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

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BETEL VINE

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PART I.

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Introductory

In more ways than one, the Betel vine is a peculiar and unique crop. Neither a food stuff nor a textile, it is yet, in our country as important as the cereals, the pulses, the millets, the sugarcane and the cotton. In a sense it is even more valuable than any of the aforementioned since it is an essential factor in the social and religious life of Indians. It is to Indians what the wine is to the Italians and the French. It is the token of hospitable welcome to the guest and emblem of good will at parting. No religious ceremony of the Hindu, whether it be a worship at an altar or festivity at home, is considered complete without the betel leaf functioning. It is the alpha and the omega of every ritual, performed by the pious Hindu.

Is it a marriage that you are celebrating with pomp and show? Then distribute pan to the assembled guests. Is it a Tea or a dinner you are giving to one to whom you manifest good will at a farewell function? hen let Betel leaf be the last item on the programme. Have you nothing ..se to give to the sweating labourer or the dirty scavenger? Then give him some betel, and he departs grinning his satisfaction, more pleased than if you had given him a blank cheque.

The Betel leaf knows no distinction of caste or creed. Curiously, it is one of the few items of consumption which is beyond the pale of pollution. It is sacred and held in veneration. It is a sign of prosperity and of Goddess Lakshmi smiling all her benignant favour. Between the timid bride and the nervous bridegroom on the nuptial night, it is a link of introduction for future

bliss and concord, and every Hindu wife feels proud of her right to give the leaf to her husband in preference to any other woman. The proud father announces his first born son through the medium of betel. In out of the way places and during dull journeys betel is the 'Sesame' that opens doors of strangers and starts new acquaintances. High or low, rich or poor, young or old, man or woman, the betel exerts the same fascination over all, and there is not one who is not pleased with a gift of *Thambulam*.

What indeed are the charms whereby betel holds sway over all. O, Betel, art thou indeed, yet another emblem of the mystic east, the land of charms and spells? So cheap and yet so dear, what indeed is the mysterious power that opens doors at your approach and pouring oil on troubled waters, knits again sundered friendships in peace. Thou dost leave a stain on teeth, it is true, but why is it men prefer thee in ailment and give the cold shoulder to the Dentist. Inexplicable, but none the less felt, are your powers, and oh that I were a De Quincy to immortalise you in the archives of literature with my 'Confessions of a Betel chewer'!

The Betel leaf is in fact one of the most readily available remedies in common ailments. Medical authorities say that is a stimulant, digestive, carminative, expectorant and a counter-irritant. It would be difficult to find another drug in British or Ayurvedic pharmacopœia, which has such various and diversified functions and such a cosmopolitan love for the eradication of different diseases. The Roman Emperors in their days of glory would never have had recourse to emetics, if they had known the soothing influence of betel after a Bacchanalian feast. If the drowning man will catch at a straw, no less true is it that the indiscreet diner who has feasted well but not wisely, will as eagerly turn his longing eyes to Betel.

It is not indigestion, but cold and cough and congestion at the chest that the patient is suffering from. At once comes the grandmother's recipe, 'chew some betel, crush the juice out and take it in'. She believes, it is an infallible expectorant and will bring the phlegm out from the stuffed throat. It is neither indigestion nor cough, but an ulcer neglected on the foot that is the source of all the trouble. The betel now adapts itself to the changed conditions and functions with the co-operation of a little oil, as an excellent ointment. In fact there is no part of the human anatomy, external or internal that in its disordered state cannot but be benefited by the requisition Dr. Betel who soothes as he heals, and who available at all hours of or night never sends his bills.

Besides all these traits enumerated, the Betel leaf is supposed to be an aphrodisiac. Possibly, the ancients recognised it and that is why, it is an emblem of married life and the privilege of chewing is denied to ascetics and widows. It is curious that the leaves should possess this property, for authorities say that the roots crushed in water and administered, cause sterility in women—an effect exactly contrary to that produced by the leaves. Can it be that during the flow of the sap from the root to the leaves, some internal rearrangement of molecules and atoms is brought about resulting in the possession and manifestation of different properties. Here is indeed a problem to the philosopher and the scientist. Yet one more aspect, which if unravelled will add another plume to man's feathers.

Botanically, the Betel vine plant affords great interest to the student. It belongs to the family *Piperaceæ*, a natural order that revels in the tropics where a bright sun with good rain and moist situations smiles. To the same family

belong pepper, long pepper and tailed pepper, spices for which the east and the Far East have been famous from the days of Vasco de Gama, and for which adventurous spirits of the West, have braved the danger of the sea and the storm. It only differs from the other members of the genera, in that, while they are cultivated for their fruits and seeds, betel vine is raised for its yield of leaves alone.

The Betel vine is a very graceful creeper, which requires a moist situation without undue waterlogged condition and with very good facilities for drainage. It is a perennial, but under cultivation the growth is limited to a number of years ranging from three to ten. Stem and branches are fairly stout, leaves are stipulate, cordate at base, and vary in length from 3 to 9 inches, petiole is thick and ½ to 1 inch long. Inflorescences are spikes called catkins, containing male or female flowers, the females being longer than the males. Most of the plants are female, fruit and ovary are undeveloped and are cylindric and pendulous. Evidently, like the pepper, the betel also originally must have developed and matured normal fruits and seeds, but ages of cultivation by man, and the vegetative reproduction to which it has been subjected, has probably killed or at least suppressed the instinct of propagation by seeds. If such should really be the case, it is a great piece of wonder, that a plant should have adapted itself to be of most service to mankind.

Except in the far north and north-west, Betel is grown in almost every province; Bengal heads the list with about 50,000 acres under cultivation, while Madras follows next with 27,970 acres, Bombay and Central Provinces coming next in order, in total area under cultivation. In Bengal however, the chief variety grown along the Hoogly river is a coarse one, and a fine variety known as *Ramtek-karpuri* is grown only in a limited area. Central Provinces leaves are famous for their quality, and large quantities are even exported to Calcutta. In Bombay the chief centres of cultivation are Poona and Dharwar, and one variety known as the *Ramtek-karpuri* is valued very highly.

In Madras Betel is grown in almost every district although, Malabar, Tanjore, Coimbatore and Madura grow the largest amount, about one-half of the total area in the Presidency being covered by these four districts alone. Malabar 4,896, Madura 2,478, Coimbatore 2,190, Tanjore 2,160.

There are any number of varieties in betel leaves, depending on the colour, size, shape, feel, texture and chewing quality; the last named is the most important and very often leaves of a particular chewing quality, carry with them the other factors mentioned. The chewing quality again depends on the consumer whether he uses tobacco with his chew or not, for, if he does, he usually prefer, a thick dark pungent type which gives the necessary volume in the mouth, even if half a betel leaf is used. Delicate mouths, however, prefer the light coloured and comparatively insipid quality.

The common varieties in the Coimbatore district are *Karpurakodi*, *Kallaskodi*, *Vattakodi*, and *Chittukodi*. The first named as its name implies smells like camphor, is light green to greenish yellow in colour, linear in shape, and is the most attractive to the novice. *Kallaskodi* is the most common variety in the market but even in this there are many grades; it is usually dark green, coarse-textured and very pungent, but leaves from an older crop get lighter in colour, finer to the feel and less pungent to the taste, so much so, that the usual vellai vettalai of the market are really leaves from an old garden of *Kallaskodi*. The Kallas leaves are much broader than the *Karpurakodi* which taper to the tip more suddenly.

The *Vattakodi* leaf is a big one in size, more circular in shape than the other varieties, and probably because it has a larger surface keeps much longer than the others. It is in fact valued for this keeping quality, and, in out of the way villages far from betel vine gardens, where the weekly shandy is the only source of replenishing stores it is the most common variety, beyond the village fairs, therefore, it rarely finds a market.

The *Chittukodi* is the most aristocratic leaf of the lot. It is small in size, velvety to the touch, and very agreeable to the taste, neither very insipid nor very pungent. It however does not keep long and unless there is a market immediately after the harvest it is not very profitable to cultivate.

There are other varieties grown in other districts but they are probably only types of the four in Coimbatore. Thus in Malabar, where almost every chewer uses tobacco, the variety mostly cultivated is very much like the *kallas* type, big, dark and thick. The famous Kumbakonam leaves available even in the Madras Market is very much like the *Chittukodi*, while similar is the case with the *Ravase Vettalai* of Madras which is supplied by the gardens of Poonamallee. Other places in the Presidency famous for their good quality leaves are Tiruppuvanam in Madura, Tenkasi in Tinnevelly and Nellimarla in Vizag. The leaves of Tiruppuvanam are famous for their thinness and soft texture, it being contended that even a hundred leaves could be chewed at a time, without inconvenience.

The methods of cultivation of Betel vine vary in details with the localities, but in the main, they depend upon the nature of the plant itself and the system of land tenure. Below is given a detailed account of the cultivation, as it is practised in Vellalore and adjoining villages of the Noyyal tract in the Coimbatore District.

Notes on Betel Vine Cultivation

Land

The cultivation of the Betel vine is a joint stock concern. The land taken out on lease by one man, who takes into partnership with him, other individuals who are allotted the several pieces or '*pullis*' as they are called, by means of a lottery. By this system, each man is assigned from half to one 'pathi' according to his means; a *pulli* is the local unit and is roughly about 14 to 15 cents in area. The man who takes the land on lease, gets his portion free of rent, the rental value varying from 120 to 150 rupees, although in places near Singanallur it goes up to even Rs 200 per acre. If the rental value is high, the number of *pullis* per acre is increased thus enabling a greater number to participate in the concern. This is done by the rows being put nearer than usual. Consequently the number of *pullis*—which by the way is a linear unit measured along the rows—is increased. Sometimes, the nature of the soil also determines the space between the rows; in a clayey soil the ridges can stand firmly even when they are close, but in a loose soil a larger interspace will be required to keep the ridges intact.

Rotation

Betel vine usually follows paddy the usual local rotation being sugarcane one year, followed by paddy one year, followed by betel vine for three years.

Cultivation

No ploughing is given but rows are marked and therein the land is thoroughly dug with up mamotti; the clods are then broken, and the soil weeded and levelled, all by hand. This levelling is done about a week after the mamotti digging. Then about the month of *Adi* (July–August) *Agathi* seeds are sown in clusters of four or five, all along the rows, at a rate of about 10 to 12 m. m. per acre. It is usually supposed that a new moon day is best for sowing *Agathi*. Sometimes along with the *Agathi*, are sown also *Gogu* and *Moringa*, the former for fibre and the latter for standards, plantain suckers also are planted after this, generally one at each end of the row. The land is then fenced with thorn and cuttings of wild cane (*Saccharum*) are planted to mark off the fence.

After sowing the agathi seeds, the whole land is flooded and then drained, after the sprouts come up another watering is given, one point to be noted being that *agathi* in the early stages does not stand water-logged conditions.

Depending on the nature of the soil and the growth of the agathi, trenching is done fifteen days to one month before the planting of the vines. Then the agathi leaves at the lower nodes and axillary branches are plucked off to induce tall growth and this plucking is done about once a month.

Planting

This is done in *Aippasi* (November-December). Just before planting water is let in and after splashing over the rows, a digging is given close to the base of the *Agathi* stem. Cuttings from one year old gardens are preferred and about forty to forty-two thousand are required per acre, the cuttings have about three nodes each and are planted in doubles and water is splashed on to them immediately after planting (irrigation for betel vine is always done by splashing). A few days after, another trenching is done. Irrigation is then given on alternate days for about a week more and then as often as the crop requires, usually one per week in cold weather the crop requiring humid conditions, free drainage, and copious irrigation.

Manuring

Manure is not usually applied before planting but a fortnight later, a dressing of 15 cart loads of cattle manure is given, three or four doses are then applied during the growth of the crop the second dose in the following July-August just before the first picking, the third in December before pruning and the fourth sometime in the third year. Depending on market requirements, when it is necessary to keep the crop longer, another dose also may be applied. Calotropis leaves and green manure dressings are given also at four to six cartloads per acre per time, four or five times. *Kolinji* leaves are preferred to other dressings, because they are supposed to give a colour to the leaves. Three months after planting (in February-March) when the *agathis* are about twelve feet high they are pollarded and before the break of the south-west monsoon they are grouped and arched. Blanks in the *agathi* rows are filled up by bamboos. Weeding and irrigation have to be done as often as is necessary, the former usually one in two months.

It takes about a month after planting to know if there are any blanks and these are then filled up. As they grow the vines have to be tied at every node to the *agathi* stem. This is done very carefully keeping the vine at the

back of the *agathi*, and tying loosely the knot always coming on the *agathi* stem. After the first year the tying is not done.

The first picking—virgin picking as it is called—comes about July-August when the crop is about eight to nine months old, and then a picking is given once a month. In December, the crop is given a pruning to induce more axillary branches and leaves to be given off.

Yield

Usually the crop gives 4500 to 5000 palagais of leaves during the three years, a palagai consisting of 2000 leaves.

Economics

A rough balance sheet of the crop (appendix) shows a profit of about Rs. 1500, per acre for three years. This must mean very small profit per annum to the several participants in the concern. But, although the yield and the corresponding outturn, may not be much increased, the expenses in actual practice get diminished, for the cultivator does most of the work himself. The items shown under 'tying vines', 'watch' &c., in the cost of cultivation, are attended to by the ryot and other members of his family. Also, the ryot manages his labour to very efficient limits, by providing perquisites for the coolies. Most of the work in the betel vine garden like trenching etc., is done by contract. During the planting season, a cooly is given a midday meal for collecting 100 cuttings and planting them properly. During harvest, a cooly is given a 'cowley" (200 leaves) of leaves, for every 3 palagais of leaves, that he picks and packs ready for the harvest. Besides, the auxiliary crops like vegetables, which the ryot raises, are a by-product source of revenue for him, and some of the expenses like, cost of bamboos, fencing, thatties are permanent. Thus his profits are very much more than is actually seen on paper.

Diseases

Batel vine is subject to the attack of various diseases, which go by expressive names in the locality. The most common and disastrous is the one known as the '*Karunthal*' (black stalk—literally). The plant gets black and mouldy, and the whole vine dries up and dies. A garden badly affected by this disease presents a black appearance, with all the plants—foliage, stem and all—dried up and drooping. Another disease called the *Vellai Narakkai* (white greying disease) makes the plants stunted in growth and sickly; the leaves get quite pale and are attached very weakly to the nodes, a gust of wind sufficing to break them loose. A third disease which is not so common as these two and is rather sporadic in its appearance is known as the '*Kollikkattai Noi*' (firebrand disease). Plants attacked by this, look as if they have been scorched by fire; the lips and edges of the leaves first dry up, and then the withering spreads to the whole plant. These are the common diseases found in the Vellalur tract.

Reports have been received from Poonamallee of a serious disease, which causes wholesale destruction of betel-vine crops; this is supposed to be caused by a *phytophthera* fungus, and the disease and remedial measures are being investigated into by the Mycologist.

Insect pests. Insect ravages on betel vine, of a serious nature, have not so far been noticed in the south; but during recent years, reports have been

received from the Tungabhadra Valley, of the enormous amount of loss caused to the crop by a certain bug, which infests the tender portions of the plants in swarms and sap away the crop out of existence.

It has not been found to cause any damage to betel gardens in the south, although the bug has been noticed attacking the *Karpurakodi* variety alone, rather violently, during some seasons.

The cultivation of betel vine does not differ in its essentials, in other parts of the country from the method followed in Coimbatore district, as, it depends largely on the peculiar nature of the crop itself. Thus in Bombay, instead of *Agathi*, *Erythrina* stems are used as the standards, on which, the vines are trained and tied. In Bengal and in some parts of the northern circar, as also in some places in Malabar, bamboos are used exclusively as the standards. In North India, betel vine is not grown as a three year crop as in the south, but after three years the vines are released from the standards and the top portions coiled into the soil, and from these a fresh crop arises, thus having more or less a perennial growth.

Everywhere, irrigation is always done by splashing, as the crop is a delicate one and cannot stand water-logging to any extent. In certain parts of Central Provinces, it is reported that artificial shades are provided above the crop to protect it from the severe sun. It would appear, that betel vine gardens are so cool and comfortable that not infrequently cheetahs and tigers come in for a slumber into the shade.

If there is one crop in India, about which there are superstitious associations, and which is treated with veneration, not only by the cultivators, but by the masses themselves, that surely is the betel vine. Throughout the country, north or south, the cultivation is done, with strict adherence to rules and ceremonies, and in Bombay and Central Provinces, only certain castes are allowed to grow the crop, and they are treated with great respect by the others. In Tanjore district, the crop is grown almost exclusively by Muhammadans. In certain parts of South India, Brahmins are not allowed entry into the betel-vine gardens, and most ryots do not allow shoes or sandals to be worn inside, by anyone. It is reported that in Central Provinces the vines soon after planting are given an unusual luxury—they are fed with milk. Many of these superstitious ideas are slowly disappearing, it is true, but still the idea of religious respect is yet there, the crop being considered as an incarnation of Goddess Lakshmi herself and any sacrilege perpetrated within the precincts of the garden, is supposed to bring positive punishment to the wrong doer.

Quaint and very expressive, are many of the terms used by ryots in the cultivation of the crop. *Sadaikkal* (garden with tresses when only the *agathis* have been planted), *Ilangal* (infant crop), *Muthikal* (mature crop), *Vaippuvai munn* (cuttings covering earth), *Kannippari* (virgin picking for the first harvest), *Kondai Vettuthayhai* (topping from *Agathis*), these and others terms, so self explanatory and suggestive, testify to the ability of the ryots to add to the vocabulary, convenient and intelligible words and phrases.

It is difficult to write with any great accuracy about betel trade. By its perishable nature, the trade in betel has necessarily to be confined to places within the country and that too to parts, which are reachable by Mail or fast passenger trains, by a two days' journey at the most, from the gardens. Two or three factors which govern marketing are however obvious. In cities like

Madras, Bombay and Calcutta, there is always a demand for nice and tender leaves, and no matter how far the gardens are, these towns get their requirements in any quantity. Other towns, where there is no such demand for such high grade leaves and which also have no gardens within easy reach, get thick, large leaves from distant places, as only this type of leaves keep for some time. Thus from Coimbatore, leaves are sent by train, to places like Sholapur, Hindupur and Tiruvannamalai.

As in the case of other crops, it is the merchants or middlemen (as they should be strictly called) that get much profit out of the crop. A little understanding between these middlemen, tells economically upon the poor ryots. The latter is compelled to harvest his leaves once every month, as, if he leaves them over even for two or three days, the leaves get rank, thick and wild and lose market value. He is therefore at the mercy of the merchants who dictate terms, and who sometimes even produce (by arrangement) telegrams from customers in distant places, cancelling orders and thus bring down a slump in the betel market. Other factors like growth of the crop during seasons, demand during the marriage months of the year and the age of the crop also operate to alter the price. Below is given a statement showing the price of betel leaves per palagai during the several months of the year 1926–27:

		Rs	A	P
September	1926	0	12	0
October	,,	0	9	0
November	,,	0	9	0
January	1927	1	4	0
February	,,	1	5	0
March	,,	0	15	0
April	,,	0	8	6
May	,,	1	4	0
June	,,	1	0	6
July	,,	0	12	0
August	,,	0	10	0
September	,,	0	14	0
October	,,	0	7	0
November	,,	0	6	0
Total	...	11	4	0
Average..		0	12	10

It will be seen that the price is lowest in October–November, rainy months, when the growth is quite luxuriant and there is not much demand. In December the crops get a pruning and in January and February, the leaves from the fresh flush get a higher price. During the dry months March–April, the leaves get also coarse and the price goes down again, although not so much as in September, October, as there will be more demand. During May, June and July there is again a rise as these are marriage months.

That betel leaf is bleached, is probably not known to many in South India, but bleached betel leaf is the chief ingredient in what is known as the 'Pucca Pan' in North India. The bleaching is done by a certain sect of people, who have developed the process almost to an art and keep their methods as a trade-secret. The process,—in outline—is very simple. A large number of healthy

leaves about 20,000 or more are neatly packed in baskets lined with wet plantain leaves or gunnies, with their petioles all cut off, and the baskets are then kept in a dark, but ventilated room for several days. Every day, the baskets are examined and leaves rotting or showing signs of rot are at once removed. In about a fortnight, the leaves get quite bleached and amber in colour. They are then removed, dried to drive off surface moisture and then stored; the leaves thus bleached keeping for quite a long time. Simple as it seems, great experience is required to select the healthy leaves, to sift and pick out the diseased one, and to regulate the temperature and moisture during the whole period. By bleaching, the chewing quality of the leaf is said to be improved and the bleached leaf is sold at a higher price—nearly double—than the unbleached one.

Dr. Mann and Messrs. Sahasrabudde and Patawardhan, of Poona were interested in the bleaching of betel leaf and conducted elaborate investigations into the process and the chemical changes occurring therein. As a result of their experiments they found that during the bleaching, there is an increase in the percentage of essential oils and the diastatic activity of the leaf. The higher chewing value of the bleached leaf is evidently due to this increase.

Appendix

	Rs	A	P
Preparatory cultivation			
Digging in lines, with Mammatti, usually given by contract at 12 annas per *pulli*	5	4	0
Breaking clods and levelling, 10 men per acre ...	5	0	0
Total ...	10	4	0
Manures and Manuring			
60 cart loads of cattle manure at 2½ to 3 rupees per cartload inclusive of carthire (applied in 3 or 4 dozes) ...	160	0	0
Cost of application cleaning, powdering and spreading, 100 women per acre	30	0	0
Green leaves 25 to 30 cartloads at 5 rupees per cartload ...	150	0	0
Carrying and applying	10	0	0
Total ...	350	0	0
Seeds and Sowing			
Agathi seeds, 10 M.M.	15	0	0
Sowing *agathi*—8 men per acre	4	0	0
Auxiliary crops			
Plantains, 500 per acre at Rs. 2–8–0 per 100	12	8	0
Carrying and planting plantains	3	0	0
Wild canes for fence, 1,000 cuttings	7	8	0
Other crops	30	0	0
Betel vine cuttings 42,000 per acre at Rs. 5 per 1.000 ...	210	0	0
Planting	25	0	0
Filling up blanks and cost of planting (500)	2	8	0
Total ...	309	8	0

	Rs	A	P
After-cultivation			
15 to 15 weedings throughout the crop period, 100 women and 100 men per aere	75	0	0
Trenching and earthing up 12 to 15 times at 9 annas per pulli	50	0	0
Raising and trimming edges about 15 to 20 times, 10 annas per acre	90	0	0
Mamnatti digging along the rows after planting at 6 annas per pulli	3	0	0
Tying vines	300	0	0
Tying *agathi* bowers 3 times	25	0	0
50 head loads of plantain fibre	100	0	0
3600 bamboos	200	0	0
Wind breaks			
200 *agathi* trees	20	0	0
40 men per acre	20	0	0
Coconut leaves 50 head loads	25	0	0
Fencing, bringing thorns	15	0	0
Total ...	923	0	0
Watchman for 1½ years (will look after 2 to 3 acres) ...	100	0	0
Irrigation			
Splashing 400 men for 3 years	200	0	0
Mhoting for 10 months for the 3 years	300	0	0
Total ...	500	0	0
Harvesting			
Harvesting, packing, sorting etc. 4,800 *palagais* for 3 years	800	0	0
Agathi leaves and topping off and on	75	0	0
Miscellaneous crops	50	0	0
Total ...	925	0	0
Cleaning of the land	15	0	0
Digging up and levelling—60 men	30	0	0

Expenditure

	Rs	A	P
Preparatory cultivation	10	4	0
Manures and manuring	350	0	0
Seeds and sowing	309	8	0
After-cultivation	923	0	0
Watch	100	0	0
Irrigation	500	0	0
Harvesting	925	0	0
Clearing and levelling of the land	45	0	0
Total ...	3,162	12	0

Receipts

	Rs	A	P
Betel leaves at 1 Rupee per palagai	4,000	0	0
Agathi leaves	200	0	0
Cuttings sold	200	0	0
Plantains	500	0	0
Vegetables	50	0	0
Agathi trees for fuel	75	0	0
Total ...	5,025	0	0

PART II

During recent years, there has been considerable deterioration in the quality and quantity of betel leaves produced in the gardens along the Noyyal river, in Coimbatore district : the outward manifestation of this deterioration, has been the prevalence of one or more diseases attacking the betel crop, the chief of them being the *Karunthal* disease, which has been responsible for the wholesale destruction of the crop in many gardens. With a view to investigate into the diseases and, if possible, to suggest remedies for checking, the Department opened the Betel-vine Experimental Station, at Vellalur in the year 1924.

Vellalur is a typical betel growing and betel trading village, about three miles to the east of Podanur Junction, and the site selected for conducting the experiments was one of the worst affected gardens in the locality. The cultural operations and the administrative work connected with the Station are under the immediate charge of the Deputy Director of Agriculture, VIII circle, while experiments are being conducted by the Mycologist, Entomologist and the Agricultural Chemist. While each is attacking the problem with special reference to his point of view, the three experts collaborate their results and are engaged in finding out what is responsible for the diseases and how they can be checked. It is proposed in this paper to give in detail, the nature of the experiments conducted by the Chemist and the results achieved so far.

One chief feature of betel-vine cultivation in this tract, is the extreme waterlogged nature of the soil. In close proximity to the tanks or the

channels of the Noyyal river, and consisting mostly of clayey soil, the land gets saturated with water, and it is not unusual during the moonsoon months when the tanks and water-ways are quite full, to see the fields submerged under water; and though betel-vine requires enormous quantities of water during its growth, it is quite possible that this excess of water and the defective drainage conditions that prevail have a great deal to do with the incidence of disease and the lowering of yield. The most important investigation, therefore, that was started by the Chemist was to study and improve the drainage facilities and see how the yield of leaves was affected thereby.

The drainage experiments

Before going into the details of the lay-out of the experiments in the several plots, it will be necessary to recall for a moment, some of the existing methods in the cultivation of betel-vine as adopted by the ryots locally. We have seen already, how the vines are planted on either side of the ridges at the bases of the *agathi* plants, and how as they grow, they are tied on at the nodes to the *agathi* stems, which have been arched together at the top to form a bower. Periodically the trenches between these ridges get deeper and deeper, as the soil from there is dug up and earthed on over the growing vines on the ridges. Thus the depth of the trenches, becomes in fact a gauge for measuring the age of the crop, for what at first was more or less level land with the *agathis* grown in was arched and gets at the end of the three years when the betel crop is pulled out, into a number of ridges and furrows.

It will thus be seen, that this essential feature of betel-vine cultivation which entails the cutting up of the land into ridges and trenches, is in itself an advantage, since, the vines are always grown on ridges, and the trenches in between afford facilities for drainage. But during the growth of the crop, there is a limit to the depth to which these trenches are dug, and consequently to the height to which the ridges could be raised with the earth so dug out.

Let us suppose that during the growth of a betel crop, these ridges get raised—as is followed locally—to a height of $2\frac{1}{2}$ to 3 feet above the trench level. If side by side with these, we could have ridges raised with earth, to a height of two feet more, than is done locally, then by comparing the yields of betel grown on the local ridges with those grown on the 'raised' ridges, we have a means whereby we can say whether drainage is the defect for, by raising we improve drainage, and if raising gives a better yield, then bad drainage was the defect, that this raising cancelled the effects of.

It is this principle that is worked out in the lay-out of plot 5, in the betel-vine station. The whole plot is 35 cents in area, and consists of 31 ridges or 30 arches (*agathi*) running north to south, the ridges being numbered from west to east. Every three alternate ridges here have been raised with earth brought from outside, to a height of $1\frac{1}{2}$ feet more than the others, which are of the height usually adopted in local practice. Thus we have three local ridges, then three 'raised' ridges, then again three 'local' ones and so on. But, for purposes of record of yield, the arches are our unit, each arch being made up of rows of vines grown on two ridges on either side of a trench. Thus we see that every third arch is made up of vines, one half from a 'local' ridge and the other half from a 'raised' ridge. These therefore have to be discarded for experimental interpretation. We are then reduced to this

2 L's—1 LR—2 R's—1 RL—2 L's and so on.

Rejecting the alternate ones, we have
2 L's—2 R's—2 L's and so on.

Thus we have 5 series of 'locals' and 5 series of 'Raised' each series consisting of two rows. The series have been numbered from west to east, and the first series in Plot 5, is a 'local'.

Thus in the end we have
* L I, R I, L II, R II, L III, R III, L IV, R IV, L V, R V.

In addition, the experimental rows have outskirts all round, and another cutting of them into two halves—the northern and the southern—while recording yields these halves are harvested separately and the advantages of this procedure are obvious. While serving as duplicate of the same treatment, they enable one to get an idea of the fertility of the land, not only as we go from west to east, but also from south to north. With these preliminary remarks about the lay out of the plot, we can now take up the monthly harvest yield and discuss the figures.

The crop on plot 5 was planted in December 1926 and the first picking was done in September 1927; from then onwards it was harvested every month (except in December when it was given a pruning) until December 1927 when it was pulled. Below are given the yields of the 'local' and the 'Raised' rows, for thirteen harvests:

STATEMENT I

Number of harvest	Month of harvest	Raised Rows R lbs.	Raised Rows R oz.	Local Rows L lbs.	Local Rows L oz.	Percentage increase of R over L
1	September 1926	14	11	10	6	41·6
2	October ,, ...	32	$13\frac{3}{4}$	23	$6\frac{1}{2}$	40·4
3	November ,, ...	51	$6\frac{1}{2}$	33	$2\frac{1}{2}$	55·0
4	January 1927	55	9	38	5	45·0
5	February ,, ...	47	5	37	$15\frac{1}{2}$	24·4
6	March ,, ...	53	$6\frac{1}{2}$	44	11	19·5
7	April ,, ...	109	1	72	7	50·6
8	May ,, ...	159	2	103	14	53·2
9	June ,, ...	132	9	96	4	37·7
10	July ,, ...	160	14	132	4	21·6
11	August ,, ...	...	...	...	...	...
12	September ,, ...	137	$10\frac{1}{2}$	136	6	0·9
13	October ,, ...	105	8	100	5	5·2
14	November ,, ...	88	10	73	$12\frac{1}{2}$	20·1
	Total ...					

* L I=I series 'Locals'.
R I=I series 'Raised'.

It will be seen from the above statement that except in September and October 1927, all the other months the 'raised' rows shew a distinct percentage increase over the 'local' rows and for all the harvests together show a percentage increase of 27 over the 'locals'. The figures for the 12th and 13th harvest were when the crop had already reached the decadent stage, just before being removed from the field. Taking the other month's figures, it will be seen that superiority of the 'raised' rows to the 'local' rows is emphasised during the wet and rainy months, while during the dry months (February and March for example) the percentage increase of the 'raised' over the 'locals' is going down.

So far for the yields of all the 'raised' rows as compared with the yields of all the 'local' rows. Below is given a statement of yields from each series of 'raised' and 'local' in plot 5, for all the 13 harvests together:

STATEMENT II

Statement showing the yields of 13 harvests of each series 'raised' against corresponding series of 'locals'

Heading	Raised Rows lbs.	oz.	Local Rows lbs.	oz.	Percentage increase or decrease of R over L
1st series R-1 and L-1 ...	493	12	337	13½	45·88
2nd series R-2 and L-2 ...	360	14½	339	11	5· 9
3rd series R-3 and L-3 ...	143	0	157	10	—9· 5
4th series R-4 and L-4 ...	125	0	39	11	110· 3
5th series R-5 and L-5 ...	25	15¾	28	5½	—9· 9
Total ...	1148	10¼	903	3	27· 4

It will be seen from this statement, that the 3rd and the 5th series of the experiment give a negative result, and what proved to be a score for the 'raised'. When we considered all the 'raised' against all the 'locals' (as in statement I) appears to get a set back by the behaviour of these two series, 3rd and 5th. In other words, if we consider the experiment in Plot 5 as a pentaplicate repetition of 'raised' versus 'locals', we find that the 1st, 2nd and 4th series decide very favourably for the 'raised' while the 3rd and the 5th series show the 'locals' to be superior; but that this negative evidence is more than counterbalanced by the positive results of the other three series, so that on the whole the 'raised' show a percentage increase of 27 over the 'locals'.

This line of argument will lead to no strong evidence in favour of the 'raised' over the 'locals'; and the experiment must be considered a failure; at best it cannot be looked upon as a decided success. But when we scrutinize the figures and attempt to find a reason for the contrary behaviour of these two series alone (3rd and 5th) we shall see that this apparent negative result, is really a positive one and adds one more link to the chain of argument, whereby it is proved that the 'raiseds' are certainly better than the locals.

For this, we have to take the figures of harvest of plots 4 and 3 corresponding to those of plot 5. There the plots lie immediately to the south of and contiguous to plot 5, and contain exactly the same number of rows similarly laid out as in plot 5; only all the beds are of the same height, namely, that of the locals in plot 5. In a sense, therefore, these are control plots, and the variation in yields of the rows as we go from west to the east (i.e. from series to series) of these two plots should give an indication of the slope of fertility and a possible clue to the curious behaviour of series 3 and 5 in plot 5.

It has already been said that in plots 3 and 4, there are no experiments. But taking the rows in these, corresponding to the raised and the local rows in plot 5, and working out the percentage increase or decrease, exactly as we did in plot 5, we get the following statement:

Statement III—showing percentage increase or decrease of R over L—compared from the yields of Plots, 3, 4 and 5.

Heading	Plot 3	Plot 4	Plot 5
Whole plot ...	—6·1	—5·0	27·4
Southern half ...	—3·0	—6·3	26·7
Northern half ...	—9·6	—4·0	27·3
1st series ...	5·5	17·9	45·4
2nd ,, ...	—2·4	—13·4	5·9
3rd ,, ...	5·1	2·1	—9·5
4th ,, ...	—27·5	—28·7	110·3
5th ,, ...	—19·7	—65·7	—9·9

N.B.—Figures in negative are those where R has failed against L.

It will be seen at a glance, that the Raised's of plot 5 have scored distinctly against the corresponding rows in plots 3 and 4. Series 3, which gave a negative result (see statement II) need not disturb us any more, for the negative result is evidently not due to the experiment, as corresponding series in plots 3 and 4, show that something in the land itself is responsible; and as regards series 5 of plot 5 which gave a negative value (—9·9), scrutiny will show that is really much less negative than the 5th series of plots 3 and 4 and is thus positively indicative of the superiority of the Raiseds over the Locals.

The fact is, that, whether it be due to difference in level or slope of fertility of the land, in all the three plots 3, 4 and 5 the eastern half is poorer in yield than the west, and the further east the series, the poorer is its growth. Now in our methods of comparing every local series with the raised one near it, there is an error; for since the numbering of the rows is from west to east, and since (as can be seen from the sketch of plot 5) the locals start the experiment, in such a method of comparison the local series will have the advantage of position (being more to the west) when compared with the raised series immediately to the east of it; with this disadvantage the 1st, 2nd and 4th series have shown that the Raised's are better than the Locals; and we have seen that in series 5, the eastern most of the series, the negative result was really not negative but quite positive from comparison with the 5th

series of plots 3 and 4. We are thus left with the 3rd series where alone a negative result has been obtained. Let us examine this further

Now the 3rd series of Raised gave ... lbs. 143-0
While the 3rd series of Local gave ... ,, 157-10

Here bearing in mind that the local series is to the west of the raised and has thus the advantage of position. We shall try to allow for this, by taking the averages of the two local series on either side of the 3rd Raised series and comparing it with the yield of the 3rd Raised series. The two local series on either side of the 3rd Raised series are the 3rd locals (on the west) and the 4th local (on the east). The yields of these are :

3rd local series ... lbs. 157-10
4th local series ... ,, 39-11 } 197-5 : Average 98—10½
3rd Raised series ... ,, 143-0

Therefore percentage of increase of 3rd R over average of 3 L and 4 L.

$$\text{equals to } \frac{143-(98-10\frac{1}{2})\times 100}{98-10\frac{1}{2}} = 44\cdot 8.$$

Now this result is positive and in perfect agreement with the results of the other series; only those series of Raised which even with the disadvantage of position showed themselves to be superior to the locals will be found to be much more so; if we apply the correction for position, that we have done in the case of the 3rd series.

Yet another way of looking at the figures of harvest of plots 3, 4 and 5, brings home clearly the positive superiority of the raised rows to the local rows. Below are given the total yields to the nearest point of the experimental portion of the three plots for all the thirteen harvests.

	lbs.		lbs.		lbs.
Plot 3	... 3,779	Plot 4	... 2,433	Plot 5	... 2,052

Now, all along plot 3 has given the highest yield and then comes plot 4, and last plot 5. This evidently is due to the slope of fertility of the land. The rate of fall of yield from plot 3 to plot 4 $= \frac{3779-2433}{3779} = \frac{1}{2\cdot 8}$ nearly.

If the same rate of fall had obtained from plot 4 to plot 5, plot 5 should have yielded $2433-\frac{1}{2\cdot 8}\times 2433 = 1563$ lbs. nearly. But plot 5 has actually yielded 2052 lbs. or 500 lbs. more, the rate of fall being $\frac{2433-2052}{2433} = \frac{1}{6\cdot 4}$ nearly and thus the rate of fall has been considerably lessened. What is this due to ?

We will now take up the yields of the Locals rows alone in plot 5 and the corresponding rows in plots 3 and 4 and work out similarly the rates of fall

Local rows—yields of

	lbs.		lbs.		lbs.
Plot 3	... 1,949	Plot 4	... 1,248	Plot 5	... 903

The rate of fall here, from plot 3 to plot 4 is $\frac{1949-1248}{1949} = \frac{1}{2\cdot 8}$ and from plot 4 to 5 is $\frac{1248-903}{1248} = \frac{1}{3\cdot 6}$

Let us now take the Raised rows.

	lbs.		lbs.		lbs.
Plot 3	... 1,830	Plot 4	... 1,185	Plot 5	1,149

The rate of fall from plot 3 to plot 4 is $\frac{1830-1185}{1830} = \frac{1}{2\cdot 8}$ and that from plot 4 to plot 5, $\frac{1185-1149}{1185} = \frac{1}{33}$

Putting all these figures together and converting rates of fall into percentages we have the following statement ;

	Fall per 100 from plot 3 to plot 4	Fall per 100 from plot 4 to plot 5
Whole plot	... 35·7	15·6
Local rows	... 35·7	27·9
Raised rows	... 35·7	3

It is clear from this statement that while the tendency of the soil is to indicate poorer yield as we from south to north—which is lower in level—the raising of the rows has served to counteract this tendency ; for while the rate of fall is very uniform in the local rows, the raised rows of plot 5 have been nearly equal to those of plot 4 in yield, so insignificant is the rate of fall (only 3 per cent.)

(*To be continued in the next issue*)

WHAT 'AGRICULTURE' MEANS:

A.—Acquire the best plants when planting your field.
G.—Give careful attention to select the best soil.
R.—Remember to plant at right distances apart.
I.—Inspect the early growth of your plants.
C.—Cure any mistake early by supplying defective growth with good plants.
U.—Use any manure that is near at hand.
L.—Listen to the advice of your Agricultural Inspector.
T.—Turn up the soil and fork in dry weather.
U.—Use any material nearby for mulching.
R.—Reap for sale only the best in your field.
E.—Endeavour to deliver at wharf without bruising.

Journal of the Jamaica Agricultural Society.

THE LAC INDUSTRY

By S. V. DURAISWAMI

Many of us are, perhaps, unaware of the extreme economic importance of Lac Industry in India. It is a most fascinating subject as may be seen from the extensive use made of lac in the manufacture of many of the articles in common use such as sealing wax, gramophone records, varnishes, lacquer-ware, wooden toys, electrical goods, dyes, etc. The fact that, except for a small percentage contributed by Annam and Siam, India practically holds the monopoly for the world supply of this commodity, should be sufficient reason to justify our taking greater interest in the cultivation and production of lac. It is upto us to see that this industry is developed to the utmost on up-to-date lines so as to enable our controlling and dictating prices in the world market, instead of depending as at present upon the whims and fancies of purchasers in the foreign market. The total quantity and value of lac exported from India, as shown in the following table, indicate that this industry is by no means such a small and negligible one as it is supposed to be.

Year	Rupees	Tons
1923–24	90,526,887	24,284
1924–25	75,389,058	21,351
1925–26	68,759,299	27,046
1926–27	54,294,570	29,602
1927–28	69,112,746	27,129

It may be noted that there has been a decrease in the value of lac exported in recent years, which is, however, due to the fall in prices rather than to any decrease in the quantity of production. It is gratifying to add that this fall in prices has not been due to any successful competition arising out of the attempts to produce lac synthetically. It is again encouraging to learn that the Indian Lac Research Institute, Ranchi, has started work in right earnest so that ere long the production of lac of the best quality on a large scale may be an accomplished fact.

What is lac?

Lac is the name given to the resinous matter secreted by a scale insect—the Lac insect (*Tachardia lacca*) found living on certain kinds of trees. The lac is secreted to form an encrustation around its body serving to protect it from inclement weather and from its enemies. Dark-red in colour, the lac is composed mainly of a resin mixed with a small percentage of wax. Crude lac contains many impurities such as dust, bark, the remains of the lac insect, etc., and to prepare it for the market it has to be refined and specially treated in different ways; one of the well-known forms being Shellac, which is molten lac solidified so as to form thin flakes.

The life history of the lac insect

It will be now clear that the lac industry is based on the activities of the tiny lac insect, the successful rearing of which involves a certain amount of

expert knowledge as to its habits and life history. As already stated the insect lives and thrives upon particular species of trees. The insect starts its life as a tiny nymph emerging from under the encrustation of the mother insect in large numbers. These crawl about on the tender branches of the host-tree, in search of suitable places to fix themselves in for feeding. This exodus is called 'swarming'. Once settled, the insects never stir out, but continue to use their tubular mouth-parts for vigourously sucking up nutriment. As they grow into the adults, they continue to secrete lac till eventually they reach the swarming stage. Among these one can distinguish two kinds, the male and the female, the latter being the more preponderant. The male cell is found to be egg-shaped while the female one is fairly round with an irregular edge. During its active period, a sticky secretion called 'honey-dew' oozes out through its anal cleft and ants are often seen crowding round the cells attracted by this substance. When fully grown, the male insects, some of which may develop wings particularly in winter, emerge from their cells and move about to fertilise the females, with the fulfilment of which function their life comes to an end. The females continue to feed and grow till after some time the fertilised eggs hatch and the tiny larvae begin swarming and start another generation. The life-cycle is about four to four and a half months as observed under Mysore conditions on *Shorea talura*, but in North India there are only two cycles in the year, producing two crops of lac. What is known as the '*Katki*' crop is obtained from insects whose development is between June and November, while the '*Baisakhi*' crop is preceded by a longer season, from November to June. Under Mysore conditions therefore it has been possible to take three crops in about thirteen months. Cases have been noted, in Mysore, of the cycle being completed in about ninety days.

Suitable host-plants

Lac insect is by itself parasitic upon particular species of trees which vary with the tract to some extent. A study of the host-plant on which the insect entirely depends for its nourishment and growth, is also equally important in this industry. For it is found that the quantity and quality of lac produced generally depend upon the type of host-plant the insect has. The names of host-plants special to the different areas where lac is produced, are given below:

Tract	Local name	Botanical name
Punjab	*Ber*	*Zizyphus jujuba*
United Provinces	*Palas*	*Butea frondosa*
Bihar and Orissa	,,	,, ,,
	Kusum	*Schleichera trijuga*
Bengal	*Ber*	*Zizyphus jujuba*
Assam		*Ficus bengalensis*
		,, *rumphii*
	Rahar	*Cajanus indicus*
		Grewia laevigata
Burma	*Palas*	*Butea frondosa*
		Dalbergia sp.
Central India	,,	*Butea frondosa*
Central Provinces	,,	,, ,,
	Kusum	*Schleichera trijuga*

TRACT	LOCAL NAME	BOTANICAL NAME
Mysore		*Shorea talura*
Madras (Salem and Palni hills)		,, ,,
		Zizyphus jujuba
		Schleichera trijuga

Production of lac

The swarming larvae when settling on the succulent branches, nestle together so closely that ultimately when fully developed we find the encrustation continuous and completely covering the twigs. All branches bearing the encrustation are now cut and removed for lac extraction. By the time the 'harvest' approaches, the males have emerged and the female cells are found to be full of the newly-hatched larvae. Such twigs with well developed encrustations are then selected and tied on to a fresh set of host-trees kept ready for this purpose, by pruning them a few months in advance so as to ensure the availability of tender shoots for the young ones to settle upon. Thus a new group of host-trees are infected with what is known as the 'brood-lac' and the cultivation continued. After the removal of this brood-lac from the old hosts, all the lac-bearing branches, are cut out, thus effecting a pruning in itself and stimulating the trees to put forth fresh shoots so as to be ready for infection the next season. In North India generally during the long season, i.e., the *Baisakhi* crop, the activity of the insects ceases some six or seven weeks before swarming would naturally occur and therefore the collection of lac-bearing branches commences immediately, with the reservation, of course, of the brood-lac.

Schleichera trijuga has been found to yield the best quality lac as also the *Kusum* brood infected on to *Zizyphus* and *Butea*. The lac section of the Mysore Forest Department and the Indian Lac Research Institute have among many other things, taken up the study of host-plants and their influence on lac production. *Acacia catechu* has been found to give good lac, and from trials undertaken, much light is expected to be thrown on many other host-plants yet under study.

Preparation for the market

Crude lac contains many impurities as already stated above and has to be thoroughly cleaned before it can be ready for the market. The general method of refining is to disintegrate crude lac in a hand or power mill, work it in sieves, grade it according to the size of particles and then wash with ordinary water. For this it is immersed in water in a stone mortar about two feet in diameter and as deep and then constantly treaded by a man working his legs. This goes on for three days. The top layer of liquid with the impurities is now and then drawn out in a vessel and drained off and a fresh quantity of water added each time. Dissolved in the water thus drained off is the dye that originates from the body of the insect itself. This liquid is therefore not usually thrown off, but filtered and treated so as to recover the dye which is considered to be one of the fastest and best of its kind in the market.

After this process of washing, lac is spread out in trays indoors for drying. When completely dry, it is bagged, weighed and stored till prices are favourable for disposal. The cleaned lac can be distinguished by its attractive shining colour. The price offered per maund (80 lbs.) varies from Rs 35 to Rs 100 according to the fluctuations of the market. The demand is mainly

from foreign countries where lac is utilised largely as the basic substance in the manufacture of many well-known articles. Another form in which lac is also made available to a small extent is 'button lac'. This is probably the purest form of lac and is used where high grade quality is required. Button lac is in the form of flat buttons about two inches in diameter and is obtained by gently warming ordinary lac in a tough cloth bag and collecting the liquid lac that oozes out and pressing it into buttons of the required size before it solidifies. Shellac is another form, which is lac drawn out into fine flakes and highly suitable for ready use in industries where lac is freely used.

Some industrial uses of lac

Lac forms the essential material in the manufacture of gramophone records, insulators in electrical goods and machinery, sealing wax and many other articles requiring the peculiar qualities special to lac. Sealing wax contains about 33 to 35 per cent of pure lac, the other ingredients being kaolin, resin, turpentine and the required colouring matter. The mixture is melted in a slow fire upto boiling point and then poured into bronze moulds of the usual shape and size. The rods when cool are taken out and carefully worked on a glass plate after gently warming it previously, to smoothen the surfaces and otherwise make them perfect.

The liquid obtained by washing lac contains the dye principle which is excellently suited for colouring silk, wool and other organic fabrics. In the Mysore Government Lac Factory the cloth bag used in the preparation of button lac which contains along with the impurities small quantities of the lac adhering to the sides, is put into alcohol to dissolve the lac out. For this purpose, it is interesting to note, butter-churns are being used, as they are found to be very efficient for rinsing the cloth bags in alcohol. When all of the lac has been dissolved the bags are taken out, cleaned of the extraneous substances and again used. The alcohol is filtered into large bottles and the liquor thus obtained serves as a polish. The quantity of lac that has gone into the solution determines the density and hence the quality of the polish and the purposes for which it can be used.

In painting wooden-toys as manufactured in Chennapatna town of the Mysore State, lac is used in a peculiar and interesting manner. The necessary colouring matter is mixed with lac and rods of different colours are made and kept ready. These rods are handy for giving the finished toys delicate tints of various colours. This operation is done by simply pressing one end of the lac rodagainst the toy, as it is rotated fast fixed in a handlathe. By the heat gene rated by friction, the rod melts and a very thin layer of colour adheres to it and quickly gets polished in those shining and attractive tints with which we are very familiar in the wooden toys handled by children in our homes. The surfaces of several varieties of buttons obtainable in the bazaar, have been treated to a fine spray of lac which is responsible for the various delicate shades of scarlet observable on them. Bangles of different workmanship and colour as also sometimes necklaces are largely made out of ordinary lac. The possibilities of much more extensive utilisation of such a peculiar natural substance as lac in many other industries of our country, have yet to be explored.

The future of the lac industry

The comparative cheapness with which lac can be cultivated on a large scale in practically any part of the country and the large demand that exists

for this product as an essential and unreplaceable article in the manufacture of so many well-known articles, certainly call for a rapid expansion of this industry. The constant fluctuations in the prices, the want of facilities and encouragement for proper cultivation, the absence of more economic and upto-date methods of refining and preparing for the market, the paucity of well developed industries which would consume a great part of the production, all these are, on the other hand, factors which act adversely on such an expansion. There is, therefore, much scope for study and improvement both on the productive and the technical sides.

The question of the most advantageous host-plant from the point of view of quality and production of lac, has to be tackled with reference to particular tracts. Other conditions incidental to the growing period such as variations in temperature, humidity, rainfall and other natural causes have not been systematically studied for sufficiently long periods to enable us to draw conclusive inferences. The habits and life-histories of the insect-enemies of the lac insect have to be studied in connection with their proper control. These, combined with squirrels, birds and monkeys, cause appreciable loss to lac cultivation every year. The insect enemies fall into two groups called the predators attacking from outside and the parasites which start their activity of destruction from inside the cells. The control methods have to be carefully worked out and advantage is also to be taken of the existence of parasites upon these insect enemies, the introduction of which may control the inroads of these destructive breeds. The importance of the use of disease and pest-free brood-lac for infection has to be emphasised.

On the technical side there is yet large scope for improvement in the preparation of lac for the market and in the methods for utilising it in many of the minor industrial products. The most important factor is the production of lac in the cheapest manner possible. The whole industry is now threatened, as it were, by attempts which are being made in the West for producing synthetic lac, but which have not been, fortunately for India, successful so far. It is clear therefore that taking advantage of the exclusive favour bestowed by Nature on India, the cultivation and production of lac should be thoroughly improved and modernised with the aim of making the product so cheaply available that synthetic lac would find it very hard to compete. This is a fond, though legitimate hope, and from the way in which the Indian Lac Research Institute has started work along most of the lines mentioned above, it will not be too much to hope that the lac industry will have a very bright future.

On the commercial side, a good deal of advertising work has to be undertaken by the Government to popularise many of the articles manufactured out of and with lac in some of the lac factories and other industrial centres in the country. There is again the need for research to be carried out with a view to perfect the processes of manufacture of these articles on up-to-date lines consistent with economy. The consumption of lac in the country, as a result of industrial progress, should phenomenally increase, if foreign domination and market fluctuations are to be counteracted. There will be then definite encouragement given to an extensive cultivation of lac, attempts being made side by side to place the product in the market a very cheap rate.

In this connection it will be interesting to read the remarks of Rai Bahadur C. S. Misra on the working of the Mysore Government Lac Factory at Bangalore, which is as follows,

'From what I saw of the lac work at Bangalore, I was very much struck with the progress made. It demonstrated clearly what could be done with ceaseless efforts to organise the work and to put it on a paying basis. The work done was methodical and all the bye-products were usefully employed. The total produce, though 500 maunds now, is likely to expand soon, and this at Rs 20 per maund for the crude material works up to Rs 10,000, whilst the total expenses were not more than Rs 3,000. This practically represents the out-turn from four hundred acres which are much scattered about within the State. The processes employed for the utilisation of the refuse were interesting and showed that every care was taken to prevent waste. It was the only place visited by me where regular accounts were kept and where it was possible to see what could be done by improved methods of cultivation and refining to get the best results. I think this is all due to the untiring efforts of Mr. Basappa who was trained at Pusa, and who is in charge of lac work in Mysore.' [1]

My thanks are due to Mr. Basappa, Officer in Charge, the Government Lac Factory at Bangalore, who kindly supplied me with much of the information incorporated in this article and who was generous enough to present specimens of lac and lac-products available in the factory for exhibition in the Agricultural College Museum at Coimbatore.

[1] Published in the *Quarterly Journal* of the Mysore Forest Department, Volume I, No. 3.

A NOTE ON THE IMPROVEMENT OF SUGARCANE CULTIVATION IN THE GOLUGONDA TALUQ VIZAGAPATAM DISTRICT

BY P. L. NARASIMHAM

The sugarcane crop in this taluk is mostly concentrated along the course of the River Varaha and its main tributary, the Kothakota river, occupying an area of about 1,500 acres. This tract possesses good facilities for both flow and lift irrigation. The crop is cultivated mostly on wet lands in rotation with paddy (once in 3 years), but in a few places it is also raised on garden lands entirely under lift irrigation. The sugarcane tract may, for convenience in dealing with the improvement of the crop, be divided into 6 areas, viz.,—

1. The Kothakota area.
2. The Komaravolu area.
3. The Kusarlapudi area.
4. The Makavarapalem area.
5. The Uratla area.
6. The Gottivada area.

The Uratla area is the best portion of the sugarcane tract. Here the cultivation is mostly in the hands of 'Gavaras' a hard-working agricultural class. The Makavarapalem is the next best area where also good sugarcane crops are grown. In the Gottivada tract the crop is cultivated in garden lands also. In the Kusarlapudi and Makavarapalem areas sugarcane is said to be under cultivation from an earlier date than in the others.

In the Kothakota area the soil is a sandy or red loam with good drainage, and the water supply being fair, conditions may be said to be more or less ideal. In the Gottivada area it is more reddish, while in the Makavarapalem area it is mostly loamy, slightly heavy soils also occurring under the Pydipala tank. In the Kusarlapudi area the soil is somewhat similar, but it is said to be badly deteriorated on account of the frequent cultivation of sugarcane as well as of 'punasa' and—'paira' crops, as a result of which not only is the sugarcane crop poor but also paddy. The Uratla area also consists of somewhat loamy or sandy loams, the soils in the northern portion being heavier than those in the southern. The Komaravolu area contains the heaviest soils liable to suffer from the effects of poor drainage.

Prior to the introduction of 'Mauritius' and 'Barbadoes' varieties of sugarcane by the department, a number of varieties, Chittibonta Namalu, Valu, Keli, Bombaye, Vedurujanam and Palabontha were under cultivation, the last one having been the latest to come in and to win the greatest popularity, quickly ousting out most of the others. Attempts were made to trace out the history of these varieties but correct information was not forthcoming. Palabontha, however, is said to have come about thirty years ago. B. 208 was brought in, about the year 1910, from the Godavari District, where it had been introduced by the Department from the Samalkot Agricultural Station. About ten years later, Purple Mauritius is said to have been brought in from the same district, when both Palabontha and B. 208 showed signs of disease. The latest variety to be introduced was J. 247 from the Anakapalli Agricultural Station in 1923. And with this, commences the improvement of sugarcane cultivation in this taluk.

In the Kusarlapudi and Uratla areas the cane crops were in a deplorable condition during the years 1920 to 1923. 'Palabontha' which was the chief variety then under cultivation having been badly diseased, the average yields fell from about 10 to 12 candies per acre to 3 to 5 candies. It was under these conditions that it was felt necessary to introduce a hardier variety, and J. 247 was pitched upon. It was first introduced in Tadapala in the Kusarlapudi area in 1923, in a small area. As this was found to resist disease as well as drought, it soon came to be appreciated by the ryots and in the course of a couple of years practically the whole area was cultivated with this variety. In the Uratla area this variety was first introduced in 1925 in about 25 cents amidst 2 acres of 'palabonta' crop and it was found that this patch of J. 247 was the only area that was not affected by 'red tot,' though even in this there were a few attacked clumps. These diseased clumps were removed and the rest of the crop used for seed in the next season, during which three more ryots took to its cultivation. In the following year, 1927, there was material to plant about 50 per cent of the area in this locality and by 1928, 99 per cent of the area was brought under this variety. Besides, being resistant to drought and disease this variety has also been found to progress fairly well under less liberal treatment, while at the same time capable of responding to a more liberal one, so that both the poor ryot as well as the rich landlord have been benefited by its introduction. J. 247 was introduced in the other areas also from 1926 onwards. In the Gottivada area it has largely replaced Palabontha and B. 208. In the Makavarapalem area also, it has made fair progress, 60 per cent of the area being under this variety. But in the Komaravolu and Kothakota areas it did not make much progress. In the latter place 'Palabontha' and B. 208 are still doing well especially in the lands recently brought under cultivation, and J. 247 has been given up after a trial, the ryots having found it no better than the varieties under cultivation.

In the Uratla area where conditions are good, the average yield of J. 247 may be said to be about 18 candies i.e., 50 per cent more than the average of the yield of 'Palabontha,' where it did best. In 1928, a record yield of 33 candies per acre was noted from J. 247, the average weight of cane being about 4½ pounds. In the Makavarapalem area also fairly good yields of 10 to 15 candies of jaggery per acre are obtained but in the Kusarlapudi area the growth of the crop is poor in general on account of the worn out condition of the soil referred to already. But even here, J. 247 yields much better than others. The crops in this tract, however, seem to have improved considerably since the floods of 1928, which appear to have renovated the soil of the area, and now there is a better response to manures. In the Komaravolu area, the crop grows quickly in the earlier stages but ceases to grow well from September to December, and sometimes, the cane assumes such a stunted growth that very meagre progress is visible even after the cold season is over. The soils of this area are the heaviest in the taluk and ill-drained and this may explain the poor growth referred to above. To summarise the work done on this item of improvement, it may be stated that J. 247 now occupies no less than 60 per cent of the total area of the cane cultivated in this taluk.

Another chief item of improvement effected in this tract is the introduction of the 'line system' of planting setts. At first, it was done with the aid of ropes but this was found cumbersome, and did not appeal to the ryots; in 1928 planting in plough furrows was started and it was found labour saving, quick, and economic. In 1929 it was introduced into 20 per cent of

the area under cane in the Uratla area, and it is now spreading into the other areas. But the ryots persist in having the lines closer than desirable,—two to two and a half links apart. Attempts are being made to induce them to adapt a spacing of three to four links. The chief advantage of this system of planting is that irrigation is greatly facilitated, especially at the time of planting, enabling the operation to be done quicker. Further irrigations are also more effective, the young plants thereby standing drought better. Even when there is heavy rain after planting, the germination does not suffer as much as in the local system, since the soil that is irrigated along the furrows alone is not so wet to start with, the dry ridges absorbing the excess of moisture. Where the ryots adopt a spacing of three and half to four links, there is also a considerable saving in the number of setts required which may be estimated at 4 to 5 thousands per acre, worth about Rs 20—25. With the introduction of this system, the growth of the crop has also improved and better wrapping and propping being, therefore, found necessary, the ryots are being persuaded to do this.

A beginning has been made in the Gottivada area to improve the seed material by raising short crops. No other improvements have been found feasible, but it may not be out of place to note a few other points of interest regarding other aspects of sugarcane cultivation in this tract.

No cakes or other concentrated manures are generally used in the tract. Thirty to forty cart loads of cattle manure are applied before planting in addition to the penning of three to four thousand sheep per acre. After planting, green leaf (wild indigo) is applied and hoed in up to about five thousand pounds per acre in one or two doses, after the first hoeing or before trenching.

Under the Pydipala tank in the Makavarapalem area where soils are heavier, it has been noticed that the crop does better than elsewhere in the same tract with light soils, when it receives good irrigation in summer (especially where there is good drainage) and the same thing has also been noticed in other tracts with fairly heavy soils. J. 237 no doubt withstands drought but responds to better irrigation in summer.

In Gottivada area, most of the crop is planted in lines but trenching is not done as most of the crop is grown under garden land conditions and there is good drainage.

The cost of cultivation of sugarcane in the tract is not much, as most of the operations are done by the ryots themselves. He does not spend money except for sheep penning, purchase of wild indigo leaf, extra labour for trenching, and the last few wrappings which require the operations to be done with the aid of ladders, stools, purchase of bamboos, and sometimes hire on the mill and pan. These come up to Rs 130 to 175 per acre depending upon the rates of labour and cost of bamboos. Taking an average crop to yield about 15 candies and the market rate at Rs 35 per candy, the ryot makes a profit of about Rs 350 to 400 per acre. Very few capitalists cultivate sugarcane in this tract, as it leaves very little or no profit considering the high cost of cultivation when the whole labour is to be paid for, and the market is dull.

STUDIES IN THE COST OF PRODUCTION OF CROPS

(*Continued*)

By D. G. MUNRO

VII

Name of Crop:	Paddy (Poombalai).
Area:	90 Cents.
Locality:	Pottipuram village, Omalur Taluk, Salem District

This tenant cultivated the lands on *Varam* system—$\frac{3}{5}$ share of grain and the entire straw were given to the tenant, while $\frac{2}{5}$ of the produce of the grain was taken by the landlord. The tenant bears all cultivation charges himself.

As per details given in the previous tenant's crop, the paddy seed was sown at the end of July. The seedlings were transplanted when they were $2\frac{1}{2}$ months old, and harvesting was done at the end of January. Thus the crop has taken practically 6 months from the time of sowing in the seed bed up to the time of harvest. The lands in question were commanded by the tank which had only 2 to 3 months' supply of water. This year, there was water only for about a month. Puddling was started immediately after the rains were received in October and the planting was completed hurriedly. Variety of paddy—Poombalai—was supplied by the Department. Irrigation charges were not heavy as the cultivation was started late in the season.

Details of cost of cultivation, etc.

Particulars	Men @ 2&3as.	Women @ 3 & 4 as.	Pairs @ 3 as.	Amount
Seeds and Sowing (Nursery)				Rs A P
Preparing seed bed, irrigating, etc. ...	3	...	3	0 15 0
Irrigation for 12 days	6	...	6	1 14 0
Application of 5 bundles of Kolinji leaves and transplanting, etc. ...	...	5	...	0 15 0
Cost of seed ...	...	...	...	4 0 0
Pulling seedlings and transplanting ...	...	21	...	5 4 0
Total ...	9	26	9	13 0 0
Preparatory cultivation				
Ploughing for 10 days (2 pairs per day), levelling, etc. ...	20	...	20	6 4 0
Trimming bunds, etc. ...	8	...	...	1 0 0
Total ...	28	...	20	7 4 0
Manures and Manuring				
Bringing all kinds of leaves—70 bundles of 50 lbs. each ...	8	6	...	2 2 0
Trampling leaves ...	3	3	...	0 15 0
Total ...	11	9	...	3 1 0
Irrigation				
Irrigating for 80 days ...	80	...	80	25 0 0
Cost of Mhote buckets, mhote ropes, etc. ...	...	...	...	14 0 0
Wages of chuckler, carpenter, etc ...	...	...	...	3 0 0
Total ...	80	...	80	42 0 0
Interest on value of cattle (on Rs. 200 for 6 months) ...	...	...	...	12 0 0

Details of cost of cultivation, etc.—*Continued*

Particulars	Men @ 2&3as.	Women @ 3 & 4 as.	Pairs @ 3 as.	Amount
Harvesting and Threshing				Rs A P
Harvesting, bundling etc. ...	...	15	...	3 12 0
		3	...	0 9 0
Cattle threshing ...	3	3	4	1 14 0
Total ...	3	21	4	6 3 0
Landlord's share of produce or 3 khandagams at Rs. 13 per *khandagam of* 90 M. M.	...	...	...	39 0 0
Grand total ...	...	...	...	129 8 0

Statement of Yields and Value

		Per Acre
Paddy—per plot (90 cents)	2025 lbs.	2250 lbs.
Straw per plot (90 cents)	2400 lbs.	2667 lbs.
	Rs A P	Rs A P
Grain	117 0 0	130 0 0
Straw	24 0 0	26 10 0
Total ...	141 0 0	156 10 0
Net profit	11 8 0	12 12 0

Note. (1) Grain valued at Rs 13 per *khandagam* of 225 lbs. and straw at 100 lbs. per rupee.

Note. (2) Owing to late planting the yield has been rather low. This is found much better than the Sadai Samba variety of paddy. As the tenant in question is a poor ryot, he managed to graze the cattle and hence the charges of maintaining them have been very low. Wages of the tenant and those of his relatives have been calculated as per minimum amount required for their maintenance.

VIII

Name of Crop : Paddy.
Area : 1¾ Acres.
Locality : Pottipuram village, Omalur Taluk, Salem District.

Paddy was cultivated by this ryot in 1¾ acres of land, commanded by the tank. Though it was a wet land, water was found insufficient and could be used only for a few days. Hence water from the well had to be baled almost throughout the season.

The ryot cultivated under his direct supervision with his farm servants employed on monthly wages. The cattle were given either green fodder or grazed and no concentrated food was given and the charges of maintenance of cattle came to Rs 0–3–6 per pair and the wages of the cooly attending to the animals come to Rs 0–2–6. The animals had work almost all through the year, because the ryot had different types of land, viz., dry garden, and wet.

2 varieties of paddy were planted, viz., G. E. B. 24 and local *Karthikai Samba*. These were again planted each in 2 different times, according to the rains received. Thus the growth of the crop was very much varied in character. 2 seed beds were prepared—one seed bed of *Karthikai Samba* was sown about the 20th of July. Half an acre was planted when the seedlings were 30 days old—½ acre when the seedlings were 60 days old.

G. E. B. 24 paddy was sown in another seed bed on the 10th August, and the seedlings were planted when they were 60 days old. Though seedlings were ready for planting, larger area could not be cultivated due to deficiency of water supply in the well. The seedlings having been found insufficient, the ryot had to purchase seedlings from outside and plant the same. Thus, the block had to be planted in 4 stages. The forest block showed good growth and produced satisfactory yield. During the growth of the crop, the plants were found diseased, and the ryot applied Ammonium-sulphate as top dressing. Large quantities of green-manure leaves, e.g., *Kolinji*, were purchased and applied as manure for the crop. A few days before harvest the mhotes in the well collapsed and in consequence, about ½ an acre could not be irrigated and hence the crop suffered badly and thereby the yield was affected to some extent.

Details of cost of cultivation, etc.—*Continued*

Particulars	Men @ 2½ as.	Women @ 3 as.	Pairs @ 3½ as.	Amount
Preparatory cultivation				Rs A P
Ploughing, irrigating and levelling 1st Block ...	30	...	30	11 4 0
Ploughing, irrigating and levelling 2nd Block ...	15	...	15	5 10 0
Ploughing, irrigating and levelling 3rd Block and irrigating with tank water etc. ploughing for 10 days with 3 pairs ...	30	...	30	... 11 4 0
Total ...	75	...	75	28 2 0
Seeds and Sowing (Karthigai)				
Purchase of seed, ploughing, etc. ...	5	...	5	1 14 0
Cost of 4 big bundles of *Kolinji* ...	...	...	...	1 0 0
Trampling leaves ...	1	...	...	0 2 6
Further ploughings ...	7	...	6	3 6 6
Cost of seed *Karthikai Samba* ...	...	...	...	4 0 0
Cost of seed—G. E. B. 24. ...	...	...	...	5 0 0
Cost of *Karthigai Samba* seedlings and transplanting charges ...	...	...	...	11 0 4
Pulling seedlings and transplanting (contract rate) ...				5 8 0
Totai ...	13	...	11	32 3 0
Manures and Manuring				
Green leaves—1st Block—64 bundles @ 2 as. ...	8	...	...	8 0 0
Trampling ...	...	...	...	1 4 0
2nd and 3rd Blocks—Leaves of all sorts at 1 anna per bundle of 64 bundles.	...	...	...	4 0 0
Trampling ...	...	12	...	2 4 0
Application of artificial manures. 1 cwt. of Super and 80 lbs. of Ammonium sulphate ...	...	...	...	12 0 0
Total ...	8	12	...	27 8 0

Details of cost of cultivation, etc.—*Continued*

Particulars	Men @ 2½ as.	Women @ 3 as.	Pairs @ 3½ as.	Amount
				Rs A P
After-cultivation (by contract) ..	...	...	...	2 0 0
Irrigation				
1st Block for 50 days from 25-8-1929.	50	...	50	18 12 0
1st Block again for 40 days ...	40	...	40	15 0 0
2nd Block irrigating ...	10	...	10	3 12 0
2nd Block irrigating with tank water.	30	...	30	11 4 0
3rd Block for 80 days at ½ pair a day....	40	...	40	15 0 0
Cost of mhote buckets ...	...	...	...	15 0 0
Mhote and tail ropes ...	...	...	...	10 0 0
Preparing charges of buckets ...	...	...	...	5 0 0
Carpenter wages, etc.	...	...	...	1 8 0
Total ...	170	...	170	95 4 0
Harvesting				
By contract—40 *vallams* of 2 M. M. each. ...	16	...	...	13 0 0
Permanent labour—cattle threshing...	...	8	...	2 8 0
Permanent labour—cattle threshing ...	...	8	...	1 0 0
Miscellaneous				16 8 0
Interest on the capital outlay spent on the purchase of cattle, wages paid to labourers etc., for 6 months on Rs 450 at 12% ...	...	...	..	27 0 0
Rent ou land ...	...	...	...	7 0 0
Miscellaneous ...	...	...	...	2 7 0
	...	...	...	36 7 8
Grand Total ...	...	...	...	238 0 0

Statement of Yields and Value

	Rs A P
22 *khandagams* of paddy at Rs. 12-8-0 per *kandagam* of 225 lbs. ...	275 0 0
4,000 lbs. of straw at 100 lbs. per rupee ...	40 0 0
Total ...	315 0 0
Less Expenses ...	238 0 0
Net profit per plot ...	77 0 0
Net profit per acre ...	44 0 0

The yield of straw was poor due to late planting and also planting of G.E.B. 24 (*Karthikai Samba*) strain.

AN ANXIOUS TWENTY MINUTES

By K. M. T.

'It is not safe to go up the Ghaut-road now' said in Kanarese, a well-meaning Badaga inhabitant of the neighbouring village when I alighted at about 6-30 p.m. from the bus which took me to the foot of the hills. 'What is the matter?' I enquired 'There are elephants on the road' said he. I smiled to thank him for the information, but possibly there was in smile an unconscious contempt for elephant stories of which one hears a good many during one's travels in the hill districts. 'You may stay the night in the bungalow and go early in the morning', he pleaded pointing to the Forest dak bungalow on the side of the road. I paused to think. The bungalow was familiar to me. I had the misfortune on a previous occasion to make an enforced stay there one night and the experience was fresh in my memory. The prospect of semi-starvation and a sleepless night in a vermin infested building in a notoriously malarial tract was far from inviting. I had programmed to conduct some field experiments on Capt. M's Coffee Estate the next day and a night's stay meant a day's delay in starting the work. The Ford which Capt. M. had sent down to the foot of the Ghaut to convey me and my luggage was there awaiting my arrival. From my supposed knowledge of the habits of elephants, I felt that it was too early an hour for them to leave their haunts for a stroll on the road. The chauffeur who was familiar with the road held the same view and assured me that we could cover the distance of 18 miles before 8 o'clock. Throwing discretion to the winds I made up my mind to proceed on my journey. The car drew alongside the bus, my belongings were soon transferred to it and taking leave of the small group of inquisitive villagers who had collected round the car, we burred off.

I had my D.B.B.L. by my side, one barrel loaded with ball and the other with shot, ready for contingencies. A jungle cock who was less discreet than his wife, proudly strutted on the roadside unmindful of the approaching car and paid the penalty for his indiscretion. It was soon dark and the headlights were switched on. Before we proceeded a couple of miles an innocent rabbit was caught in the glare of the headlights a few yards ahead of the car and I meekly yielded to the tempting offer. The driver who was evidently pleased with the evening's bag told me that further up the Ghaut there was a cheetah which roamed about on the road after night-fall. I kept a keen look-out for him expecting to meet him at every curve on the serpentine road, only to be disappointed. About halfway, we came to a fairly flat country which was the supposed haunts of elephants. We passed two heaps of elephant's droppings which were apparently some days old; but according to my calculations, it was too early an hour of the night to entertain any hope of meeting the criminal who had committed this nuisance on the highway. I kept a sharp look-out, however, for the smaller fauna of the jungle which are frequently confronted with on such roads. We negotiated a sharp curve and were approaching another, when lo! there stood a few paces in front of us a huge earth-strewn figure with his back towards us. I realised the danger, cautioned the driver and grabbed at the trigger of my gun. The brakes were applied The car stood still. The monster of the woods was there in the full blaze of

the lights hardly 20 yards ahead of the car and apparently unperturbed Realisation, for once, proved immensely more thrilling than imagination. The doubtful utility of the smooth-bored barrels against a five-tonner flashed through my mind. There was no provocation and a cool-head was all that was needed. The brute moved forward and vanished from our view into the bend of the road. His disappearance was some momentary relief, but ignorance of his movements was the cause of grave anxiety. I repented my disregard of the Badaga gentleman's warning. It was too late to mend. There was no human habitation in a five-mile radius. Where did the elephant go? There was complete stillness in the air. He was a solitary fellow. Could he be a rogue? Did he move forward to turn round at a position of better vantage? The road was too narrow to turn the car round and beat a hasty retreat. Surely the best thing was to keep cool and try to scare him away. The horns sounded; the electric hooter trumpeted; the engine roared; the driver whistled at the top of his voice. The incessant noise which was continued for about ten minutes was enough to scare the dullest beast within a half-mile radius. But would a rogue take exception to it and question our right to disturb his equanimity? In such an eventuality we had only to 'trust in God and keep our powder dry.' We stopped the noise and listened. The crash of a broken bough or a crushed bamboo in the nullah below would have relieved the tension. But there was dead stillness in the air. *Encore* the stream of noises went on for another ten minutes. Again there was complete silence. We decided to move on. The car moved on low gear, creeping at a snail's pace at every irritating curve. The Krupp-Kynock alliance was mobilized and kept in readiness for eventualities. But the rest of the journey was fortunately uneventful. As we learnt subsequently, the beast had proceeded some distance further up along the road and got down into the nullah below giving us room to pass through. Whether it was an act of courtesy, contempt or cowardice it is not possible to say. It was, however, a piece of good fortune that we met him moving in the same direction as ourselves. Were he facing us on that extremely narrow-strip of road and had he in a mood of frightfulness or mischief taken the silly idea of making a mad rush downhill, one cannot say what fate would have awaited the tin Lizzie and her precious contents! I reached my objective, however, without any mishap where Mrs. M's very inviting cup of coffee served to restore my nerves to me. I slept over the eventful experience with a feeling of relief: 'All's well that ends well.'

Salesman.—These shirts simply laugh at the laundry, Sir.

Customer.—I know, I have had some come back with their sides split.

TESTING THE PRODUCER'S MILK FOR QUALITY

By C. K. JOHNS AND A. G. LOCHHEAD

Introduction

In the earlier days of the dairy industry, information as to the quality of a given lot of milk could be obtained only through the senses of taste, smell and sight, no other means being then available for the purpose. With the development of the sciences of bacteriology and chemistry within recent years, however, more exact methods of testing have been devised to supplement the earlier ones. For some time the health departments in most large cities have been applying these scientific tests in order to protect the consumer from dirty, badly contaminated or adulterated milk. To-day, in addition to the health departments, up-to-date milk dealers are making use of these tests to protect consumer, dealer, and careful producer alike. By systematic testing and grading of incoming raw milk supplies, the dealer is able to eliminate milk unsuitable for bottling, and thus to improve the quality of milk offered to the consumer. In addition, the producer of milk of suitable quality is relieved of the unfair competition of low-grade milk produced with a minimum of sanitary precaution and consequent lower production costs. The maximum improvement in quality awaits the adoption of the practice of payment on a grade basis, whereby the price paid to the producer will vary in accordance with the quality as determined by suitable tests. Payment on a grade basis presents many difficulties, but these are gradually being overcome and the practice is slowly gaining ground. Success depends largely upon both dealers and producers being familiar with the principles involved, the tests available, and their relative suitability, for only under these conditions can best results be expected. There still appears however, to be general lack of exact information on the part of those primarily interested, and the aim of the present bulletin is to present in unbiassed fashion salient features in connection with milk quality and quality testing for the benefit of all concerned.

What do we mean by quality in milk?

Before discussing methods of testing for quality it is essential that we have a clear idea of the meaning of the term 'quality' when applied to milk. Quality in milk embraces five factors:—

(1) Food value.
(2) Freedom from dirt.
(3) Keeping quality.
(4) Safety to health.
(5) Freedom from off-flavours and odours.

All these factors must be considered when the quality of a given milk supply is being estimated, so that it is essential to consider each one a little more in detail.

(1) Food Value.

Apart from its vitamine content, the food value of milk depends almost entirely upon the amount of fat and non-fatty solids (milk, sugar, casein,

albumin, mineral salts, etc.), contained. The richer the milk in these constituents, the higher its food value. The minimum standard set by Federal regulation requires 3·25 per cent fat and 8·50 per cent solids-not-fat, but a milk barely meeting these requirements would not be considered of high quality. The consumer attempts to judge the richness of the milk by the depth of the cream layer at the top of the bottle. Pasteurization tends to reduce the depth of this cream layer, hence this method of judging richness is unreliable when comparing raw with pasteurized milk. Nevertheless keen competition between dealers in deepening this cream layer brings a demand for richer milk from the farms. Since the feed cost of producing milk increases as the percentage of the total solids rises, it is only fair that the price per hundredweight should vary accordingly. In earlier years a flat rate was paid for all milk regardless of its food value but at present the general practice is to adjust the price paid according to the fat test.[1]

(2) Freedom from Dirt.

When a bottle of milk is held up and observed from below, any dirt or sediment which has settled to the bottom is clearly visible through the glass against the whitish background of the milk. A heavy sediment is soon noticed by the consumer, and usually leads to a change of dairies. Such dirt indicates carelessness in production or handling, for dirt has no place in any food product, particularly in milk. No milk showing a noticeable amount of sediment can be considered of high quality.

(3) Keeping Quality

Early souring of milk is annoying to the consumer, and also to the milk dealer, for milk close to the point of souring cannot be pasteurized and bottled, and must be returned or otherwise disposed of. The consumer has a right to expect milk to keep sweet for at least 24 hours in a properly iced refrigerator, and spoilage within a shorter period indicates considerable growth of bacteria prior to delivery. This growth of bacteria may be the result of careless, unsanitary milking, insufficient cooling, or keeping milk too long before delivery.

Unfortunately, some consumers are extremely careless in the handling of milk after delivery. Bottles of milk are allowed to remain outside in the hot sun, or in a hot kitchen, for hours, while all too frequently the temperature inside the refrigerator is far higher than it should be. Under conditions such as these, it is not surprising that milk occasionally sours in a shorter period of time, and the consumer has no legitimate cause for complaint when this occurs.

Pasteurization improves the keeping quality, but as it destroys only a certain percentage of the bacteria present, the keeping quality after pasteuri-

[1] If the price differential is to be proportional to the feed cost of production, it is necessary to recognise that as the percentage of fat increases, the percentage of solids-not-fat rises much more slowly. Gaines (Illinois Agric. Exper. Station Circular 318, 1927) has made a study of this relationship and has found that the cost of producing milk is proportional to the *percentage of fat plus 2·66*. Thus the feed cost differential for a 3·5 per cent milk would be $100 \times \frac{0\,1}{3{\cdot}5 \times 2{\cdot}66} = 1{\cdot}623$. Where 3·5 per cent milk receives a base price of $2·40 per cwt. each point above 3·5 would receive 1·623 per cent of $2·40 or 3·9 per cent. This formula offers the most exact method known for adjusting the price of milk in accordance with the feed cost of production.

zation is affected by the number of bacteria present before heating. Many cities require that pasteurized milk shall contain not more than a specified number of bacteria hence the urgent necessity of the dealer obtaining milk with a low bacterial content from his suppliers.

(4) Safety to Health.

Milk may be rich, clean, keep sweet for a long period, and yet be a source of danger to the public health. Outbreaks of typhoid, scarlet fever, septic sore throat and other diseases of human organ origin, in addition to that dread foe of young children, bovine tuberculosis, have been traced to the milk supply time and again. Consequently the factor of freedom from disease producing organisms must be included under quality. Most large cities maintain a health department, one of the main duties of which is to reduce the possibilities of disease being spread by milk. Pasteurization, properly supervised, is universally regarded by public health authorities as being the strongest line of defence. In addition, the tuberculin testing of dairy cows, the periodical examination of dairy and milk plant employees, and home pasteurization of raw milk are all of value. The practice of pasteurizing milk in the home is urgently recommended for all localities where milk properly pasteurized is not obtainable. Were this universally adopted, much sickness and loss would be avoided and many lives saved.

(5) Freedom from off-flavours and Odours.

This, the last of the five-factors influencing quality, should need little stressing. Milk with a flavour or odour foreign to that of good, fresh milk should never be offered for human consumption, yet at certain seasons, bad flavours and odours are all too common, and a considerable percentage of the milk arriving at the city plants would not grade very high under our definition of quality.

As we have seen above, quality in milk is a highly complex matter, embracing all five factors discussed. The extent to which the individual producer is justified in aiming for absolute perfection of product depends largely upon the requirements of the market he is supplying and upon the inducements offered to compensate him for the extra care taken. It is particularly in connection with the latter point that the practice of applying certain quality tests to milk is of importance, since without adequate means of measuring the comparative quality of different lots of milk it is scarcely feasible to put into operation a system of payment according to grade. These various quality tests will now be discussed at some length, in order that those interested in the matter may become familiar with them, and understand the advantages and disadvantages of each test.

Quality Tests for Market Milk

Food Value

As previously mentioned, apart from its vitamine content the food value of milk depends almost entirely upon the amounts of fat and non-fatty solids contained. These two constituents occur in milk in a certain definite relation to each other, so that by determining the percentage of each, it is possible to detect milk which has been skimmed, watered, or skimmed and watered, in addition to milk which is naturally so low in these substances as to be below

the minimum standard set by the Federal government. With the adoption of payment for milk on the basis of its fat content by most cities, little attention is paid to watering, skimming, etc., by the dealers, since the producer can gain nothing by such practice. However, in those districts where a flat price is paid, there is always a temptation for the producer of rich milk to reduce it to more nearly the composition of that of his neighbours. Under such conditions much time must be spent in checking up on possible adulteration of the milk.

Fat Test

The percentage of butterfat in milk is commonly determined by means of the Babcock Test. In this test, strong acid is added to a measured volume of milk to free the fat from the casein, etc., and by adding hot water and whirling in a centrifuge at high speed the fat is floated up into the graduated neck of the test bottle where the percentage of fat may be read off directly. Further details may be obtained from Dominion Department of Agriculture, Bulletin No. 14, New Series, entitled, 'The Testing of Milk, Cream and Dairy By-Products by Means of the Babcock Test.'

There are other more delicate and exact methods for determining the fat percentage of milk, but these are rarely used in milk plants for the testing of shippers' milk.

Solids-not-fat

The chemical method of determining solids-not-fat by evaporating all moisture in an oven, to determine total solids, and then subtracting the fat percentage to obtain solids-not-fat, is rarely used as a routine method where large numbers of samples must be handled. Instead, use is made of the lactometer, which measures the specific gravity of the milk. Knowing the percentage of fat and lactometer reading, the solids-not-fat may be calculated by any one of several formulae, of which Babcock's is given here :

$$\frac{\text{Lactometer reading}}{4} \text{ plus } \frac{\text{Fat percentage}}{5} = \text{Solids-not-fat.}$$

Freedom from Dirt

Sediment Test

There are several types of testers on the market, but the principle is the same in each. A measured quantity of milk, usually one pint, is warmed slightly and forced through a small cotton disc, which filters out any insoluble dirt present. After drying, comparison with a set of standard discs (prepared from clean milk to which definite amounts of dry stable dirt have been added) reveals the amount of dirt present in the milk.[1] By such comparisons, the milk may be classified as (1) clean, (2) fairly clean, (3) slightly dirty, (4) dirty, (5) very dirty. Any sample falling below (2) is regarded as unsatisfacto.

The sediment test is a measure of one thing only—the amount of insoluble dirt which can be filtered out of the milk by passage through a cotton disc.

[1] Full details regarding this test, also the tests for keeping quality, are found in the Standard Methods of Milk Analysis, 5th Edition, published by the American Public Health Association, 370 Seventh Avenue, New York, N. Y., U.S.A.

Dirt has no place in milk, therefore the use of this test in grading milk is quite justifiable. Unfortunately, the employment of the sediment test too often results in greater care being taken to 'clean' milk by thorough straining than to protect it from dirt by careful milking and handling. Straining may remove the undissolved dirt but it cannot take out the dissolved dirt or bacteria. Consequently, mere freedom from sediment is no guarantee of care and cleanliness in production.

On the other hand, it is practically impossible to produce a high grade milk containing few bacteria and have any more than a trace of sediment show upon the disc. Therefore, care in the production and handling of milk to protect it from dirt has a definite influence upon the keeping quality. While the bacterial content is not directly proportional to the amount of sediment, a milk showing heavy sediment is rarely low in bacteria. The type of dirt has a great deal to do with the number of bacteria added; fresh manure, for instance, generally adds far more bacteria in proportion to sediment than dried manure, stable dust, bedding, etc. On the other hand, milking machines and utensils, where not properly washed and sterilized, often add enormous numbers of bacteria to the milk, without adding a trace of dirt to show up in the sediment test. Consequently, the sediment test cannot be used to determine the probable keeping quality of the milk; this must be left to the proper tests, which will be described in the next section.

Keeping Quality

Since the common spoiling of milk by souring is due to bacterial growth and activity, methods for the determination of keeping quality usually attempt to measure either the number of bacteria present or the amount of by-products of their growth present in the milk.

Standard Plate Count of Bacteria

The plate count was the first satisfactory method devised for counting bacteria in milk, water, etc., and is still the standard for public health and other control laboratories.

In this method, a small measured quantity of diluted milk is mixed with a melted jelly-like nutrient medium and poured into sterile covered glass dishes. The jelly material hardens and holds the bacterial cells, or groups of cells, in place. Incubated at blood heat, single cells multiply until after 48 hours there are many millions formed. By this time each mass of cells, called a 'colony' is visible to the naked eye. By counting these colonies and multiplying by the dilution, it is possible to estimate the number of bacteria present which is expressed as the standard plate count per cubic centimeter (c.c.)[1] of milk.

No method has yet been devised by which it is possible to determine with absolute accuracy the number of living bacteria present in milk, and any count must be regarded as a careful estimate, subject to errors beyond the control of the analyst. For instance, many species of bacteria are present in milk in the form of clumps or groups, so that the actual number of bacteria present would be considerably greater than the number of colonies developing on the nutrient medium. Then again, certain species will not grow upon the

[1] One cubic centimeter contains about 20 drops.

nutrient used, or at blood heat, or else grow too slowly to be visible at the end of the incubation period.

The plate count is employed in milk control work chiefly by public health laboratories, and by milk-plant laboratories for the examination of pasteurized, certified and other low count milk. Because of the necessity for a fully equipped laboratory and trained workers, and the limited number of samples which can be handled at one time, the method is too expensive to commend itself for routine analysis of milk as received from the farm. This field is more frequently left to the microscopic count or the methylene blue reduction method, which are less subject to the disadvantages just nentioned.

Microscopic count of bacteria (Breed's method)

The microscopic examination of a dried film of milk furnishes valuable information as to the number of bacteria present in unpasteurized milk. It is not suited to the analysis of pasteurized milk, however, since the bacterial cells killed in the heating process cannot be distinguished from the surviving cells. In addition, the analysis of high grade milk, containing few bacteria is more difficult because of the extremely small amount of milk (generally 1/500,000 of a c.c.), visible in the field of the microscope at one time.

In the method devised by Breed, a small measured quantity of milk is spread over a definite area on a clean microscopic slide, dried, treated and stained to render the bacteria more clearly visible. The stained smear is then observed under a powerful microscope, and the bacterial cells visible in a number of different fields of the microscope are counted. Knowing the relation between the area of the microscopic field and the total area of the smear, the number of bacteria present in one cubic centimeter of milk may be readily estimated.

Since the Breed count represents the total number of bacteria present in the milk, while the plate count represents only the number of colonies developing, the former count is generally noticeably greater than the latter. A great deal of work has been done comparing the results of both methods when applied to the same milk, and it has been found that on an average

Figure 1

Fig. 1. The appearance of milk of low bacterial content when viewed under a magnification of 600 diameters.

Figure 2

Fig. 2. The same milk as shown in Fig. 1., after remaining at 68° F., for 24 hours. Numerous bacteria are seen in the microscopic field indicating a count of millions per cubic centimeter.

the Breed count is four times as high as the plate count. This factor naturally varies quite widely with individual milks, depending upon the extent to which the bacteria occurs in clumps or groups, and the number of cells in these clumps. If each clump of cells is counted as only one cell in the Breed method, the count obtained will correspond fairly closely to that obtained by the plate count.

In the examination of raw milk arriving at the pasteurizing plant, it is rarely necessary for an experienced analyst to make actual counts of each shippers' milk, except where the sample appears to be on the borderline

between grades. Consequently, a large number of samples can be analysed in the course of a day and each lot of milk given a grade corresponding to a bacterial count lying between certain limits. A well-trained analyst is also able to indicate the probable source of high bacterial counts, especially where these are due to udder trouble, poorly sterilized utensils, or insufficient cooling. Against these advantages must be set the fact that there is considerable eye strain involved where a large number of samples must be examined at one time. There is also the possibility that persons inexperienced with microscopic work may mistake small specks of extraneous matter for bacteria, and where high-grade milk is being examined, such errors might seriously affect the grade given the milk.

Methylene Blue Reduction Test (Reductase Test)

This test, commonly called the 'Blue Test', was developed by baterio' logists in Scandinavia, where it has proved extremely useful in the grading of milk supplies. The test is based upon the discovery that bacteria growing in milk to which a dye such as methylene blue has been added are able to reduce the dye to a—colourless form. The more bacteria there are in the milk, the sooner the colour will disappear. Therefore, the time required to decolourize the milk is roughly proportional to the number of bacteria present.

The test, as described in Standard Methods of Milk Analysis, is conducted by adding 1 c.c. of a standard solution of methylene blue to 10 c.c. of milk in a test tube, mixing thoroughly, then placing the tube in a water bath at blood heat; the tube is then observed at certain stated intervals until the blue colour has disappeared. The Scandinavian classification, officially adopted on this continent, is as follows:

Class 1. Good milk, not decolourized in 5½ hours; plate count generally less than one half million per c.c.

Class 2. Milk of fair average quality, decolourized in less than 5½ hours but not less than 2 hours; plate count, as a rule, one half to four million per c.c.

Class 3. Bad milk, decolourized in less than 2 hours but not less than 20 minutes; plate count, as a rule, four to twenty million per c.c.

Class 4. Very bad milk, decolourized in 20 minutes or less; plate count, as a rule over twenty million per c.c.

There are other classifications in use which differ somewhat from the one outlined above, but the Scandinavian classification seems to be adequate under most conditions.

The methylene blue test has been widely adopted on this continent during the past few years, and has shown itself to be extremely useful in the rapid grading of milk as received from the farm. Among its advantages may be listed the fact that information as to the quality of milk is obtained quite rapidly, thus facilitating the work of fieldmen; the poorest milk is detected first; the apparatus required is relatively simple and inexpensive; the test may be conducted by anyone of average intelligence; a large number of samples may be handled in one day; and the milks are readily classified by observing them for decolourization at the end of the various periods.

Where the test is applied to milk containing few bacteria, the relation between reduction time and keeping quality is more variable. For this reason

it cannot be depended upon to make fine distinctions between milks of the highest grade. Recent studies[1] tend to show that the methylene blue test gives a better indication of the actual keeping quality of the milk than does the bacterial count by the standard plate method. In any event, the test is a very valuable one for the milk receiving plant, and promises to come into general use in the near future.

Fermentation Test

There are several fermentation tests, which differ slightly from each other. In general, a measured quantity of milk is incubated in a sterile tube at blood heat, and the changes taking place observed at various intervals. These tests were designed to assist the cheesemaker in judging the condition of the milk to be used in cheesemaking, where the presence of gas-producing bacteria in any numbers may cause considerable trouble and loss. The presence of these bacteria is indicated by the type of curd formed when the milk clots. Occasionally a fermentation test (generally in combination with the methylene blue test) is conducted by a milk dealer on milk from the farm, but because of the difficulty in properly interpreting the results in relation to keeping quality, the value of this practice is still in doubt.

Acidity Test

This method is extremely useful as a means of confirming the suspicions of the man inspecting in the receiving room. Where acidity has developed from the growth of bacteria (as when milk has not been properly cooled, a trained man can readily detect the fact by his sense of smell. Should such milk contain more acid than allowed, it would be rejected as being too near souring to be satisfactory for condensing, powdering, or the city milk trade.

In this test, the quantity of acid present in the milk is measured by gradually adding a standard solution of alkali until a chemical indicator shows by a change of colour that no more acid remains. The acidity is then calculated and expressed as the percentage of lactic acid present.

The maximum acidity accepted for market milk is usually 0·18 per cent, although higher and lower values are occasionally used. Milk freshly drawn from healthy cows has occasionally been found to contain a higher acidity value than 0·18 per cent, but it is rare for the mixed milk of a herd to exceed 0·15 per cent. Where milk is cleanly produced and thoroughly cooled, the increase in acidity within 24 hours is so small that it can scarcely be measured and such milk would never lead the inspector to suspect high acidity. In any case, where the acidity test is used only to confirm the inspector's suspicions, there is no reason for believing that milk of good keeping quality would be condemned.

Unlike the other tests for keeping quality considered so far, this test enables information to be obtained within a few moments, so that milk suspected of abnormal acidity may be rejected. With the other tests, the information is ordinarily obtained too late to prevent the mixing of undesirable milk with the satisfactory supply and can best be used as a measure of the grade of milk being shipped by any particular producer over a period of time.

[1] A comparison of the methylene blue reduction test and the agar plate count for determining quality of milk. Ellemberger, H.B., Bond, M.C., Robertson, A.H., and Moody, R.I. Vermont Agr: Exper. Sta. Bul. 264, 1927.

Temperature

Other things being equal, well cooled milk will remain sweet longer than warm milk. This has been known for generations, and prompt cooling of milk on the farm or in the milk plant is a general practice. Because temperature is an important factor the attempt is sometimes made to judge the keeping quality of milk by taking the temperature. Such a practice frequently yields misleading results, and is unsatisfactory to all concerned.

Milk may become contaminated with enormous numbers of bacteria where milking machines or utensils are not properly cared for, or where cows are suffering from garget. Where the temperature is the only criterion of keeping quality, such milk, if well cooled, will pass as being satisfactory. On the other hand, morning's milk produced under sanitary conditions may have to be shipped before it has cooled sufficiently. Such milk, together with other high-grade milk which has warmed up during shipment, would be condemned by the thermometer, while in reality possessing keeping quality infinitely superior to that of the unsanitary but well cooled milk discussed above.

Poor keeping quality means large number of bacteria in the milk. These bacteria are the result of one or more factors initial contamination (from cow's udder, milker's hands, utensils, etc.), length of period between milking and delivery at factory, and the temperature at which it is held during this period. In tests such as the methylene blue test, microscopic count, plate count, etc., these three factors are all considered; such tests are therefore much more reliable measures of keeping quality than the thermometer method, which measures but one factor and disregards the others.

Safety to Health

Quite apart from specific pathogenic bacteria, milk containing large numbers of organisms not usually consider to be disease-producing has been frequently established to be the cause of complaints such as summer diarrhoea of infants. Such disturbances are usually brought about by the ingestion of enormous numbers of bacteria, resulting in excessive fermentation and putrefaction in the digestive tract. For the detection of milk of this type, no special tests are usually required other than those already outlined for keeping quality.

Milk, however, is more commonly dangerous to human health when containing specific disease germs. These may be present in the milk as drawn from the udder, as in tuberculosis, undulant fever and septic sore throat, or may be introduced from human sources (typhoid, dysentery, scarlet fever, cholera, human tnberculosis, etc.) during milking and subsequent handling. In many cases the disease germs comprise an insignificant proportion of the total bacterial content, and it is rarely possible by ordinary analytical methods to demonstrate their existence in a given sample of milk. In most cases methods must be resorted to which are far too expensive and time-consuming to be used in the routine examination of milk supplies.

Since there are no tests available which are sufficiently practicable, public health authorities strive to reduce the amount of milk-borne disease by insisting upon sanitary methods of production and handling, disease-free dairy herds and employees, properly supervised pasteurization to destroy any disease germs which may have entered the milk, and proper protection from recontamination after pasteurization. By giving careful attention to all these points the health departments in most of the large cities have almost

completely eradicated milk-borne disease. In the smaller communities, this phase of health work has received less attention, and raw milk, often produced under dubious sanitary conditions and from diseased cows, is unfortunately still all too common. Where a supply of properly pasteurized milk cannot be obtained, raw milk of the best quality obtainable should be pasteurized in the home.[1]

Flavours and Odours

Because the substances responsible for undesirable flavours and odours in milk are present in quantities too small to be detected by chemical analysis, there are no tests available for their detection other than the senses of taste and smell. Since an abnormal flavour or odour is so readily detected by the consumer, the man inspecting milk arriving at the plant must be constantly on guard to prevent milk with a bad flavour or odour from being mixed with the remainder of the supply. Slight flavours from certain feeds often pass off during the pasteurizing process, but where garlic, gasoline, musty, rancid, disinfectant, or other objectionable flavours are encountered, such milk should be rejected as being unsuitable for human consumption.

Grading Milk on a Quality Basis

Since the milk dealer must supply his customers with as high a quality of milk as they demand, he in turn must take steps to ensure that the milk he purchases from each individual producer comes up to a reasonable standard; as judged by the tests described above.

The evolution of a single plan for grading milk on a quality basis which could be followed successfully in every district is too much to hope for. When the variation in conditions between different localities—different customs and practices which have grown up, different breeds of cattle, different standards of requirements by health departments and consumers,—different systems of marketing different climatic conditions, etc.—is considered, together with the complexity of the problem of giving proper weight to each of the factors involved in the determination of quality, the difficulty of achieving such an aim becomes apparent. This does not mean that grading cannot be successfully applied in every locality. Rather, it means that the system adopted in each district must be designed with careful reference to local conditions.

In spite of the obstacles in the way of formulating a single plan applicable to all conditions, there are nevertheless certain general principles which should be borne in mind in regard to the development of a system of grading milk. The first, and most important, is that high-quality milk—milk rich in fat, clean, of good keeping quality, free from objectionable odours or flavours, from healthy cows—is a more valuable product than milk lacking one or more of these desirable characteristics. The man producing the high quality milk should receive a higher price than the producer of lower grade milk. When this is carried out there is a definite financial incentive to every one to produce a high grade of milk.[2]

[1] A fuller discussion of the process of pasteurization, with directions for pasteurizing milk in the home, will be found in Publication.

[2] One of the most promising systems in this connection is the ranking of each shipper in order of merit for each month, the forwarding of a full report of standing to each farmer and the payment of a bonus to a certain percentage at the top—say 10 or 15 per cent of the shippers. Such a system not only rewards the careful producer but also stimulates keen rivalry among neighbours for the honour of standing highest in the district. In addition the distributor knows in advance the total cost of the premiums.

Other principles to be borne in mind include the use of the most suitable tests for determining quality, and the development of a grading system which is not too elaborate or complicated. A satisfactory system should make provision for daily sampling of milk for a periodical composite Babcock Test, for the detecting of off flavours, odours, bloody milk, etc., by the man inspecting the incoming milk and for the rejection of milk unsuitable for human consumption; for the periodical testing of sediment, preferably weekly; and for a similar periodical testing for keeping quality by one of the suitable tests previously discussed. Such a system would entail little extra work at the receiving plant, and would provide sufficient information for the ranking of the shippers in order of merit.

Finally, a system of grading must take into account local conditions, such as the present quality of milk supplied, the relative shortages and surpluses at different seasons, and the competition from other outlets for milk. Unless this is done, a grading system can scarcely be expected to give maximum satisfaction to all parties concerned.

It is regrettable that in certain districts producers have shown considerable hostility to the idea of grading milk, regarding it simply as a device whereby additional work is imposed upon them without any financial compensation. While adjustment of the price paid the producer in accordance with the grade of milk supplied has been attempted in only a few districts, the majority of dealers fully realize the justice of the underlying principle but have not yet found a satisfactory basis for grading and price differentiation. While payment on a grade basis is the quickest method to obtain an improvement, and the easiest means of maintaining quality at a high level, yet even where no difference in price exists, the producer of high grade milk benefits through the gradual elimination of the careless shipper who consistently fails to meet the standards set. This tends to reduce the competition in the city milk field since the careless producer must eventually drop out of dairying or seek some other avenue for the disposal of his milk. The production of milk for the city trade is becoming more and more a specialised line, in which a knowledge of the details concerning the production of a high grade product is a necessity. No article of food has such a direct relation to the nation's health and the public are quite within their rights in demanding that the old time dairyman, with his careless habits and limited knowledge of sanitation, shall give way to the better trained, more careful producer.

CASTOR PLANT; ITS CULTIVATION, AND UTILISATION OF PRODUCE

General.—The castor plant which is not cultivated on a large scale as other crops, except probably in a few patches here and there, makes its existence felt by its produce, viz., the oil, which is largely used in lubricants, lighting and as a laxative. Besides these there are several other uses to which the seed and oil are put; and the industrial utilization of the same on a large scale has given a great impetus to the cultivation of the crop, in spite of some inherent defects in its harvest. The chief difficulty lies in the fact that the crop does not often mature uniformly and such being the case it does not pay the ryot to grow on a large scale, especially in places where labour is dear. Dealing with such a crop on a co-operative basis, though grown in small patches, is really worth the trouble in view of the great demand, as the export and import figures in the sequel would indicate. It thrives in tropics and subtropics except in very arid regions. In temperate zones also it does well, but the summer is not sufficiently long to completely ripen the crop.

Botanical characters.—Castor (*Ricinus communis*) (*inn*) belongs to the natural order *Euphorbiaceae* and is widely distributed throughout the tropics. It is believed to be a native of North Africa and also probably of India. From an annual to perennial it is seen growing under varying climatic conditions and the height accordingly varies from 8 to 30 feet. The leaves have long stalks, are palmate, glaucous, green, and have serrate margins. The flowers of the two sexes are produced in terminal panicled racemes; the staminate flowers being seen at the base and the pistillate at the top. Fruit is a 3-celled, 3-sided capsule, covered with spiny prominences. The seeds are oval, vary in colour and are flattened on one side. When ripe the capsules dehisce and throw the seeds to a great distance, a point which has to be noted in connection with harvest. Owing to the poisonous nature of the castor seeds which contain 'ricin' the blood coagulant, it is not safe to allow the crop to ripen till the capsules dehisce, especially when it is grown adjacent to some other fodder crops. The seeds on pressing give nearly 50 per cent of oil, and this varies with the place of origin of the seed as follows:—

Uganda	...	48—50·8 per cent	Rhodesia	39·6	52·2—per cent.
Sudan	...	41—48·7 per cent	Fiji	47·4	49·6—per cent.

Cultivation, Harvest, etc.—As a rule all places suited for the cultivation of maize are suitable for cultivating castor. It is easily sensitive to frost, sand and places where the summer is sufficiently long are well-suited. It grows from the sea level up to a height of 5,000 feet. Sufficient rainfall is necessary till the roots establish themselves but afterwards very little is required. The soils that are best suited are well drained sandy or clay loams. In India alluvial soils and red soils at the foot of the hills are also well-suited. Soils which are poor in organic matter require manuring with sheep or cattle manure. Even in India which stands first as regards the world's supply of castor seed and oil, the crop is seen growing here and there either in mixtures with legumes etc., or as a border crop for sugar-cane and cotton. More often, it is seen cultivated in the back yards, waste places, manure heaps etc., which are in the vicinity of the ryot's houses.

Since the crop is deep-rooted, deep ploughing is necessary and this in India is generally done in cold weather to eliminate all grubs, eggs of insects, etc., which are carried away by birds, as the crop is often badly infested with these insects.

There are two distinct varieties of seed viz., the large and the small, 28 of the former or 55 of the latter go for an ounce, and the seed-rate can thus be easily calculated. The spacing between the rows and between the plants depends on the kind of seed used. If the small seeds are used, a spacing of 3 feet between the rows and 18 inches between the plant is required. In some cases preliminary soaking of the seed in water for 24 hours is recommended to soften the seed-coat, and facilitate germination. In India the large seeded variety is sown during the monsoon rainfall in small patches in gardens, whereas the small seeded one is used on a field scale at the end of the monsoon. Very little attention is needed after sowing except it be by way of a little intercultivation to remove weeds and conserve moisture.

The crop, depending on the variety sown, comes to harvest in 7 to 10 months if it is large, or 4 to 5 months if it is small. The capsules before they dehisce should be collected once a week and carried to a shed which is protected on all sides to prevent the escape of the seeds by the dehiscence of the capsules. The shed should be so constructed as to allow good sunshine and ventilation. On heaping for a time all the capsules dehisce and the shells are separated from the seeds by winnowing. The produce is then ready for marketing and should be properly stored. A good crop gives the following quantities of yield per acre depending upon the place and the climatic conditions.

India (mixed crop)	... 250 lbs.	India (pure crop)	... 500—900 lbs.
United States of America.	900—1350 lbs.	Ceylon	... 800—1200 lbs.
Queensland	... 1,000—1,600 lbs.	Egypt.	1000 lbs.

Pests.—There are a good number of insect and fungoid pests and they can be controlled by spraying with copper sulphate or Paris Green or by hand picking.

Utilization of castor seed.—The seeds contain 20 per cent husk and 80 per cent kernel. The whole seed gives 46–53 per cent oil and the kernel 58–66 per cent. The seeds contain a blood coagulating toxin 'ricin', and synthesising facts. The large seeded varieties give prolific yield of seed, whereas the smaller ones give less oil. The seeds are mostly used for the preparation of oil and as a source of *lipase* which is employed in the fermentation process of fat-splitting. *Preparation of oil.*—In India the methods of extracting oil are more crude compared to those employed in Europe and as such the export of oil from India has very much diminished, the seed itself being exported in very large quantities.

Exports from India

Year	Castor oil gallons.	Castor seeds tons.
1879-80	2,651,889	11,880
1889-90	2,664,990	44,731
1908-09	1,099,967	82,523
1928-29	538,652	121,346

There are two distinct methods of extracting the oil viz., the cold and the hot drawn. The cold drawn oil is clear and colourless and is used only for medicinal purposes. For the preparation of this, choicest seeds are taken and the husk removed after which it is pressed at a temperature not exceeding 90-100° F. By this method 33 per cent of oil is obtained which is free from the poisonous principle 'ricin'. The cake obtained is then broken and is either pressed at a higher temperature or extracted with an organic solvent like Benzol which gives a deep yellow or brown coloured oil, inferior in quality. This is only for technical purposes. In Britain the oil is treated with live steam to remove the albuminoid matter by coagulation. In America it is heated under ordinary atmospheric pressure or under reduced pressure by closed steam coils to remove moisture and then bleached by heating at 200° F. with 2–4 per cent Fuller's earth. The cold drawn oil is not acidic and hence no addition of lime is necessary. Broken seed or seed which has been decorticated and kept for a long time should not be used for extracting the cold drawn oil, as the enzyme, lipase, present liberates the free acids from the oil present.

Properties of the oil.—The physical and chemical constants are as follows:

Specific gravity at 14·5° C.	..	0·959 to 0·969
Refractive Index 40° C.	..	1·4679 to 1·4723
Viscosity (Redwood) secs. at 100° F.	..	1160 to 1190
Optical Rotation (200 mm).	..	7·5 to 9·0
Acid value	..	1·0 to 20·0
Saponification value	..	176 to 186
Iodine value (Wif's)	..	80 to 90 per cent.
Unsaponifiable matter	..	0·3 to 0·8
Acetyl value	..	148 to 151

The oil contains Glycerides of Ricinoleic, Oleic, Linoleic, Stearic and Di-hydroxi-stearic acids, but the characteristic properties of it are due to Ricinolein only.

Uses of Castor oil

(1) Cold drawn oil is used as a medicament.

(2) The most important use is as a lubricant in internal combustion engines and especially for aero-engines for which it is particularly suited owing to its remaining in a liquid form at low temperatures and retaining its viscosity at high ones.

(3) It is used for preparing Turkey-red oil in the dyeing industry.

(4) By heating it at atmospheric or reduced pressures at 300° C for several hours it is converted into a polymer which is soluble in mineral oils and is used as a lubricant.

(5) By heating the oil with sulphur or sulphur chloride at a high temperature, rubber substitutes are formed.

(6) It is not much used in the preparation of soaps as they are not easily salted out. Only a few transparent soaps are prepared with it.

(7) Other minor uses are in the preparation of 'cognac oil,' floricin, artificial leather, cutting oils, linoleum, wood oil and as an illuminant.

Use of castor seed as a hydrolytic agent.—The lipase contained in the seed is industrially used for the splitting up of oil, into Glycerine and Fatty acids and the latter are used in the preparation of soaps. The seeds are decorticated

and the kernels macerated with water to form a thick paste. This is centrifuged to separate the seed particles from the emulsion, and allowed to remain at 23° C for a day or two when fermentation sets in, and the emulsion separates into an aqueous layer and an upper layer of the consistency of thick cream. The aqueous layer consisting of an aqueous emulsion of castor oil fatty acids holding the lipase in suspension is used for hydrolysis.

The oil or fat to be hydrolysed is boiled well with dilute sulphuric acid and washed. This is then treated with half its weight of water and 7 to 10 per cent of hydrolytic agent obtained above, in wooden vats which are provided with perforated copper coils at the base to admit air for agitation. A small quantity of Manganese sulphate (0·2 per cent) is also added as a catalyst. The liquid after agitation is allowed to remain for a day or two till the hydrolysis is complete, and this depends on the activity of the enzyme. After hydrolysis is complete the emulsion is broken up by agitation, and also by adding a small quantity of sulphuric acid if necessary. The whole solution will settle down into 3 layers, the top one containing fatty acids, the bottom glycerine and water, and the middle a mixture of water, albuminoid matter, glycerine and water. The bottom and top layers are separated, and the middle one treated with sulphuric acid to recover some more of fatty acids. The top layer consists of fatty acids which are of a pale color, and good in quality, and these after washing well are used in the preparation of soaps.

Uses of the castor cake.—Because the cake contains the poisonous principle 'ricin', it is not used as a cattle food but only as a manure. Attempts were made to remove the 'ricin' by treating with salt solution and also by steaming, and even then the farmers do not patronise it, and are not prepared to take the risk. The composition of the cake varies with the method of pressing, and whether the seed is decorticated or not.

Composition of castor cake

	From whole seed per cent.	From decorticated seed per cent.	Castor seed meal extracted by solvents per cent.
Moisture ...	9·85	10·38	11·75
Ash ...	15·02	10·50	6·05
Oil ...	5·25	8·75	1·10
Protein ...	20·44	46·37	30·62
Fibre, Carbo-hydrates ...	49·44	24·00	36·52
P_2O_5 ...	1·62	2·26	13·96

Exports and Imports of castor seed and oil.—Regarding trade movements, India has been and still ranks first as chief source of supply of oil and seed in the whole world. Due to the primitive methods of expressing oil which are still in vogue in the country, the demand for it has considerably decreased giving place to the export of seed in enormous quantities, as will be seen from the tables below.

Exports of castor oil from British India

Country to which exported	1923–24 gallons	1924–25 gallons	1925–26 gallons	1926–27 gallons	1927–28 gallons
United Kingdom ...	296,261	219,122	320,647	467,215	264,486
Ceylon ...	23,495	26,257	30,820	24,016	31,295
Straits Settlements ...	19,546	20,048	23,169	22,223	17,439
Union of South Africa ...	50,567	43,989	57,392	33,912	58,866
Mauritius and dependencies ...	24,504	33,874	30,220	26,070	22,715
Australia ...	58,534	36,567	34,999	16,104	15,542
New Zealand ...	64,013	35,799	72,625	24,589	21,804
Germany ...	28,581	68,679	81,141	24,016	16,811
Others ...	15,829	13,140	48,073	8,969	25,493
Total ...	581,330	497,475	699,626	647,114	474,451

Export of castor seed from British India

Country to which exported	1923–24 Tons	1924–25 Tons	1925–26 Tons	1926–27 Tons	1927–28 Tons	1928–29 Tons
United Kingdom ...	14,780	24,668	29,930	22,883	32,540	25,552
Belgium ...	6,783	4,855	6,255	4,645	7,695	7,662
France ...	18,684	16,513	17,774	18,245	16,462	15,139
Spain ...	1,850	2,851	2,575	2,025	2,400	2,175
Italy ...	5,765	12,347	7,892	7,594	10,393	9,702
United States of America ...	35,673	32,181	43,860	43,731	49,291	56,074
Others ...	1,495	2,033	1,502	2,425	2,930	5,042
Total ...	85,030	95,448	109,788	101,548	121,711	121,346

How far other countries like United Kingdom and America are dependent on India for this produce will be seen from the following tables:

Import of castor seed into United Kingdom

Country from which imported	1924 tons	1925 tons	1926 tons	1927 tons	1928 tons
British India ...	22,564	28,768	25,687	30,372	35,519
Belgium ...	263	29	345	1,060	17
Brazil ...	1,135	383	388	1,368	106
Others ...	2,037	776	752	2,467	1,214
Total ...	25,999	29,956	27,172	35,267	36,856

Import of castor seed into the United States of America

Country from which imported	1924 tons	1925 tons	1926 tons	1927 tons	1928 tons	1929 tons
British India ...	31,855	37,669	40,336	48,818	...	...
Brazil ...	3,245	8,820	4,502	5,733	...	...
Hayti ...	204	472	66	39	...	...
Others ...	2,632	910	144	302	...	...
Total ...	37,396	47,871	45,048	54,892	...	...

Conclusion :—From the above figures it is more than evident that India plays a great part in the export of this valuable product, and in spite of the inherent difficulties felt in the harvest of the crop as already pointed out, it seems to pay the ryots even if grown on a small scale, particularly when the marketing of the material is undertaken on a co-operative basis. Attempts should also be made to extract oil by improved methods, as in other countries, thereby exporting the oil only and retaining the cake which is a valuable manure. (Extracted from a recent Bulletin of the Imperial Institute, London, by P. Satyanarayana).

College Day and Conference 1930

The 20th College Day and Conference will be held this year from July 15th to 18th. G. R. Hilson Esq., Director of Agriculture, Madras has kindly consented to preside over the Conference.

The following is the tentative programme :

Tuesday 15th July. Sports. M.A.S.U. 'At Home.'
Wednesday 16th ,, Exhibition.
Thursday 17th ,, Forenoon.—Exhibition.
Afternoon.—Union General body Meeting.
Friday 18th ,, 12 noon to 4 p.m. • Conference.
(*A Symposium on Sugarcane*)

NOTES AND COMMENTS

Imperial Council of Agricultural Research Advisory Board

A meeting of the Advisory Board of the Imperial Council of Agricultural Research was held in Simla on Monday, the 9th June and the succeeding days under the chairmanship of Dewan Bahadur Sir T. Vijayaraghavacharya. A number of subjects of varied interest were discussed and recommended for the consideration of the Governing Body.

A Popular review of Research

One of the recommendations was that arrangements should be made for the production of a semi-popular book on the lines of 'Research and Land,' reviewing the results of Agricultural and Veterinary research in India for the last twenty-five years.

Water-Hyacinth

The problem of water-hyacinth received the attention of the Advisory Board and an allowance of Rs 100 per mensem for carrying out research on water-hyacinth at Cuttack by Prof. Parija was recommended.

A Botanical section at Karnal

The establishment at Karnal of a Botanical section of the Pusa Institute was also among the recommendations for the consideration of the Governing Body.

Veterinary Research

Veterinary research received liberal consideration at the hands of the Advisory Board, resulting in the recommendation of (i) a research officer for five years for the investigation of contagious abortion of cattle at a cost not exceeding Rs 1,45,400; (ii) a protozoologist for five years at a cost of Rs 1,06,520; (iii) a research officer for equine diseases for three years at an expenditure of Rs 86,170 and a special officer for investigating tuberculosis and Joni's disease. The appointments are conditional that the recruitment should be made by the Public Services Commission. The Board rightly rejected financial assistance for a scheme of Veterinary Research in Central Provinces and it was interpreted that that the function of the Council was not to provide funds for expenditure on buildings required for the normal veterinary work of the province. The Board was however of opinion that if the local government provided buildings for the Institute itself, the council might later be disposed to consider favourably some useful scheme of Veterinary Research to be carried out at such an Institute. No grants were made for research work on Rinderpest and 'Haemorrhagic Septicaemia' as in the opinion of the Board it was both unnecessary and unprofitable for such a research as there were already available, very efficient products for combating Rinderpest and 'Haemorrhagic Septicaemia' and besides it was felt unlikely that at the present time they would not be able to obtain a suitable man for that purpose.

Locust Research

A contribution of £500 per annum may be made to the Imperial Bureau of Entomology for five years to the Empire Locust Research Scheme. In addition, recommendations were made for appointing Entomologists to study the locust problem.

Agricultural Intelligence Bureau

The establishment of a Bureau of agricultural Intelligence was recommended.

Mechanical cultivation

Another recommendation was to appoint a committee of Agricultural Engineers and Deputy Directors of Agriculture to frame a programme of co-operative experiments on Mechanical Cultivation, including within their scope, the eradication of deep-rooted weeds.

Rice Research

The Board considered a number of proposals and recommended special schemes for the improvement of Rice cultivation in the Central Provinces, Burma, Bihar and Assam and a general coordinated scheme for rice research. We are unable to see eye to eye with the Board in recommending grants for work which, in our opinion, should be ordinarily financed by the local governments.

Water requirements of crops

The Board was strongly of opinion that research into the water requirements of crops was a matter of urgent necessity and recommended to local governments the desirability of supporting work in this direction.

Agricultural Meteorology

It was resolved that a branch of Agricultural Meteorology be established, only half the total expenditure of the scheme being met by the Council.

Destructive Insects and Pest Acts

In regard to the working of the Destructive Insects and Pest Acts of 1914 with special reference to the problem presented by the maritime Indian States, the Board resolved that co-operation of the Indian States be sought as specific problems arose.

Interchange of Research workers

In regard to the proposal of the Imperial Agricultural Research Council of 1927 for interchange of workers, the Board considered that while research workers from abroad would be welcomed in institutions of India on due notice being given, it would not ordinarily be possible to arrange for exchange of workers from India owing to paucity of staff.

World's grain Exhibition

The invitation of the Government of India to participate in the World's Grain Exhibition and conference to be held in the City of Regina in the province of Saskatchewan from the 25th July to 6th August 1932 was accepted. It was agreed to recommend that Exhibits illustrating

Indian cereal productions—for example, specimens of pedigree strains of wheat, rice, barley—should be sent to the Exhibition and that arrangements should be made for papers on the improvements effected in Indian cereal crops being circulated at the Exhibition. A delegate might be sent to the Conference who in his turn would obtain information for subsequent diffusion in India.

Oil seed Industry

The appointment of a Committee to consider the development of the Indian oil seed crushing industry was recommended, as it was considered that the better utilisation of oil seeds was of great importance to Indian agriculture both for better feeding of cattle and for better manuring of Indian soils.

Soil colloids

A scheme of research into the colloidal soil constituents to be conducted by Dr. J. N. Mukherjee, Khaira, Professor of Chemistry, University of Calcutta was sanctioned, involving a non-recurring grant of Rs 200 and a recurring grant of Rs 2,000 for a period of 5 years.

Statistics

Mr. P. C. Mahalanobis, Professor, Presidency College, Calcutta, was recommended, a non-recurring grant of Rs 2,500 for a period of 3 years for statistical investigations on experimental errors in field trials.

Fruit growing

A scheme for research in fruit growing in Madras Presidency was not recommended on the ground that its consideration might be postponed till other provinces put up schemes for similar work. It is unfortunate that such a useful piece of work should suffer because other provinces had been late in putting up their own schemes.

Prizes

The award commencing from 1932 of an annual prize for the most striking Agricultural improvement of the year, was recommended by the Board. For the purposes of the award, groups of improvements would be as follows:

1. Veterinary, Scientific Instruments and appliances:
2. Dairying and the care of the animals;
3. Field implements and appliances;
4. Machinery for preparing crops for marketing for food or for storage;
5. Water lifts.

Medals

A recommendation was also made for the award of one or more gold medals and a number of silver medals for improvements of distinct merit in the science and art of Agriculture and Animal Husbandry. While the gold medals are for work of All India importance, the silver ones will be for improvements which are in the main of provincial importance.

Fertilisers Committee

The first meeting of the Fertilisers Committee brought into existence by the Imperial Council of Agricultural Research in December last, was held at Simla on the 16th, 17th and 18th June 1930. The Director of Agriculture and Mr. B. Viswanath, Government Agricultural Chemist are members on the Committee for Madras. This Committee was appointed for the investigation of problems relating to the conservation of indigenous manurial resources, the development of the use of indigenous fertilisers and the preparation of a programme of research, special attention being directed to

1. the careful study of the existing data and the correlation of the results hitherto obtained from field trials of (*a*) farm yard manure, (*b*) green manures, (*c*) oil cakes, (*d*) bonemeal, (*e*) fish manure, and (*f*) Indian Saltpetre.
2. the means by which the above manures may be conserved.
3. the means by which indigenous manures may be cheapened and their use extended;
4. further research in regard to the possibility of indigenous manures, especially in unirrigated tracts and in tracts with defective irrigation facilities.

At the outset the Committee realised that the enumeration of manures for inquiry was illustrative rather than exhaustive and that all manures, mineral and organic, may come within the scope of fertiliser enquiry. It was considered that the provincial departments of Agriculture were so understaffed that it would take a considerable time to collate and compile existing data on all experimental work on manures, without any special assistance from the Council of Agricultural Research. It was therefore recommended that the Council should give a small grant for 3 months to each province, without exception, for extra staff to do this work and that the grants should be for the salary of one Agricultural Officer on Rs 350 and one statistical assistant on Rs 200 for 3 months making a total contribution to each province of Rs 1,550.

In discussing the means by which the manures might be conserved, the Committee agreed that by conservation was meant not conservation in the technical sense of preserving the manure but in the sense of increasing the supply of manure to the cultivator. The consideration of this question would depend on the results of collation of previous experimental work. Meanwhile the position in regard to such indigenous manures like farmyard manure, green manure, oil cakes, bonemeal and fish manure and Indian salt-petre was discussed in detail by the representatives of the differeat provinces.

Every member of the Committee who has had any experience with manures and fertilisers complained about the adulteration of artificial manures. They felt that it was now no longer the case as stated by the Royal Commission on Agriculture advising against the passing of a Fertilisers' Act. But the time had come for the passing of an All India Fertilisers' Act. The Committee agreed to examine in greater detail by the time it next meets the necessity for the Act. In regard to cheapening the production of bonemeal, the Committee recommended the award of a prize of Rs 3,500 in each case for a bone crusher worked (*a*) by bullock power and (*b*) by engine power, a few conditions being laid down for the award. It was suggested that between now and the next meeting of the Committee, the possibility of easily disintegrating bone by previous fermentation should be investigated. Mr. Viswanath from

Madras, Dr. Harrison and Dr. Sen from Pusa and Mr. Sahasrabuddhe from Bombay undertook to carry out the experiments. In regard to Poudrette manufacture the Government Agricultural Chemist, Madras, referred to a recent number of the *Madras Agricultural Journal* (March 1930) wherein is described the bore-hole system of disposal of night-soil and other literature on the subject.

It is gratifying to note that we at Coimbatore have already been making use of night soil for Poudrette trenching and that the Activated Sludge plant has already been erected at our Institute.

Unbreakable Phonograph Records :—*Lac Industry ! Beware ! !*

These new phonographic records are the invention—according to the *Scientific American* of April, 1930,—of Dr. H. T. Beans of the Columbia University. They are made of a new product—called *Durium*—a resinoid substance which is a liquid in its original form but when subjected to heat becomes an insoluble, infusible solid, which combines hardness and flexibility to a remarkable degree. A thin film of this substance is so hard that it can scarcely be broken with an ordinary hammer and is almost as flexible as a piece of paper. The Durium phonograph record consists of a coating of only six-or-eight-thousandths of an inch of Durium upon a heavy fibre paper. This paper is impregnated with Durium, passed through a drying room out into workable sections, passed rapidly through a stamping machine, and finally printed with titles in another machine. The die with which it is stamped is precisely the same as those used in making the ordinary records.

It is reported that the records had not depreciated in any way even after having been used for 200 times, and that no injurious effects on its tone quality were perceptible even after being hammered and scratched with great force.

(When the Durium records are produced on a commercial scale, we are afraid that the lac industry may receive a big set-back.—*Editor, M.A.J.*)

Dishonest Advertising

During the past year or so, some of the Cigarette manufacturers of America had taken to advertising their products in a new style altogether, with the purpose of increasing their use among women, boys and girls. They had two principal lines of appeal. One was an attack on all sweet foods, and took the form, for instance, of the following slogan ' Reach for a *Lucky* instead of a sweet ', implying that sweet foods had a fattening effect and were to be shunned by those who wished to preserve a slender figure, and, on the other hand, their cigarettes would give the desired effect. The second consisted of the broadcasting of ' testimonials ' from various popular celebrities, such as professional athletes, moving picture actresses, popular war heroes, retiring generals, stage stars etc., the association of whose name was sought to throw out the implication that whatever success they had achieved in life in their various lines, had all been due to their use of the particular brand of cigarettes.

This naturally had the result of bringing against them of the resentment not only of an important group of business interests interested in sugar, but also of various organizations devoted to the improvement of public health and morals, such as the National Food Products Protective Committee, the American Medical Association, the World Society of Christian Endeavour, and various Church boards of education. It was evident that the sentiment of the

right-thinking public had been touched, and as a result the matter was investigated by the Federal Trade Commission. In their findings the Commission proved that the 'testimonials' had all been bought for a consideration, and that in many cases the celebrities mentioned in the advertisements had never smoked these or any other cigarettes!! It showed that the attempt to boost the sale of one product by attacking another class of commodities—especially a valued food—was creditable to the company concerned neither from the point of view of public health, nor even from that of business. The claims regarding the fattening effect of sugar-containing foods and the slenderizing qualities of cigarettes could not be substantiated, and the manufacturers of the particular brand of cigarettes have finally been called upon to 'cease and desist' from practices that cannot but be fairly characterised as a fraud on the public and as a public swindle.

Prof. H. E. Armstrong on Agricultural Research

In the course of a discussion on 'Scientific and Industrial Research in the British Empire' by Arthur W. Hill, C.M.G., Sc. D., F.R.S., Director, Royal Botanic Gardens, Kew, on Tuesday the February 25th 1930, Professor H.E. Armstrong, F.R.S., deprecated the use of the word 'research'. He said he would like to see that word banned from discussions, in general, as, to his mind, it signified little more than pottering in the laboratory.

He would suggest a new term—*Real-Search*—as meaning study and enquiry carried out scientifically, real study, under proper leadership, with a definite objective and some guarantee that rational use could and would be made of the results.

'Research workers, especially in agriculture, to-day, were for the most part an unco-ordinated whole, engaged upon trivial tasks, wasting a large amount of money. It was all very well, in the past, to accumulate results, hoping to make use of them. To-day we had *scientific method* at our disposal —if we chose to make use of it. We did not, as a rule. We allowed incompetent leaders to control incompetent workers—both incompetent, because they had no clear objective, never having been trained to think and to set out their results with effect. To tell farmers that you would accumulate facts for them to make use of was worse than absurd.

'To make agricultural enquiry effective to-day we needed a new class of workers—men with a fully developed sense of scientific method—not myopic specialists—men who would study the subject of an enquiry entrusted to them and fit themselves for it before entering upon the work.

'Primarily, the problems were economic. Take sugar and grain. Was not over-production, the greed to manufacture, the root-evil? Crookes made the fatal blunder of assuming that we should want for wheat in the future, because of the lack of nitrogen. We never could, while we had our atmosphere and the leguminous plant. Europe was fouling its own nest to-day by sending manufactured nitrogenous fertilisers to the East, there to be converted into sugar. As a consequence, in the face of such competition, the economic production of sugar in Europe was becoming impossible. Canada, he believed, "had grown more barley this last year than the world needed" —with the aid of cheap land and machinery. Man was now at a discount upon our lands.

Our country to-day had no agricultural policy—not a man, capable of formulating one. Here was the opportunity for—*Real-search* to begin. We needed to pool our knowledge and experience effectively—rarely brought the right people together—the blind were usually asked to lead the halt. We talk eternally of science and of research—but as yet there was no calculated scientific method in us. Our research was make-believe, in large part.

'With such problems in the offing, something more than sitting upon the laboratory stool—upon the fence—was depended of us: real hard thought—*Real-search*!'

Journal of The Royal Society of Arts—April 11th, 1930, pp. 598-600.

The Monsoon

Often very punctual in its appearance the South West Monsoon this year played a game of 'hide and seek' so to speak, till about the end of the month. As we go to press, the weather has changed really 'monsoonish' with drizzles and strong western wind. Unusually, in the early part of May, the Peninsula experienced almost monsoon weather conditions, Coimbatore receiving nearly six inches of rain in a week. This was, however, welcome not only for mitigating the heat of summer but also for cholam, green manure, fodder and other vegetable crops which put on a luxuriant growth. At any rate, such exceptional weather conditions in early May seem to have put off the monsoon for more than three weeks with the result that cultivation, particularly wet, has to be started much later than usual.

The College—New Admissions

The college reopened after the summer vacation on the 16th June for classes II and III. For the first time in the annals of the college, seven students of the first year class have not been promoted to the second year. It is a good system not to encourage pupils to undergo a course of study by pursuing which they are least likely to be benefited and for which they have otherwise distinctly proved themselves to be below the mark. This is bound to have a salutory effect upon succeeding batches of students who will be stimulated to take greater interest and devote greater time to their studies.

This year the Selection Committee (names of members of which were published in the previous issue) interviewed the candidates for admission, at Samalkotah, Madras, and Coimbatore as usual. After several days of arduous scrutiny and consultations, they selected 42 candidates, representing all the districts of the Presidency and consisting of 24 non-Brahmins, 12 Brahmins, 4 Christians and two Mahomedans. Six more candidates are expected to be sent in from the Agency Tracts to make up the total to 48, the maximum number the college can now provide for. The following is the distribution of candidates according to districts. Ganjam 2, Vizagapatam 1, W. Godavary 1, E. Godavary 3, Kistna 1, Guntur 2, Nellore 1, Chittore 4, Bellary 1, Kurnool 1, Anantapur 3, Chingleput 1, Madras 4, Cuddapah 1, N. Arcot 2, S. Arcot 1, Tanjore 1, Nilgiris 1, Coimbatore 2, Salem 1, Trichinopoly 1, Madura 1, Ramnad 1, Tinnevelly 2, Malabar 2, South Canara 1, (Agency 6).

Mr. U. Vittal Rao

An Ex-Secretary of the Union and one connected with the Working Committee for several years, Mr. Vittal Rao needs no introduction to most of our readers. After over a decade of creditable work at the Imperial Sugar-cane Station, he joined the teaching staff of the College recently. He

has been one of the most conspicuous figures in the sports field, particularly in Cricket and Hockey. As a Hockey Coach he has been an inspiration and a model to the students. His transfer to the Samalkotah Agricultural Research Station as the Farm Manager is therefore regretted. However, we sincerely wish that this is for his own good as well as that of the Department, since he can, by his previous experience in Sugar-cane work, utilise his knowledge to the best extent in the improvement of cane in the Circars. We wish him all success and luck in his new sphere of activity.

GLEANINGS

Sugar and Convulsions

When changes occur in the blood, the body reacts in various manners according to the chemical substances that may be present. If the amount of sugar in the blood is extremely low, the patient becomes confused and may develop convulsions. This has happened in some cases when an overdose of insulin has been taken. Whenever this occurs, it is customary to feed quantities of sugar and orange juice to supply the deficiency and the convulsions are promptly relieved after taking the food.—*Scientific American.*

Effect of Fumigants on the Germination of Seeds

Wheat, oats, rye, barley, corn, buckwheat, sunflowers, beans, Lima beans, cowpeas, alfalfa, clover, and timothy seeds may be fumigated with *tertiary butyl chloride*, *isopropyl formate*, *ethylene dichloride*, and *trichloroethylene* in concentrations up to twice the minimum lethal concentration required to kill rice weevils without seriously impairing the germination of the seeds.

Ethylene oxide and *methyl chloroacetate* seriously impair the germination of these seeds.—*Journal of Agr. Research*, Vol. 39, No. 12.

An Extraordinary Artesian Spring

The *Engineer* of May 16th, 1930, contains a note on the sinking of an extraordinary artesian well in Slough, England, which is considered to be one of the largest in the world. The total depth of bore is 1042 feet sunk through layers of chalk. When the lowest 'green-sand' layer was touched, a remarkable overflow happened, the water rising to a height of 30 feet in a solid column a foot in diameter. The total discharge is calculated to be 250,000 gallons per hour. On analysis the water was found to be very satisfactory, the total hardness being 6 deg. (Clarke's scale).

Xylose Sugar

In the xylose experimental factory at Anniston, it was found by the Bureau of Standards that the gums and ash must first be removed from the cotton-seed hull bran. This is accomplished by washing the bran with cold water, followed by cold, very dilute sulphuric acid. Treatment with hot dilute sulphuric acid hydrolizes certain constituents of the bran to form xylose which dissolves the acid. The solution is then partially neutralized with calcium carbonate treated with carbon to remove the yellow colouring matter, filtered and evaporated to a rather thick consistency. When this solution is cooled, xylose crystalises out. There is at present, no market, however, for this 6-carbon sugar, and the Bureau are sending out samples asking for suggestion for its profitable utilization.—*The International Sugar Journal*, April 30.

Sugar as Food

Dr. Donald A. Laird, Director of the Colgate University Psychological Laboratory, in reporting the outcome of a series of experiments to determine the best means of counteracting mental and physical fatigue, declares that the secret of recovering mental poise and physical energy is to take more sugar in tea or coffee. He asserts that in almost every mental and physical test it was found that sugar helped the subject to recover mental and motor control after exercise. Sugar, instead of being fat-forming, he declares, builds up energy.—*The International Sugar Journal.* Vol. XXXII, No. 376, P. 212. April 30.

Vitamin-B Value of Some Foodstuffs

A number of tests have been made to establish the relative status with regard to the Vitamin B content of certain pulses and nuts. The tests were performed by subjecting pigeons to diets lacking in Vitamin B except in so far as it was contained in the added pulse or nut. Dried yeast was taken as a standard and placed at 100. Four per cent of yeast included in a diet was sufficient to maintain a pair of pigeons in good health. Of the food-stuffs examined, groundnuts were found to have the highest content of Vitamin B. They had a value of 29 relative to dried yeast. For maintenance, a diet required 20 per cent. of groundnuts. Hazelnuts had a similar value. Soya beans were found to have a relative value of 13, necessitating the inclusion of 30 per cent. in a maintenance diet. Almonds had a value of 10. Coconuts and wasted coffee had no maintenance value for pigeons, while green coffee had a low value. Biochemical Journal—Vol. XXIII, p. 546.—From *Tropical Agriculture*, Vol. VII, No. 2, p. 53.

Carbon Dioxide Gas used to Fight Fire

Carbon-dioxide is, of late, being extensively used for fire fighting. It is comparatively easy to liquify and as in that condition it can be safely handled, its fire-blanketing properties can be utilised for bringing conflagrations of certain kinds under control. In using liquid carbon-dioxide, not only is the fire-blanketing quality of the gas made use of, but also the flame is directly quenched because, owing to the high pressure under which it is stored, the carbon-dioxide falls on the fire at a temperature far below zero. This is the principle on which the 'Fyre-Freez' system is based.—*Scientific American*, December 29, p. 534.

Burn Aluminum Dust for Intense Flame

A flame so intense as to melt its way through any known solid substance is produced by a new type of blowpipe, employing finely powdered aluminum instead of the more familiar hydrogen or acytelene gases. The new invention

was described by Dr. Frank M. Strong of Syracuse University, speaking before members of the American Chemical Society.

Dr. Strong's blowpipe cambines the principles of the familiar oxy-hydrogen or oxy-acytelene blowpipes with that of thermite, a powder used for the generation of intense heat on a limited area, such as the ends of rails in welding. Thermite consists of aluminum powder mixed with another chemical which on heating yields free oxygen at a rapid rate. In the new blowpipe the oxygen is supplied directly in the form of a gas instead of being generated on the spot from a chemical.—*Science Service.*—From *Scientific American*, December 29, p. 544.

A Novel Method for Making Citric Acid

Citric Acid from lemon juice and similar raw materials without the intermediate production of citrate of lime, has been worked out by Prof. Dr. C. Crotto of the School of Pharmacy in Buenos Aires, says a recent issue of 'Quimicae Industria.'. The elimination of the usual step of neutralising the acid of lemon juice with lime to form calcium acetate is expensive and the yield poor, so that this novel process promises appreciable savings.

In outline the process is as follows: The lemon juice is concentrated in vacuo to the consistency of a semi-solid and is then macerated with acetone, the weight of acetone being double that of the concentrated juice. The albuminous, pectic, mucilaginous, and other insoluble substances are separated by filtration and the filtrate treated with half of its weight of distilled water. The citric acid dissolves in the water and the acetone is separated and recovered. The process is patented and is stated to give perfectly satisfactory results on a semi-large scale.—*Scientific American*, December 29, p. 545.

Production of Tantalum

Tantalum, the metal rarer than gold, which absorbs 740 times its volume of hydrogen gas, successfully resists attack by the strongest mineral acids, and changes alternating into direct current, is finding greater use for dental instruments, surgical tools, pen points, hypodermic needles and acid proof pumps, Professor George W. Sears of the University of Nevada, reported to the American Institute of Mining and Metallurgical Engineer.

Even though tantalum was used for electric light filaments in 1906, until the past few years it has been only a rarity. It forms a much smaller portion of the earth's crust than gold. The production in 1928 was 35,000 pounds.

Because it absorbs gas so well, it is used for the metal parts of vacuum tubes. Although there are other substances which when used as an electrode of an electrolytic cell permit the passage of electricity in only one direction, tentalum is the best. Electrolytic rectifiers for charging storage batteries contain it. 'Aqua regia, which readily dissolves both platinum and gold, has no action on this metal,' continued Professor Sears. Hydrofluoric is the only acid successful in attacking it. Strong alkalies have no effect on it.

Tantalum can be cold-rolled to a sheet one thousandth of an inch thick. It is found in the Black hills of South Dakota and in Australia.—*Science*, Vol. LXXI. No. 1834.

'Weighting' of Silk

Silk, as the silkworm produces it, is covered with an outer layer of soluble gum, known as *serecin*. This is removed by treatment in a hot alkaline bath

of soap with sulfonated oils or silicate of soda. The loss in weight due to this process is about 25 per cent. The restoration of this loss is accomplished by successive treatments in baths containing chloride of tin, sodium phosphate, and silicate of soda; but as a well-known textile chemist has recently said, the fibre has no judgment. It will go on taking up mineral matter until it no longer retains properties which we value in silk.

Every dyer knows that weighting 'plumps' the silk fibre, and improves its lustre, the feel of the goods is better, and the dyer says it has a better 'hand'; the increased weight also gives a better effect in draping. All of this results in a steady demand for silk which contains enough mineral matter to make it weigh 50 per cent more than in the raw state.

Silk is a very strong fibre and one would naturally expect the weighting to reduce its strength, but recent investigations show that moderate weighting actually increases the tensile strength of silk. It only begins to decline when the amount of mineral matter is enough to raise the weight of the fibre more than 50 per cent.

Elasticity declines at lower weights than tensile strength. A fibre which showed 26 per cent stretch after boiling off, but without weighting, showed 28 per cent stretch when weighted 30 per cent above par, 24 per cent at 40, and 20 per cent at 50 above par.

Quality of silk in relation to the conditions of its use requires much further study. There is good reason to expect that its resistance to abrasion and wear will be found better after proper weighting than before.—*Scientific American*, December 1929.

Invisible Stages of Germs

Scientific men have often been baffled in their search for disease germs, because germs have a stage or stages of development in which they are too small to be recognised by microscopic examination, filtrable through fine filters and, for a time at least, non-cultivable by ordinary methods. This is the opinion of Dr. Philip Hadley, of the Medical School of the University of Michigan. Dr. Hadley, known for his studies on the transformations which bacteria undergo in artificial cultures and in the body, told a gathering of scientists at Ann Arbour that he had been successful repeatedly in causing disease producing bacteria, appearing under the microscope and in cultures in the conventional form, to undergo dissociative changes which rendered them invisible and filtrable through fine-grained earthen and porcelain filter candles. After further laboratory procedures these minute bodies were made to re-develop into the 'normal' form. Sometimes weeks or months were required to effect this reversion.

Should Dr. Hadley's experiments and conclusions be correct—and it was admitted that it was more than possible that they were—a number of firmly held notions in present-day bacteriology would seem to demand some revision. This refers to such matters as valid criteria for judging the sterility of normal or pathological tissues and body fluids, criteria for judging when a bacterial culture was really dead, the true significance of so-called 'bacteriolysis' and the bacteriophage phenomenon; also perhaps the biological relation between the filtrable forms of bacteria and some of the so-called filtrable viruses.

Dr. Hadley had emphasised the need of studying bacteria not alone with reference to the ordinary forms that is well-known to bacteriologists and described in the text-books, but also with reference to the other cyclostage in

which the organisms masquerade for a time, and in which form they are seldom recognised. One of the most important of these is the filtrable form which appears in the G-type culture.

The speaker voiced the opinion that, contrary to the belief, any bacterial species in its entirety is not so simple a thing that it can be revealed by a study of a single cell or a single culture; but that it is highly intricate in its cellular organization. This might be taken to mean that far more remains to be discovered regarding the complex biology of many 'well-known' microbes than is already known by bacteriologists to-day.—*Science Service, Washington, D. C. Science—Supplement, March 14, 1930.*

Vitamins

If you want a vitamin,
With the alphabet begin.
First, there is A—dissolved in fat—
Cures, they say, rickets that
Might perhaps, sometimes attack
Children good or bad or slack,
Cures neuritis—poly kind—
In your body or your mind,
Butter, lettuce, eggs, and milk
All will make you feel like silk.
Eat 'em, drink 'em, bite 'em in,
If you want A-vitamin.

Next comes B-in water found—
So you see it's all around.
If you've beri-beri had,
You'll be very, very glad
After you have eaten B,
For improvement you will see.
Graham flour and husky rice,
Fruit and vegetables nice,
Milk and cheese contain the B
That will make you brave and free.
Eat 'em, drink 'em, bite 'em in,
If you want B-vitamin

Now we come to vitamin C
Called the best of all the three
If you'd 'curvy' be
And from scurvy free,
Dont say it's no use.
Drink a quart of orange juice,
Or you may instead
Such a large tomato red.
Eat 'em, drink 'em, bite 'em in,
If you want C-vitamin

Cautious words in books profound
Say that vitamins abound
In foods we'd scarce suspect.
So in eating dont neglect
Things the vitamins will give,
Some they say will make you glad,
Healthy, lucky, thin or sad
Whatsoe'er the letter be—
D or E or F or G,
H or I or may be J,
Possibly it may be K,
L, M, N, O, P,
Q, R, S, or T,
Still it may be U or V,
Or it may be even Z.
Wise ones say the end's not yet
While we have the alphabet.

Lyman C. Newell in *Industrial and Engineering Chemistry.*

College News and Notes

The Conference.—The Annual Conference is to take place on the 18th July when a symposium of five papers on Sugarcane will be read followed by a discussion. Mr. T. V. Rajagopalachary, Vice Principal, Rao Bahadur T. S. Venkataraman, Government of India Sugarcane Expert, Rao Bahadur B. Viswanath, Government Agricultural Chemist, Mr. S. Sundararaman, Government Mycologist and Rao Sahib Y. Ramachandra Rao, Government Entomologist have consented to read papers on the Agricultural breeding, manurial, pathological and entomological aspects of sugarcane cultivation. A special demonstration of the correct method of erecting the Sindwahi furnace will be conducted by Mr. D. Ananda Rao, the Head-quarters Deputy Director of Agriculture. Sixty-three subordinate officers from the moffusil are permitted to attend the conference.

Athletic Sports.—The Annual Athletic Sports of the College are announced to take place on Tuesday the 15th July commencing at 3 p.m. The cross-country race will be run on the 8th July.

Indian Tariff Board.—Mr. A. E. Mathias, President, Dr. John Matthai, Member and Mr. G. S. Bozman, Secretary of the Tariff Board arrived in Coimbatore on the 27th June to hold an inquiry into the question of Protection for the Indian Sugar industry. The Board held its sittings at the Imperial Sugarcane breeding station and examined Mr. V. C. Vellingiri Gounder, landlord, Rao Bahadur T. S. Venkataraman, Government of India Sugarcane Expert, Mr. A. T. Krishnaswami Mudaliar, proprietor of a local refinery and distillery and Messrs. M. P. Kunhi Moosa and Chellappa Ayyar, wholesale jaggery merchants. The members of the board inspected the Imperial Sugarcane Station and Mr. Krishnaswami Mudaliar's Sugar refinery.

Indian Central Cotton Committee.—Mr. D. G. Munro, who was recently nominated as a member of the committee, left Coimbatore for Poona on the 22nd June to attend a meeting of the I.C.C.C.

Send off to Mr. Vittal Rao.—On the eve of his transfer to Samalkot, the members of the Union Working Committee were 'At Home' to Mr. U. Vittal Rao on the 3rd July in the M.A.S.U. hall. Mrs. Vittal Rao was the chief guest at a similar function held on the same day at the Ladies' Club. The students of the College entertained Mr. Vittal Rao on the 4th instant at a tea party held in the Freeman buildings.

Games.—With the re-opening of the College, Sporting activities have revived and the College Maidan is as lively as ever before. The Agricultural Officers' Cricket Club has also recommenced its activities and the season was appropriately commenced with a match against the Stanes' European High School on the 22nd June. The officers who won the toss took the first tenancy of the wicket and hit up a total of 176 runs. The chief scorers on their side were Padbhanathan (52), Subramaniam (43) and Venkoba Rao (43). Stanes replied with 102 for 4 wickets of which Aldridge (42), Gabriel (29), George (25), and R. Tirus (12) were the chief scorers. The match thus ended in a draw.

Association of Economic Biologists.—The inaugural meeting of the Association came off on the 20th June in the Freeman Hall. Dr. T. V. Ramakrishna Ayyar, the President of the Association in his opening remarks traced the origin of the Association and remarked that its formation was by no means too early in a place like Coimbatore. He explained the objects of the association and the advantages which an organisation of its kind would give to its members who are working in different specialized fields of Science. This was followed by a paper read by the President on 'The role of the Zoologist in the field of Applied Biology.' The writer made a brief but masterly survey of the history and development of the Science of Zoology and reviewed the progress made in the field of Applied Biology affecting the material well-being of man. Brief references were made in the paper of some of the remarkable achievements in Zoological work to illustrate how a knowledge of various animals in their different phases and diverse activities has helped the scientist and the layman to utilize such knowledge for the every-day needs of man. The paper was illustrated by lantern slides.

This was followed by a paper on 'The influence of rainfall on the yield of Cotton' by Mr. S. N. Venkataraman. In this paper a quantitative study was made of the effect of rainfall, as judged by its distribution in the several fortnights of the year, on the yield of the cotton crop at Nandyal and Koilpatti for the last 20 years. Incidentally the nature of the rainfall distribution within the same year and from year to year in the two tracts was presented as also the course of the yield in a cycle of years. The two papers were followed by some lively discussion in which a large number of members took part.

Visitors.—Mr. P. V. Isaac, Ag. Imperial Entomologist, Pusa arrived in Coimbatore on the 6th July in connection with his study of the *Tabanidale.*

The ladies of the estate took advantage of Miss Park's visit to Coimbatore, to arrange for a lecture on 'Health in relation to citizenship.' The lecture was held in the Freeman hall before a large gathering of ladies. Another day, Miss Park gave a talk on 'Food and Nutrition' to the members of the hygiene class.

Agricultural Estate Committee.—Information has been received that Government have ordered the abolition of the College Board and the constitution in its place of an Agricultural Estate Committee, with the Principal as its *ex-officio* chairman and the heads of offices and two elected members from the staff of the College and Research Institute as its members. Voting for the elected seats has been announced to take place on the 21st July.

Weather Review

JUNE 1930

Rainfall Data

Division	Station	Actual	Departure from normal
Circars	Gopalpore	8·4	+2·6
	Vizagapatam	3·4	—1·5
	Cocanada	6·7	+1·9
	Masulipatam	6·6	+2·1
Ceded Dists.	Kurnool	3·6	+0·7
	Bellary	0·9	+1·0
	Anantapur	1·8	—0·2
	Cuddapah	4·2	+1·3
Carnatic	Nellore	4·6	+3·3
	Madras	3·1	+1·2
	Cuddalore	0·8	—0·8
Central	Vellore	4·7	+2·3
	Salem	2·3	—0·7
	Coimbatore Town	1·0	—0·7
	Coimbatore Research Institute	1·2	—0·6
	Trichinopoly	2·5	+1·1
South	Negapatam	0·7	—0·6
	Madura	3·4	+2·1
	Pamban	0·1	—0·1
	Palamcottah	0·2	—0·4
West Coast	Trivandrum	13·9	+0·5
	Cochin	25·4	—3·1
	Calicut*	25·7	—7·5
	Mangalore*	33·2	—2·3
Mysore and Coorg Hills	Bangalore	1·5	—1·4
	Mercara*	18·0	—7·4
	Kodaikanal	4·3	+0·3
	Coonoor	7·3	...

* Totals only up to the 29th owing to telegraphic interruption.

General summary of weather conditions

The monsoon conditions that should have appeared off the Malabar Coast about the first week of June did not appear till the 15th and thereafter the Monsoon appeared feebly and by the third week of the month had established itself though it did not penetrate far into the interior. Weather was disturbed off the North Madras Coast and a depression formed there towards the end of the month occasioned moderately heavy rainfall during the last few days of the month.

Rainfall was in excess in the Circars, and the East Coast down to Madras, in moderate defect on the West Coast and nearly normal elsewhere. No heavy falls were reported except for 3·1″ at Mangalore and Gopalpore on the 17th and 26th respectively. Rainfall associated with the advance of the monsoon was remarkably feeble and was not associated with rough seas and squally weather as is usual. It was heavy on the Konkan and in Burma and Assam out of the reporting area.

Temperature was very high in the South Circars and the East Coast for the first six days of the month and then fell very rapidly and was below normal over the greater part of the area for the rest of the month. Cocanada reported maxima of 113° on three days and Masulipatam on one day, this reading being the highest for the Presidency for this year.

Weather Report for the Research Institute

Absolute Maximum in Shade	94° · 0
Do Minimum in Shade	70° · 0
Mean Maximum in Shade	88° · 4
Do Minimum in Shade	73° · 2
Total Rainfall in month	1 ·22 inches
Mean Rainfall	1 ·83
Heaviest fall in 24 hours	0 ·28
Number of rainy days	4
Mean daily wind velocity	7 · 4 M. P. H.
Mean 8·00 Hours wind velocity	7 · 4 ,,
Mean Humidity	73 · 7 %
Total Hours of bright Sunshine	160 · 7 Hours
Mean daily hours of sunshine	5 ·36 ,,

Summary of weather conditions

Pressure at the beginning of the month was steady but exhibited the usual oscillatory movements characteristic of the weather at the end of May, the first movement being from the 4th and ending on the 8th, and the second starting on the 13th and the pressure reaching the trough of the curve on the 15th when the monsoon appeared on the West Coast for the first time. The movements being apparently a preliminary to the approach of the monsoon waves from the South-west. Thereafter the pressure was low and reached the lowest point on the 26th when the monsoon was very vigorous on the West Coast.

Rainfall was scanty and totalled only 1·22 inches, the departure from normal being 0·61 inches. Of this, rainfall of 0·33″ was due to local storms of the summer type accompanied by line-squalls from the North-East. Thunder and lightning were frequent for the first half of the month, but was rather feeble in intensity.

The wind was mostly from the South-West and the movement was vigorous during the second half of the month, the velocity being 15 M. P. H. on the morning of the 26th.

Temperatures were generally low during the second half of the month, and diurnal variation was low, being only 7° on the 27th.

Summary of the Official Monsoon Forecast for 1930

'Monsoon rainfall in India for the period June to September is affected by previous conditions over various parts of the earth. Not all the governing factors are known, but sufficient have been discovered to warrant in most years the issue, with a reasonable chance of success, of forecasts for certain areas. Statistical investigations carried out by Sir Gilbert Walker have shown that the rainfall of the Arabian Sea monsoon is an integral part of an oscillation extending over a large part of the earth's surface: abundant Indian rainfall tends to be associated with excess pressure over an area including the central Pacific Ocean, Chile and the Argentine, and with a defect of Pressure in the Indian Ocean and the Cape, a defect of rainfall in Java, south Rhodesia and the Zanzibar District and a defect of temperature at Dutch Harbour which provides an index of the activity of air circulation in the extreme north of the Pacific.'

From the information available this year the following inferences are drawn:

'For the Peninsula (taken to consist of Gujerat, the Konkan, the Bombay, Deccan, the Central Provinces, Hyderabad and North Madras coast) the factors found to be of most importance are rainfall in Java, South Rhodesia and Zanzibar district, pressure in South America and the Cape and temperature at Dutch Harbour. This year the data from Java, South America, Zanzibar, Rhodesia and the Dutch Harbour are favourable while those from the Cape alone are unfavourable. Taken together the factors indicate that the monsoon rainfall in the Peninsula will be above normal.'

'For the North-west India . . . . . the data suggest that the rains in North-west India will be established later than usual but that the total amount will not differ by a large amount from the normal.'

'Knowledge of the factors governing rainfall in other areas e.g., South Madras and Burma, is still meagre, and unless all the factors for any of these areas point conclusively in one direction, the issues of a forecast for that area is not statistically justifiable. As regards North-East India, the wind and rainfall data at Seychelles suggest that monsoon conditions in that area will as usual not differ greatly from normal.'

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

Departmental Notifications

First Circle :—Mr. V. Achyutharamayya, Farm Manager, Anakapalle, leave average pay for 2 months from 8-6-30 ; Mr. P. V. Sambasiva Rao, Agricultural Demo trator, Yellamancheli, leave on average pay for 2½ months from 23-6-30 ; Mr. M. N simhan, Farm Manager, Agricultural Research Station, Samalkot, transfer to Cc Specialists' section from 1-7-30 ; Mr. A. Kondayya Sarma, Assistant Agricult Demonstrator, Nidadavole, extension of leave on average pay from 15-6-30 ; Mr. Su narayana, Agricultural Demonstrator, Bobbili, extension of leave on average pay for 8 c from 21-6-30.

Second Circle :—Mr. K. V. Seshagiri Rao, Assistant Agricultural Demonstra Guntur, extension of leave on average pay for 24 days from 10-6-30.

Third Circle :—Mr. T. Krishna Reddy, Agricultural Demonstrator, Siruguppa, le on average pay for 9 days from 5-6-30 ; Mr. R. Gopalan, Agricultural Demonstra services dispensed with from 15-6-30 ; Mr. Veeraraghava Rao, District Agricul Officer, Nandyal, promotion from II to I grade.

Fourth Circle :—Mr. V. Kumaraswami, Farm Manager, Kalahasti, leave on avera pay for one month and 5 days from 2-6-30 ; Mr. Swami Rao, District Agricultural Offic Vellore, promotion from II to I grade.

Sixth Circle :—Mr. C. S. Namasivayam Pillai, Assistant Agricultural Demonstrat Rajapalayam, leave on average pay for 2 months from 15-6-30 ; Mr. C. A. S. Ramalinga Pillai, leave on average pay for one month from 1-7-30.

Seventh Circle :—Mr. A. P. Balakrishna Nair, Agricultural Demonstrator, Ponna leave on average pay for 17 days from 7-6-30.

Live-Stock Section :—Mr. M. P. Kunhikutty, Live-Stock Demonstrator, Coimbat transfer to Hosur ; Mr. H. Narahari Rao, Farm Manager, extension of leave for 5 d from 22-6-30 ; Mr. N. V. Ramayya, Farm Manager, Chintaldevi, extension of leave average pay for 2 months from 16-5-30.

Principal's Section .—Mr. U. Vittal Rao, Assistant Lecturer in Agriculture, transf Agricultural Research Station, Samalkota.

Systematic Botany Section :—Mr. M. Ratnavelu, Snb-Assistant, leave on average for 2 days from 23-6-30.

Latest Notification :—The following Upper Subordinates are confirmed in t appointments on the expiry of their probation :—

Science Section :—Messrs. T. Narayana Rao, K. Kunhikrishna Nambiyar, G. Ran badran, S. Ramachandra Rao, V. Krishnamurthi and M. K. Venkatasubramaniam.

Agricultural Section :—Messrs. C. Raman Mosad, K. Krishnan, P. K. Natesa M. Vydianathan and S. Muttuswami.

cc