280 tons.

The wholesale prices of groundnut (shelled) per imperial maund of 82⅔ lbs. (equivalent to 3,200 tolas) as reported from important markets on 3rd January 1938 was Rs. 4—10—0 in Cuddalore, Rs. 4—4—0 in Vizianagaram and Guntur, Rs. 4—3—0 in Erode, Rs. 3—15—0 in Anantapur and Vellore, Rs. 3—13—0 in Cuddapah and Coimbatore, Rs. 3—11—0 in Tadpatri, Rs. 3—9—0 in Nandyal and Bellary and Rs. 3—8—0 in Hindupur. When compared with the prices published in the last report, i. e., those which prevailed on 8th November 1937, these prices reveal a fall of 8 per cent. in Cuddalore, 6 per cent. in Vizianagaram, 5 per cent. in Nandyal, Bellary and Hindupur, 3 per cent. in Cuddapah and Erode and 2 per cent. in Coimbatore, the price remaining stationary in Vellore.

Castor—1937—First or final report. The average of the areas under castor in the Madras Presidency during the five years ending 1935-36 has represented 19·3 per cent. of the total area under castor in India.

The area under castor in the Madras Presidency up to 25th November 1937 is estimated at 240,800 acres, i. e., practically the same as the area of 240,100 acres estimated for the corresponding period of last year. The estimate for last year was below the actual area of 263,870 acres by about 9 per cent.

There was an increase in area in Vizagapatam, West Godavari, Cuddapah, Nellore, and the Central districts (Chittoor excepted) which was more than counterbalanced by a decrease in area elsewhere.

Yields below normal are reported from the Deccan, South Arcot, North Arcot, Tanjore and the West Coast and normal yields from the other districts. The crop has been affected to some extent by insect pests in Anantapur and by semi-looper caterpillar attack in parts of North Arcot. In Salem the yield which was expected to be above normal may come down to normal owing to caterpillar attack in parts of the district. The seasonal factor for the presidency is estimated to be 94 per cent. of the normal as against 92 per cent. in the previous year according to the season and crop report. On this basis, the yield is estimated at 24,000 tons as against 23,600 tons estimated for the corresponding period of last year and 24,580 tons estimated in the Season and Crop report of last year.

The wholesale price of castor seed per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 20th December 1937 was Rs. 5—7—0 in Vizagapatam, Rs. 5—5—0 in Vizianagram, Rs. 5—4—0 in Nandyal, Rs. 5—2—0 in Guntur, Rs. 4—14—0 in Salem, Rs. 4—10—0 in Hindupur, Rs. 4—6—0 in Cuddapah, Rs. 4—8—0 in Anantapur and Rs. 4—2—0 in Bellary. When compared with the prices reported in the previous year, i. e., those which prevailed towards the close of November 1936, these prices reveal a rise of about 10 per cent. in Salem and a fall of about 13 per cent. in Bellary and Cuddapah and 1 per cent. in Vizianagram, the price remaining Stationary in Vizagapatam.

Pepper Crop—1937—Final report. The area under pepper in 1937 in the districts of Malabar and South Kanara is estimated at 105,000 acres (96,500 acres in Malabar and 8,500 acres in South Kanara) as against the final area of 103,924 acres (95,492 acres in Malabar and 8,432 acres in South Kanara) in the previous year.

The condition of the crop is generally fair. The early setting in of the South West monsoon with a subsequent break gave rise to two flushings in most places and this affected the productive power of the vines in some measure. The seasonal factor is estimated at 90 per cent. of the average in Malabar and 95 per cent. in South Kanara as in the previous year. On this basis, the yield is estimated at 9,120 tons (8,340 tons in Malabar and 780 tons in South Kanara) as against the revised estimate of 8,900 tons (8,120 tons in Malabar and 780 tons in South Kanara) for the previous year.

The wholesale price of pepper per imperial maund of 82⅔ lbs. as reported from important markets on 3rd January 1938 was Rs. 12—8—0 in Calicut, Rs. 11—13—0 in Tellicherry and Rs. 12—14—0 in Mangalore. When compared with the prices published in the last report, i. e, those which prevailed on 6th September 1937, the prices reveal a fall of about six per cent. in Calicut and Mangalore and 14 per cent. in Tellicherry.

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1937 to 14th January 1938 amounted to 512,281 bales of 400 lb. lint as against an estimate of 497,120 bales of the total crop of 1936—37. The receipts in the corresponding period of the previous year were 626,009 bales. 438,870 bales mainly of pressed cotton were received at spinning mills and 207,378 bales were exported by sea while 111,229 bales were imported by sea mainly from Karachi and Bombay.

College News and Notes.

Students' Corner : Cricket. In connection with the Inter-divisional tournament, the Hindu College, Tinnevelly, met the Agricultural College on 22-12-'37 on the Forest College grounds, Coimbatore. Agricultural College won by an innings and 259 runs.

I innings: The Hindu College—13. (Dinker Rao 7 for 4 runs; Mukundan 2 for 8.)

The Agricultural College—330 for 6 wickets and declared. (K. K. R. Menon 115 retired, Dinker Rao 91, Rama Iyengar 43, Mukundan 28, Kothandaraman 26, G. Rajaram 17.)

II innings: The Hindu College—58 all out.

(D. R. Aiyyah 27, K. S. Ramaswami 5 for 6.)

A friendly match was played between the Scouts Recreation club and the Agricultural College on 9—1—'38 in which the Agricultural College won by 3 wickets and 36 runs.

Scouts Recreation club: (Ranganathan 29, Ramakrishnan 16, Gopalachari 10, Kothandaraman 6 for 41, Mukundan 2 for 14, Monnappa Hegde 2 for 20).

The Agricultural College: 140 for 7 wickets and declared (C. Ramaswami 43, Mukundan 30, Hegde 22 retired).

A friendly match was arranged between the Agricultural College and the Forest College on 13—1—38 in which the Agricultural College lost by 30 runs.

Forest College: 134 for 8 wickets and declared (Koppikar 50 not out, Holkar 26; Mukundan 3 for 31, Kothandaraman 3 for 19).

Agricultural College: 104 (Kothandaraman 37, C. N. Babu 32, Sheikh 4 for 23, Rodrigues 2 for 15).

Having qualified for the finals in the Inter-divisional tournament of the Madras University the Agricultural College met St. Aloysius College, Mangalore on 19—1—38 on the Marina grounds, Madras and lost to the Mangalore team.

I innings: St. Aloysius College 160 all out. Umesh Suvarna 31, Damodar 51, Dattatreya Rao 23, Bhaskar 22; Mukundan 2 for 45, Hegde 2 for 53, Kothandaraman 5 for 34

Agricultural College: 98. K. K. R. Menon 22, K. M. Shetty 19; Datta 7 for 34 (Including a hat trick).

II innings: St. Aloysius college—305. Albuquerque 67, Umesh Suvarna 45, Bhaskar 42, Damodar 43, Hegde 5 for 55.

Agricultural College: 113 (Nagaraja Rao 33, Dinker Rao 32, K. M. Shetty 28, Peter Aranha 5 for 22)

University Inter-Divisional Cricket. The residents of the Agricultural College Estate were treated to a two day cricket match between the St. Aloysius College, Mangalore and the Presidency College, Madras, when the teams met at the Agricultural College grounds on the 22nd and 23rd December. The Mangalore College won the game by 5 wickets. Scores: Presidency College 99, Swaminathan 14, Varadhan 18, R. Srinivasan 24, Dattatreya Rao 9 for 31 and 155 (Swaminathan 40, Varadhan 18, R. Srinivasan 24, Dattatreya Rao 9 for 31 and 155 (Swaminathan 40, Pinto 17, Krishna Rao 16, Varadhan 15, Dattatreya Rao 4 for 65, Aranha 6 for 56) St. Aloysius College: 196 (Umesh Suvarna; Dattatreya Rao 70, R. Srinivasan 3 for 56 Shujet All 5 for 31) and 72 for 5 (Umesh Suvarna 27, Dattatreya Rao 27, Srinivasan 5 for 29.)

Cricket Honours. We are glad to note that Mr. K. Lakshmanan B. Sc. Ag. Assistant in Entomology, Imperial Agricultural Research Institute, was chosen to represent the Delhi and district provincial team against Lord Tennyson's team in a two day match at Delhi. Mr. Lakshmanan was the captain of the Agricultural College in 1934 and was a member of the college team during his three years' stay at the college.

We are also glad that Mr. C. Ramaswami, the all India Test Cricketer, was chosen for the second time to captain the Indians in the Madras Presidency match and distinguished himself by a brilliant innings of 63 runs. He has also been selected to represent Madras against Lord Tennyson's team in a three day match at Madras.

Students' Tour. The Second year B. Sc. (Ag) students, led by the Lecturer in Agriculture, went on tour to study agricultural conditions in the Fifth and Sixth Circles. They left Coimbatore on the 2nd evening and visited the following places, Aduturai (Agricultural Research Station), Vilar (Cashew nut cultivation) Trichinopoly (Grand Anicut and Sempet Tannery) Lalgudi (Sivagnanam Co-operative and Agricultural Society and Bank), Pudukottai (State farm and neighbouring villages). Madura (Sewage farm) Koilpatti (Agricultural Research Station) and Dindigul (grapevine, betelvine and tobacco cultivation, Spencer's Cigar Factory and Anguvilas factory). They returned to Coimbatore on 17th night.

New Year Honours: We are glad to note that the Government have been pleased to award titles of Dewan Bahadur in the recent New Year Honours List to Mr. C. V. Venkatramana Iyengar, a Patron of the Union, and Rao Bahadur D. Ananda Rao Garu, retired Director of Agriculture, Madras. We congratulate them on their well merited distinction.

Indian Science Congress: We are glad to learn that the honour of presiding over the Agricultural section of the Indian Science congress to be held at Lahore in 1939 has been bestowed on Rao Saheb T. V. Ramakrishna Iyer in succession to Rao Bahadur T. S Venkatraman, C. I. E., who presided this year both of whom are members of our Union.

Visitors. Sir Arthur W. Hill, Director, Royal Botanic Gardens, Kew, Dr. E. M. Crowther, Chief Chemist, Rothamstead Experiment Station, England and Dr. F. Crowther, Plant Physiologist, Sudan, who is the younger brother of Dr. E. M. Crowther, Dr. G. D. Tothill, Director of Agriculture, Uganda, and Professor R. Ruggles Gates, F. R. S. Professor of Botany, King's College, London, visited the college and Reasearch Institute and the several breeding stations during the month.

University Extension Lecture. Under the auspices of the University Extension Board, Coimbatore, Rao Bahadur M. R. Ramaswami Sivan delivered a lecture on Agricultural Colonisation as a measure of relief for educated unemployed, at the Agricultural College on the 20th January 1938. Mr. R. C. Broadfoot, Principal, presided.

Association of Economic Biologists, Coimbatore. The annual meeting of the Association was held on 17th January 1938. The following office bearers were elected for the year 1938.

President	Dr. J. S. Patel.
Vice-president	Mr. P. V. Ramiah.
Moffusil Vice-president	Mr. K. Ramiah, Indore.
Assistant Secretary & Treasurer	Dr. S. Kasinath.
Members of the Council	Messrs. P. D. Karunakar and K. M. Thomas.

Mr. M. C. Cherian who was elected as Secretary in 1937 continues as Secretary for the year 1938 also. After the business meeting and tea, the retiring president Mr. K. Krishnamurthi Rao, delivered his presidential address on "Science and the scientist".

An ordinary meeting of the association was held on 22nd December 1937 at which the following papers were presented:—

1. Induction of somatic mutations as a method of crop improvement in rice by C. R. Srinivasa Iyenger and S. Ramanujam.
2. India and present Cotton situation by V. Ramanatha Iyer.

Under the auspices of the association, Sir Arthur Hill, Director, Royal Botanical Gardens, Kew, delivered an address on the Royal Botanical Gardens, Kew, in relation to Botanical research in the Empire, on 18th January 1938, and Dr. E. M. Crowther of the Rothamstead Experimental station on Rothamstead Field Experiments, Old and New, on 19th January 1938. Professor R. R. Gates delivered a lecture on the 23rd instant on "Heredity in Man".

Weather Review—DECEMBER 1937.

During the month two troughs of low pressure were formed in the Bay of Bengal, one in the beginning of the first week, while the other in the middle of the last week. The first trough of low pressure which extended the whole length of the bay on 1st, began to lie on the Chittagong Arakan Coast on 2nd causing very heavy rain there and later got filled up. The second depression which formed with central region between the Andamans and Nicobars on 26th, intensified into a cyclone with centre near latitude 11°N longitude 94°E caused a record of 12" rain at Port Blair on 27th. The storm later weakened and disappeared.

The north-east monsoon revived during the second week, and caused local rain in south-east Madras with a few falls in the north Madras Coast, Madras, Deccan Madras Coast, South-east Madras and Mysore, while at the end of the third week it strengthened in the neighbourhood of Ceylon and remained active in the south Bay of Bengal till 25th causing few falls of rain in Malabar and south-east Madras.

Thundershowers and scattered thunderstorms were not uncommon in south-east and south Madras during the third week of the month.

Markedly low night temperatures prevailed in Mysore, southeast Madras, east Madras and the Deccan from 6th to 8th.

Rainfall was in large defect throughout the peninsula.

Chief falls of rain:- Madras 5·5".

Agricultural College and Research Institute, Coimbatore.

ADDITIONS TO THE LIBRARY DURING DECEMBER 1937

A. Books.

1. *Rice in Madras.* Ramiah, K (1937). 2. *Baumwolle (Cotton) A Monograph in German.* Kranzlin, G. & Marcus, A. (1931). 3. *Reis (Rice) A Monograph in German.* Prinsen-Winkler, H. (1926). 4. *Zuckerrohr (Sugarcane) A Monograph in German.* Oppenheim, J. D. (1931). 5. *Citrus Fruchte (Citrus Fruit) A Monograph in German.* Oppenheim, J. D. (1931). 6. *Appertizing or The Art of Canning.* Bitting, A. W. (1937). 7. *Report on the Cold Storage and Transport of Perishable Produce in Delhi.* India Imp. Coun. Agri. Res. Pub. (1937). 8. *A Guide in Farm Organization and operation.* Garry, L. F. (1936). 9. *Farm Records.* Hopkins, J. A. (1936). 10. *Agricultural Bookkeeping.* McNall, P. C. & McMurry, K. F. (1937). 11. *Practical and Legal Aspects of Consignment Marketing in 2 vols.* Newton, C. R. (1935). 12. *The Law of Cooperative Marketing.* Evans. F. & Stokdyk, E. A. (1937). 13. *Egg Farming* Thompson, W. C. (1936). 14. *The Madras Cooperative Manual. Vol. I Revd.* Austin, T. (1937). 15. *Cloud Atlas. 2nd Edn.* India Meteorological Dept. Pubn. (1937). 16. *Silicate Analysis.* 17. *Standard Methods of Water Analysis. 8th Edn. Revd.* Groves, A. W (1936). 18. *Structure and Composition of Foods, Vol. III–Milk, Eggs, Meat and Fish* Winton, A. L. & Winton, K. B. (1937). 19. *Phytohormones.* Went, F. W. & Thimann, K. V. (1937). 20. *Floral Morphology. Vol. I.* Saunders, E. R. (1937). 21. *An Outline of Cytological Technique for Plant Bresders.* Eng. Imp. Bur. of Plant Genetics Pub. (1937). 22. *A Glossary of Genetic Terms.* American Genetic Assn. Pubn. (1937). 23. *A Manual of Entomological Equipment and Methods. Part 2.* Peterson, A. (1937). 24. *Three Thousand Mycological Terms,* Snell, W. H. (1936).

B. Reports.

1. Madras Agricultural Department Subordinate Officers Report, 1936--37. 2. Madras Agri-Horticultural Society Annual Report for 1936—37. 3. Jammu and Kashmir Province Agricultural Department Annual Report for 1935--1936. 4. Season and Crop Report of Burma for 1936--37. 5. Mauritius Agricultural Department Annual Report for 1936. 6. Nigeria Agricultural Department Annual Report for 1935. 7. North Borneo Agricultural Department Annual Report for 1936. 8. St. Lucia Agricultural Department Annual Report for 1936. 9. Canada National Research Council Annual Report for 1935--36. 10. Nebraska Agricultural Experiment Station Annual Report for 1935. 11. Nebraska State Board of Agriculture Annual Report for 1936.

C. Special Publications and Proceedings.

12. Proceedings of the Association of Economic Biologists, Coimbatore, 1936. 13. Technological Reports on Standard Indian cottons, 1937. I. C. C. C. Pubn. 14. Proceedings of the 24th Indian Science Congress (Hyderabad) 1937. 15. Report of the 26th National (U. S. A.) Conference on Weights and Measures, 1936. 16. First Annual Report on Tobacco Statistics 1937. (U. S. Agri. Dept. Stat. Bull. 58). 17. Fats, Oils and Oleagenous Raw Materials.--Statistics relating to Production, Prices, Trade etc. 1912--1935. (U. S. Agri. Dept. Stat. Bull. 59). 1937.

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