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Editorial.

Stricken Bihar. The quaking of the land of Magadha has cast a gloom over the country. Its peaceful agriculturists are in distress. Many have lost their near and dear, and extensive damages to property have occurred. Rain, disease, and insecurity fill the cup. Bihar is one of the strong-holds of the sugar industry and at a time when that industry was all hopeful, this gloom has come over it. The Central Agricultural Research Institute at Pusa has lost her wings and it is a problem if she will recover her former wholeness. This special hit at the agriculturist is distressing. Mother Earth conjures up ever-amiable pictures of succour and patience and one wonders why she has quaked with such grim effect. The intense out-burst of sympathy from all over the world comes to mind at once; next, the gush of efforts at self-help. These two upwellings of intense human consciousness have their deep constructive aspects. The foundations of human sympathy are here laid deep and so well as to be quake-proof. The poet said that one touch of nature makes the whole world kin and the response seems similar when Mother Earth quakes.

Cattle Eugenics. At the last session of the Bombay Legislative Council, an important act affecting the improvement of cattle in that Presidency was passed. This act provides for the compulsory castration of undesirable breeding bulls. These bulls at present roam about the village and are the usual source of service. They are of unknown pedigree and as a single bull leaves a very wide circle of progeny it is

desirable to control these centres of cattle wealth with a view to ensure a steady supply of sound cattle for work, meat and milk. This castration begins in villages supplied by premium bulls of the Livestock Expert and spreads to other villages as more bulls become available. We commend this act to the notice of our rural members of the Legislature and urge them to initiate a similar measure for Madras.

Road Development in Rural Areas. Colonel H. C. Smith, General Secretary, Indian Roads and Transport Development Association, speaking at the Lahore Rotary Club remarked as follows:— "In view of the fact that money can be obtained to-day at far more advantageous rates of interest than it has been possible in the past or even likely to be in the near future, this opportunity of constructing roads in the rural areas on behalf of the much distressed agriculturists must not be allowed to escape". He quoted the Road Development Committee to say that metalled roads probably meant a saving to cultivators of two annas per mile, on every trip his cart made, and pointed out that there were approximately six million bullock carts, of which perhaps four million used roads, and there were only 60,000 miles of metalled roads as compared with 140,000 miles of unmetalled roads in India. He considered the necessity for co-ordination to prevent unrestricted competition and the need for uniformity and a more equitable basis of taxation of road transport.

In this connection it is interesting to note the following from the report of the 1927 Committee of the Legislature to enquire into the Indian Roads:— "It is indeed somewhat incongruous that there should be nearly 40,000 miles of railway in India, while the total mileage of surfaced roads in British India is only 59,000." Mr. W. Rees Jeffreys, Chairman of the Roads Improvement Association, finds that in England and Wales (which have the most congested highways in the world) there are 2'58 miles of surfaced highway to every square mile of area, and 1 mile to every 266 of population, whereas British India possesses only '052 miles to every square mile of area, and 1 mile to every 4,600 of population, and this small mileage is reduced in value by lack of bridges over rivers. In 1930—31 the net loss on railways to the state after meeting all charges for interest etc., was according to him 4'18 crores. With the awakening of interest in rural development and the consciousness of the basic fact that Indian life is wholly rural, it will be obvious that the sooner there is a well-planned scheme of rural communication, the better.

As the "Indian Roads" journal remarks— "It is generally held that in India road communication is so backward, and so adversely affects general prosperity, that the loss to the railways of certain short-haul traffic will be far outweighed by the general stimulation of traffic and trade of all sorts that will follow upon the development and improvement of roads". It will be seen that the interests of roads

and railways can be made identical by a sound system of co-ordination and we urge in the interests of the Indian cultivator, his amenities and economics, that this should receive attention without delay.

Credit Facilities for Agriculturists. The decision of the Government of India to have very shortly a small conference of Provincial Governments' representatives over the question of credit to Land Mortgage Banks is a move which has come none too soon. The need for such credit is very old. The present agricultural depression has brought it out graphically. How acute the distress is, will be seen from the decision of the Pudukotta Durbar in their announcement that all loans granted for agricultural purposes and not yet completely repaid shall be declared to have been free of interest from the date of issue, that all arrears of interest will be written off, and that interest so far paid will be credited towards the principal. A meeting of some Zamindars in the United Provinces urge the extreme measure of a moratorium which may extend to five years. The Director of Agriculture, Frontier Province, urges the constructive measure of founding Agricultural Banks with branches in every taluq with powers to compound debts. Mr. Jamnadas Mehta, Chairman of the Rural Economic Committee, appointed by the Democratic Swarajya Party in Bombay, recommends the active intervention of the State in assessing and taking over debts on lands and the issue of bonds to the creditors repayable on a long term basis. Whatever the conclusions which the Schuster Conference may take, the facts set forth point to a clear recognition on the part of both officials and non-officials to concert measures for immediately relieving agriculturists of the incubus of indebtedness. We await quick and practical decision.

SOUTH INDIAN BANANAS*

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Introduction. The Banana is one of the oldest and one of the most popular fruits of the world. Mention has been made of it in ancient Sanskrit works and sages are said to have lived entirely on it. It is a highly nutritious article of diet containing 2.14% proteid, 21.8% sugars, 1% fat, 1% mineral matter and the rest being chiefly water. (Analysis of *Pachia Vazhai*). At the same time the essential ingredients are available in a very agreeable form and with sufficient bulk.

Short History. The original home of the banana is the tropical forests of Asia. Some authors have spoken of India as the home. Greeks, Latins and Arabs have in their old works praised the banana as a remarkable Indian fruit¹. Even at the present day two seeded varieties which go by the names of *Kallu Vazha* and *Kattu Vazha* occur wild in the Wynaad forests and these might prove to be the ancestors of the innumerable popular varieties of the present day.

* Paper presented at the Twenty Second Agricultural College Day and Conference, Coimbatore 23rd October 1933.

Through ages of selection and artificial culture a large number of so called varieties have sprung, and they will be discussed more fully hereafter.

From the original home the banana has been introduced into various countries. It would be worth while mentioning the introduction of the banana into tropical America including the West Indies about three centuries ago where the banana industry has since enormously developed. Though the Indians have held the fruit in high esteem from time immemorial and have used it invariably in all religious ceremonials and social functions, they have not improved it for purposes of trade, so that to-day the countries into which it has been introduced command the world banana markets while unfortunately India has no place at all in the banana markets.

Banana and Plantain. Banana or Bonana, as it was originally spelt, is the West Indian name; it is now commonly applied to all table varieties. The term plantain is popularly attributed to varieties which are usually cooked and eaten. In India, during the days of the East India Company, the term plantain alone was used. However, some writers have given certain distinguishing characters to plantain, as (1) The floral axis below the "heart" or the terminal conelike flower cluster, being covered with persistent flowers and bracts (2) The long fruits, etc.

On a critical examination of the South Indian varieties, it has been found that these morphological differences are not sufficiently distinguishing and according to the definitions published there are no real plantains in South India. But as we cannot get rid of terms which have the claim of long usage, it is better to confine the term 'plantain' to varieties like *Nendran*, *Monthan*, *Bathees*, etc., which are commonly consumed cooked.

External Morphology. The banana is a perennial giant herb. The real stem with leaf scars is underground. The stout aerial stem also called the pseudo or false stem, at times even 20 feet high, rises from the underground rhizome and is made up of leaf-sheaths and the peduncle or the stalk of the bunch, in old plants. The number of leaves produced varies from 25—40, 3—5 leaves being produced per month. It is commonly assumed that all the leaves rise from the root stock or rhizome alone; but in fact about 25% of the leaves of the old "tree" are carried up by the growing peduncle from the rhizome. The inflorescence is terminal and consists of tiers of cymose flower clusters which are monoecious and bracteate. The basal ones are female, the middle ones are neuter and the terminal ones are male. The cone-like clusters of male flowers enclosed in bracts form what is called the "heart". The females develop into fruits, while the neuters and males persist or drop away soon. The outer perigonium is 5-toothed at the apex and cleft on the inner side. The inner petal is

much smaller. Stamens are five and the sixth is often aborted. Pollen grains are sterile or fertile. Ovary is inferior and develops without being pollinated (parthenocarpy). But the flower is adapted for cross pollination and unusually large quantity of nectar is developed by the flower. Normal seeds are rarely produced and propagation is chiefly vegetative from suckers. Even small bits cut from the rhizome bearing leaf scars are capable of producing plants.

Cultivation. The details and cultivation practices vary much from place to place and with the variety planted. The banana is a surface feeder and thrives best in rich soils, with plenty of moisture, which are easily drained, and up to about 3500 feet above sea-level under South Indian conditions.

It is cultivated as a pure crop in wetlands in rotation with paddy. The crop usually stands in the same field for 3--4 years. Manuring with bulky organic manure as Farm Yard Manure or tannery refuse is done. Best yields are obtained in the second year of planting. During the third or fourth year the crop is mostly used for leaves only.

In Malabar the banana is planted as a nurse crop in newly planted arecanut and coconut gardens. In the Lower Pulneys it is planted as permanent shade plant for coffee and sweet lime.

In the West Coast, parts of Tanjore District, Panchadharla in Vizagapatam District and Uddanam in Ganjam District, the banana is grown as a perennial secondary crop in coconut gardens.

Usually single sucker planting is done about 7-8 feet apart. The narrow leaved or sword suckers are preferred to the maiden suckers.

Pruning of suckers is an important operation. Suckers are usually produced before the parent plant flowers. All except one or two are removed. The nature of the sucker or "follower" to be retained, to start the following season's crop depends upon the time when the harvest will be required. If it is wanted, say, in 12 months the youngest sucker or peeper is left; and an older sucker retained will yield a correspondingly earlier harvest. So as to avoid undue competition with the parent plant the follower if too tall is cut back. At Mayavaram, Tanjore District, the sucker is cut oblique presenting a cut surface of about 18 inches. This has the advantage of the growing young leaf being protected by the oblique cut ends.

An efficient system of irrigation and drainage is an important factor leading to successful cultivation. The best practice observed so far is the trench method common in Mayavaram, Tanjore District, and Mohanur, Salem District. Trenches 5--6 feet deep and 12--15 feet apart with proper gradient are dug. Irrigation water is allowed to stand in the trenches for full one day and is then completely drained off. The trenches, thus, serve the double purpose of irrigation and drainage as well. This method was tried in the Banana Experimental Area at Coimbatore and found to be quite successful.

It has been computed that the yield of banana from one acre is about 25,000 lbs. of food stuff, i.e., about six times as much as potato and 12 times as much as wheat from an acre. It is therefore obvious that the banana is an exhausting crop and requires proper manuring. Too heavy a dose of manure deteriorates the quality of the fruit and a correct dose depends upon the fertility of the soil and the variety.

Madras Varieties and their Classification. The banana belongs to the Genus *Musa* of the Family *Musaceae*. The genus has about 40 species². Some of these as *M. textilis*, L. Nee., which yields the Manilla Hemp, *M. superba*, Roxb., etc., are cultivated for fibre or for ornamental purposes. The bananas and plantains of the presidency, according to the tentative classification followed, come under *Musa paradisiaca*, L. The innumerable "varieties" found in the various parts of the Presidency are varieties, subvarieties, and, types of the same species.

Through ages of cultivation and selection, as has already been mentioned, the species has resulted in a multitude of varieties. In South India alone there are about 400 varietal names each representing a particular variety of a locality. After careful study in the field and critical examination all these 400 could be brought under about a dozen groups as the *Nadan*, *Kunnan*, *Monthan*, *Nendran*, etc., groups and 37 morphologically different varieties, a good many of them having one or more sub-varieties, each having a number of local names. For example, *Rasthali*, one of the favourite varieties is called *Poo Bale*, *Rasa Bale*, *Hoo Bale* in South Kanara; *Ana Poovan*, *Poovan*, *Ari Poovan*, *Nattu Poovan* in Malabar; *Desi*, *Mokiri*, *Amrithapani* in the Circars and *Ullur Poovan* in Coimbatore.

Unlike in other species, the morphological characters of the banana are extremely variable. Characters like size, length of the stem, leaves, bunch and fruits are easily influenced by the environment and treatment. Taste is influenced by elevation and manuring. The favourite variety *Sirumalai* of Sirumalai Hills when grown in the Lower Pulneys acquires *Virupakshi* flavour and at the Banana Experimental Area, Coimbatore, the flavour is partly lost. The *Sirumalai* and *Virupakshi* may thus be called eco-types of those regions. The famous "*Chakkarakeli*" produces big sized and almost insipid fruits if treated with mineral manures for a few generations.

The local varieties which go by the name of *Karpura Chakkarakeli*, *Ginni*, *Mysore Poovan*, *Erode Poovan* and *Palengodan* are all forms of the same botanical variety, though each has some slight distinguishing character from the other. Thus, "*Erode Poovan*" may be called the climax-type, for it is the type evolved in the region in which it has been cultivated through a number of generations, as the result of the accumulated effect of environmental factors influencing it. It will not therefore, acquire further variations in the Erode region but will soon become—*Karpur Chakkarakeli* when introduced into the Circars.

However, a few characters like the apex and base of the lamina, the dropping and persistent nature of the fruit, the colour and apex of the perigonium and petal are more or less constant.

Bud Variants. To add to the extreme difficulty in classification brought about by inconstant variations there are what are called Bud—Variants. These are spontaneously produced, deviate much from the type and look entirely different, from the original parent, e. g., from a stool of *Chenkadali* which has red-skinned fruits, a shoot producing greenskinned fruits has arisen. This new plant is called *Venkadali* and is a bud sport or bud variant of *Chenkadali*.

Ayiranka Poovan which has a remarkably long bunch (about 5 feet) and nearly 500 fruits reduced in size and closely packed is a bud variant of the ordinary *Rasthali*.

Similarly, both the glabrous and the ashy coated *Batheesas* of the Circars with about 32 closely packed hands in a bunch have probably been derived from the ordinary glabrous or ashy coated *Monthans* with long apex, lax bunches and few large fruits.

There are many instances of these bud variants. But unfortunately the good characters of the variants cannot be always retained long under changed conditions of environment, for they often revert to the parent type.

A thorough cytological investigation might furnish an explanation of the bud variants and the elastic nature of morphological characters. So far as the published works go the chromosome numbers also vary much from 16 to 48 (2n), 32 being the number commonly met with in most varieties³. The South Indian material is under investigation.

There is in South India a mine of rich material in the field of banana, which would yield the right sort of variety for any particular demand. *Kunnan*, a variety common in the West Coast is particularly suited for flour (meal) making, which has dietetic value and specially suited for infants, growing children and invalids. It is also medicinal and reputed to be useful for stomach complaints. It would pay to prepare the meal for export.

The *Vamanakeli* or *Pacha Vazhai* is excellent for fig manufacture. The figs should have the flavour of the ripe fruit, an inviting appearance and perfect keeping qualities. There is great demand for figs in the markets of the United States of America and Jamaica has been the supplier. It would be worth while investigating the possibilities of competing with Jamaica in this trade.

Varieties like *Virupakshi* which is a constituent of the famous Pancharnamam of the Palni Temple, Coimbatore District and *Kadali* of Malabar make splendid preserves.

Though India is said to be the home of the banana some of the varieties now met with are introduced from countries into which the

banana has originally spread. The survey of the South Indian bananas is far from complete; however, the following are the introduced varieties so far noted: *Vamanakeli* or *Pacha Vazhai* from the Canary Islands, *Thiruvananthapuram* from the West Indies, and *Surya Kadali* said to have been introduced from Australia. The *Poovan* or *Erode Poovan* also appears to have been first introduced into the Guindy Park.

The varieties coming under the *Nadan* group appear to be truly indigenous and are probably derived from the seeded variety called *Kallu Vazha* of the Wynaad forests.

A classified list of the South Indian cultivated varieties with their vernacular synonyms is appended.

Area and Trade. In 1932, the area in the Madras Presidency under banana was only 144,000 acres showing an increase of 25,000 acres over the figures of 1918. This increase is very poor in spite of the large extent of available cultivable waste suitable for banana cultivation. The forest areas of Malabar and South Kanara are particularly well-suited possessing the advantage of rich easily drained laterite soils and enough of rainfall. During the same period in the banana growing countries like the West Indies and Central America, the area has considerably increased and the industry enormously developed, because in these countries the industry is backed by the State and a good market in the United States of America for the fresh fruit and products is assured. But in India, it does not pay to grow more bananas than could be consumed locally and "fig" and flour making industries are practically wanting. There is no external trade with foreign countries. If the banana industry is to develop in India, the first consideration is to establish trade relations in banana and its products with European countries including Great Britain. Suitable varieties fit for export are not wanting. *Vamanakeli* or *Pacha Vazhai* which is in great demand in world markets thrives well in South India and can be produced in any quantity required. The variety is also fit for long distance export. It has been found that three-fourth full bunches of *Pacha Vazhai* can be kept in cold storage at 52°F even for a period of 65 days, thereafter ripening normally. In the earlier years the banana shipping industry of the West Indies was subsidized by the Imperial Government. Annually for 10 years certain shipping companies were paid at £ 20,000 as subsidy for transporting bananas from the West Indies to Great Britain⁴. Similar facilities have to be extended to companies shipping Indian produce till the industry is established. It is only then that India can successfully compete in the world market. The problems of transport, shipment and the fitness of the existing varieties for export have to be taken up and investigated thoroughly.

In spite of the fact that the banana is popular among all classes of people all over this vast country, the internal trade is very poor. This is partly due to the consumers being satisfied with the local produce. It is not in all places that the best varieties could be grown profitably. Only particular places are best suited for a particular sort; for example, as has already been pointed out, the *Sirumalai* and *Virupakshi* varieties deteriorate when grown in the plains; and there is always good demand for high class bananas. Under such circumstances one would expect large exports to various places. But due to want of transporting facilities and high cost of transport even the poor existing trade is going down. Some of the superior varieties like *Chakkarakeli*, *Then Kunnan*, *Ney Poovan*, etc., are not much known outside their native habitat. In South India, the only trade worth mentioning is in *Pacha Vazhai* exported from Trichinopoly. Dindigul also exports *Sirumalai* and *Virupakshi* varieties to Madras.

Improvement. Provided there are facilities for export, it would pay to improve the Indian bananas with a view to induce keeping, non-shedding and other desirable qualities lacking in some of the best varieties. The improvement can be effected in two ways (1) by hybridisation and (2) by selection. Improving by hybridisation is an exceedingly difficult problem. Because the parents which do not develop normal seeds should be made to produce seeds and finally the type evolved should again be made seedless. Exhaustive survey has to be carried out to procure material likely to be of use for crossing. But, after all this trouble, owing to the inconstant nature of characters inherent to the banana the variety bred may not long retain the desirable qualities.

Selection work is less laborious and might yield quicker results. But before taking up the question of improvement the importance of exhaustive survey and detailed study of all the varieties available in the country cannot be emphasised too much; for, it is simple waste of time and money to try to evolve a variety which might be already in existence.

Diseases. There are three fungus diseases attacking bananas in South India. Fortunately, none have at present proved serious under the conditions prevailing. The first is *Cigar end disease*: When the fruits are half mature, the drying up of the fruit from the apex starts and about a quarter of the fruit is damaged by the time the bunches are harvested. Varieties *Kunnan* and *Karim Kadali* are susceptible to the disease at the Experimental area, Coimbatore.

The second is *Gleosporium musarium*. The bunches when harvested look quite normal and as the fruits ripen dark brown spots appear and the flavour and taste are lost. The delicate variety *Kadali* and "Rasthali" are sometimes found susceptible.

The third one is the *Panama disease*. It is a very serious disease which at one time threatened the banana industry in the West Indies. The symptoms of the disease are red discolouration of the inside of the stem and its splitting near the base through which the inflorescence protrudes. Normal bunches do not develop in affected plants. The disease is prevalent in parts of Trichinopoly District usually attacking the variety *Rasthali*.

In conclusion, I take the present opportunity to suggest that it would be worth while instituting an enquiry and gather data to study the prospective position of India in the world banana market. Methods of transport and tariff concessions are problems by themselves. The Department of Agriculture in Madras and the Imperial Council of Agricultural Research are best fitted to take up the various problems pertaining to the banana industry.

My thanks are due to M. R. Ry. Rao Bahadur D. Ananda Rao Garu B. Sc. who, while in charge of the Office of the Director of Agriculture has asked me to take up the work, to the Principal M.R.Ry. Rao Bahadur C. Tadulingam Avl. F.L.S. who has afforded me facilities for work and suggested my reading this paper and to Messrs. G. Venkatanarayana and T. R. Naganatha Ayyar who have been assisting me in the banana investigation.

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3. *Bibliographia Genetica* Vol. VI.
4. *W. Fawcett*, The Banana.

Tentatively classified list of South Indian Bananas so far studied.

Name of variety.	Nature of axis.	Remarks.
<p style="text-align: center;">GROUP No. I.</p> <p>1. Vamanakelli (<i>Musa paradisiaca</i>, L., var., <i>Cavendishii</i>) Musa Cavendishii. <i>Pacha vazhai</i> of Madras and Trichinopoly; <i>Kabul Bale</i> of Udipi; <i>Guja Bale</i> of Kundapur; <i>Kuzhi Nendran</i> of Trichur Farm; <i>Vamanakeli</i> of Vizagapatam and Samalkot Farm; <i>Kooli vazhai</i> of Erode; <i>Kuli vazhai</i>, <i>Kooni vazhai</i>, <i>Nila vazhai</i> of Kultitalai; <i>Kandi vazhai</i>, <i>Kutta vazhai</i> of Trichinopoly.</p>	<p>Diminutive fingers bearing persistent perianth, subtended by sub-persistent bracts throughout the axis above the normal fingers (fruits).</p>	<p>(Colour of skin (peel) of ripe fruits from light green to dull yellow. It is an introduced variety. It ripens normally even after being kept in cold storage up to 65 days. There is already a demand for this variety in European countries and U. S. A.</p>
<p>2. Kullan (<i>Musa paradisiaca</i>, L., var., <i>Kullan</i>). <i>Kullan</i> of Coimbatore; <i>Rasalu</i>, <i>Rasa aratti</i> of Peddapur; <i>Ther vazhai</i> of Erode; <i>Kuzhi vazhai</i> of Udumalpet.</p>	<p>Do.</p>	<p>Fruit not terete as in No. 1. Colour of skin of ripe fruits yellow.</p>
<p>3. Chingan (<i>Musa paradisiaca</i>, L., var., <i>Chingan</i>). <i>Chingan</i> of Nilambur and Trichur Farm; <i>Chinga Bale</i> of Mangalore.</p>	<p>Do.</p>	<p>A very rare variety peculiar to West Coast. Colour of skin of ripe fruits is green.</p>
<p>4. Nendra Padaththi (<i>Musa paradisiaca</i>, L., var., <i>Nendra Padaththi</i>). <i>Nendra padaththi</i>, <i>Nendra vannan</i> of Trichur Farm; <i>Kuthiravalan</i> of Pulamanthol.</p>	<p>Do.</p>	<p>A very rare variety peculiar to West Coast.</p>

Name of variety.	Nature of axis.	Remarks.
<p align="center">II. NENDRAN GROUP</p>		
<p>5. Nana Nendran (<i>Musa paradisiaca</i>, L. var., <i>Nendran</i>). <i>Nendra vazha</i> of Calicut; <i>Nana nendran</i> of Nilambur; <i>Nendra Bava</i>, <i>Nendra Bala</i> of Moodbidri; <i>Nendra</i> of Puttur; <i>Thiruvonam</i>, <i>Thiruvodan</i> of Tellicherry; <i>Chengas-hidodan</i> of Trichur Farm; <i>Ettakka</i> of Alwaye; <i>Nendran</i> of Kasaragod, Rajahmundry and Mayavaram.</p>	<p>Diminutive fingers bearing persistent perianth, subtended by sub-persistent bracts throughout the axis above the normal fingers (fruits).</p>	<p>It has the longest and heaviest fruit of all the varieties found in the Presidency. Peculiar to West Coast. Ripe fruits are often used for table purposes after steaming. Unripe fruits are used as vegetable. Banana figs are often made of this variety. It has got good keeping quality. It may be the plantain of commerce.</p>
<p>5(a). Attu Nendran (<i>Musa paradisiaca</i>, L. var., <i>Nendran</i>, type: <i>Attu Nendran</i>).</p>	<p>Do.</p>	<p>Same as <i>Nana Nendran</i>. It produces more fruits and thrives with less water. It has longer apex than <i>Nana Nendran</i>.</p>
<p>5(b). Myndoli (<i>Musa paradisiaca</i>, L. var., <i>Nendran</i> type: <i>Myndoli</i>).</p>	<p>Do.</p>	<p>Same as <i>Attu Nendran</i> but requires copious irrigation. It yields the largest number of fruits of all the <i>Nendran</i> types.</p>
<p>6. Otta Mukil (<i>Musa paradisiaca</i>, L. var., <i>Otta Mukil</i>).</p>	<p>Variety distinguished by the abrupt termination of the floral axis into a prominent horn.</p>	<p>A variety with 1 or 2 hands of female flowers only. Not of economic importance. Appears to be a wild form of <i>Nana Nendran</i> but fingers are larger and stouter.</p>
<p>7. Chenkadali (<i>Musa paradisiaca</i>, L. var., <i>Chenkadali</i>) The Red Banana.</p>	<p>Variety with axis naked above normal fingers and terminating in a "heart" (cone-like flower head).</p>	<p>A rare variety. Colour of skin of ripe fruits red and greenish purple before ripening. The flowers of this variety open in the night.</p>
<p align="center">III. RASTHALI GROUP</p>		
<p><i>Chandra Bava</i> of Moodbidri; <i>Chandra Bala</i> of Mangalore; <i>Chora kadali</i> of Tellicherry; <i>Chenkadali</i> of Calicut; <i>Chora povan</i> of Alwaye; <i>Yerra Aratti</i> of Simhachalam; <i>Yerra Mokiri</i> of Panchadharla; <i>Cheravazhai</i> of Erode.</p>		

<p>8. Ventadali (<i>Musa paradisiaca</i>, L. var., <i>Chenkadali</i>, sub-var., <i>Venkadali</i>), <i>Vella kadali</i>, <i>Kárimkadali</i> of Manantoddy; <i>Ventadali</i> of Perintalmanna; <i>Thakkhan poovan</i> of Ponnani; <i>Vehiththa Chenkadali</i> of Trichur Farm; <i>Chora poovan</i> of Alwaye; <i>Kappurapu Keli</i> of Simbachalam; <i>Karapurpu Keli</i> of Panchadharla; <i>Ney varai</i> of Pannakkadu.</p>	<p>Variety with axis naked above normal fingers and terminating in a "heart" (cone-like flower head).</p>	<p>Bud variant of <i>Chenkadali</i>. Colour of skin of unripe fruits is green turning dull yellow when ripe. Taste, flavour and colour of flesh and other characters same as <i>Chenkadali</i>.</p>
<p>9. Rasthali (<i>Musa paradisiaca</i>, L. var., <i>Rasthali</i>). <i>Poo Bara</i>, <i>Hoo Bale</i> of Mangalore; <i>Rasa Bale</i> of Udipi; <i>Ana poovan</i> of Kurumathur; <i>Poovan</i> of Calicut; <i>Ari poovan</i> of Nilambur; <i>Nattu poovan</i> of Ponnani and Trichur Farm; <i>Desi</i> of Gopalpur; <i>Mokiri</i> of Vizagapatam; <i>Anritshani</i> of Rajahmundry; <i>Rasthali</i> of Trichinopoly.</p>	<p>Do.</p>	<p>A delicious variety.</p>
<p>9(a). Aviranga Poovan (<i>Musa paradisiaca</i>, L., <i>Rasthali</i>, type; <i>Ayiranku Poovan</i>). <i>Ayiran poovan</i> of Nilambur; <i>Ayiranka poovan</i> of Trichur Farm; <i>Poorikka Konai</i> of Pollachi.</p>	<p>Do.</p>	<p>Bud variant of <i>Rasthali</i>. All flowers develop into fruits which are slightly acidic. In other respects same as <i>Rasthali</i>. Transitional stages of this character are seen. Sometimes a sucker of this may revert to the parent and produce ordinary <i>Rasthali</i> bunches.</p>
<p>10. Ney Poovan (<i>Musa paradisiaca</i>, L. var., <i>Ney Poovan</i>, <i>Deva Bara</i>, <i>Deva Bale</i> of Moodbidri; <i>Pattu Bale</i> of Udipi; <i>Kadali</i> of Mangalore; <i>Nhani Poovan</i> of Nileshwar; <i>Ney Poovan</i> of Kurumathur; <i>Rasa Kadali</i>, <i>Ney Kadali</i> of Tellicherry; <i>Adokka Poovan</i> of Kuttuparamba; <i>Thakkhan Kadali</i> of Manantoddy; <i>Kunnan Poovan</i> of Kalpatta; <i>Tirunelli Kadali</i> of Calicut; <i>Nhali Poovan</i>, <i>Ari Poovan</i> of Ponnani; <i>Kadali Poovan</i>, <i>Poovan Kadali</i>, <i>Tirunelli Poovan</i> of Kumarnallur; <i>Vadakkhan Kadali</i> of Trichur Farm; <i>Hoo Bale</i> of Kundapur.</p>	<p>Do.</p>	<p>Peculiar to the West Coast. The skin of fruit is very thin. Flesh pure white and delicious with good keeping quality. It can be successfully introduced into other parts of the Presidency.</p>

Name of variety.	Nature of axis.	Remarks.
<p>11. Poovan (<i>Musa paradisiaca</i>, L., var., <i>Poovan</i>)—Fill Basket. <i>Mysore Bare</i>, <i>Mysore Bale</i> of Moodbidri; <i>Mysore</i> of Mangalore; <i>Mysore Poovan</i> of Nilambur and Nileshwar; <i>Mysore Pazham</i>, <i>Mysore Kai</i> of Calicut; <i>Palengodan</i> of Trichur Farm and Alwaye; <i>Mysore</i> of Kumaranallur; <i>Vasana Chettu</i> of Gopalpur; <i>Ginni</i> of Piridi; <i>Karpura Chakkarakeli</i> of Rajahmundry; <i>Poovan</i> of Erode and Trichinopoly; <i>Adukku Nasarai</i> of Pannakkadu; <i>Puttippukai</i> and <i>Korangu vazhai</i> of Pollachi.</p>	<p>Variety with axis naked above normal fingers and terminating in a "heart" (cone-like flower head).</p>	<p>It is an introduced variety thriving well in all localities and is the cheapest table variety. It is the "Fill Basket" of foreign countries.</p>
<p>IV. CHAKKARAKELI GROUP</p> <p>12. Chakkarakeli (<i>Musa paradisiaca</i>, L., var., <i>Chakkarakeli</i>). <i>Chakkarakeli</i> of Rajahmundry; <i>Chakkara kadoli</i> of Trichur Farm; <i>Godavari Chakkarakeli</i> of Piridi; <i>Saja Aratti</i> of Simbachalam; <i>Shahaja</i> of Panchadharia; <i>Thella Chakkarakeli</i> of Samalkot Farm; <i>Then kadoli</i> of Erode.</p>	<p>Do.</p>	<p>Largely grown in the Circars. It is the best table variety in the Presidency. It has very poor keeping quality even though it has the strongest pedicel. It is a costly variety.</p>
<p>12(a). Raja Vazhai (<i>Musa paradisiaca</i>, L., var., <i>Chakkarakeli</i>, eco-type <i>Raja vazhai</i>). <i>Raja vazhai</i> of Kulitalai and Trichinopoly.</p>	<p>Do.</p>	<p>The plants raised in the Banana Experimental Area, Coimbatore, produced normal <i>Chakkarakeli</i> bunches. Hence this may be the same as No. 12.</p>
<p>13. Kari Vazhai (<i>Musa paradisiaca</i>, L., var., <i>Kari vazhai</i>). <i>Kari vazhai</i> of Erode and Kulitalai; <i>Manoranjitham</i> of Trichinopoly.</p>	<p>Do.</p>	<p>Strong scented fruits. Colour of skin dark green before ripening and dull yellow when ripe. Stem has large dark blotches.</p>
<p>13(a). Nalla Chakkarakeli (<i>Musa paradisiaca</i> L. var., <i>Kari vazhai</i>, sub-var., <i>Nalla Chakkarakeli</i>). <i>Nalla Chakkarakeli</i> of Palteru near Bobbili.</p>	<p>Do.</p>	<p>Nearly same as <i>Kari Vazhai</i> but ripe fruits are not so scented as the above.</p>

<p>14. Kadali (<i>Musa paradisiaca</i>, L., var., <i>Kadali</i>). <i>Kadali</i> of Tellicherry; <i>Ney kadali</i> of Kasargod; <i>Poovun kadali</i> of Calicut; <i>Vella kadali</i> of Ponnani; <i>Devar kadali</i> of Kuttuparamba.</p>	Do.	<p>Fruits of this variety have the thinnest skin. This is the sacred banana of the West Coast and is largely used in temple offerings. It is a very rare variety peculiar to West Coast. Fruits are easily susceptible to the attack of <i>Gleosporium musarum</i>.</p>
<p>15. Namarai (<i>Musa paradisiaca</i>, L., var., <i>Namarai</i>). <i>Namarai</i> of Pannakkadu and Sirumalais.</p>	Do.	<p>A slender plant. Fruits are small and considered medicinal. Peculiar to Sirumalais and Pulneys.</p>
<p>16. Anaikomban (<i>Musa paradisiaca</i>, L., var., <i>Anaikomban</i>). <i>Anaikomban</i> of Coimbatore; <i>Komma Aratti</i> of Piridi; <i>Attu komban</i> of Pannakkadu and Pollachi.</p>	Do.	<p>A good table variety with long slender fingers. Occasionally seeds are produced in this variety.</p>
V. NADAN GROUP		
<p>17. Pacha Nadan (<i>Musa paradisiaca</i>, L., var., <i>Nadan</i>). <i>Eradan</i>, <i>Thodan</i> of Perintalmanna; <i>Pacha Nadan</i> of Coimbatore and Samalkot Farm; <i>Kadali</i> of Mayavaram; <i>Pacha Ladan</i> of Kulitalai and Trichinopoly; <i>Kali</i> of Tanjore; <i>Pacha vazhai</i>, <i>Kali vazhai</i> of Pollachi.</p>	Do.	<p>Fruits angular. Colour of skin of ripe fruits greenish yellow. Skin very thick. A table variety.</p>
<p>18. Kali (<i>Musa paradisiaca</i>, L., var., <i>Nadan</i>, sub-var., <i>Kali</i>). <i>Kali</i> of Perintalmanna; <i>Kali Vazhai</i> of Kongad; <i>Padaththi</i> of Alwaye; <i>Mannan</i> of Manantoddy; <i>Bangalore Aratti</i> of Rajahmundry; <i>Padalu</i> of Kumaranallur.</p>	Do.	<p>Colour of skin of ripe fruits yellow. An ordinary table variety; also used as vegetable.</p>
<p>19. Kapur Bale (<i>Musa paradisiaca</i>, L., var., <i>Nadan</i> sub-var., <i>Kapur</i>). <i>Kapur Bale</i> of Mangalore and Kundapur; <i>Sai Datti</i> of Mangalore; <i>Kuppa Mannan</i> of Nileshwar.</p>	Do.	<p>Colour of skin of fruit when ripe is yellow. This variety is peculiar to South Kanara. Fruits are large with very good flavour. It thrives well in other localities also.</p>

Name of variety.	Nature of axis.	Remarks.
20. Virupakshi (<i>Musa paradisiaca</i> , L. var., <i>Nadan</i> sub-var., <i>Virupakshi</i>). <i>Virupakshi</i> of Palni; <i>Vella vaz'vai</i> of Pannakkadu.	Variety with axis naked above normal flowers and terminating in a "heart" (cone-like flower head).	It is one of the most delicious table varieties of the Presidency. Being a dry fruit it is used in the preparation of the <i>Panchamritam</i> of the Palni temple. Considered next to Sirumalai and it has the best keeping quality.
20(a). Sirumalai (<i>Musa paradisiaca</i> , L. var., <i>Nadan</i> eco-type: <i>Sirumalai</i>). <i>Uduran Vachar</i> of Sirumalais.	Do.	It is considered by some as the most delicious table variety in the Presidency and better than <i>Virupakshi</i> and fetches more price. The flesh is more juicy than <i>Virupakshi</i> . It has good keeping quality.
20(b). Vannan (<i>Musa paradisiaca</i> , L. var., <i>Nadan</i> , type: <i>Vannan</i>). <i>Cheru vannan</i> of Pattambi; <i>Vannan Eradan</i> of Trichur Farm; <i>Mundil padan</i> of Nilambur.	Do.	Fruits are smaller than those of Pacha Nadan but have better taste and flavour. "Heart" is lanceolate while in Pacha Nadan it is ovate.
VI. KUNNAN GROUP		
21. Kunnan (<i>Musa paradisiaca</i> , L. var., <i>Kunnan</i>). <i>Kunnan</i> of Calicut; <i>Jirike Bars</i> , <i>Jirike Bale</i> of Kallamadkur; <i>Tirunoli kadali</i> , <i>Kulamel kulu</i> of Kasargod; <i>Adikkhu poovan</i> of Nileswar; <i>Adukkkan</i> of Kurumathur; <i>Adukkan</i> of Tellicherry, <i>Nadan kunnan</i> of Perintalmanna; <i>Vatayo kunnan</i> of Trichur Farm; <i>Kunnan</i> of Alwaye; <i>Madras Aratha</i> of Piridi; <i>Chakkarakali</i> of Vizagapatam; <i>Gini</i> of Samalkot Farm.	Do.	Peculiar to the West Coast. Flesh is rather tough. Used as table fruit. Flour is prepared of unripe fruit which is an infant food. Green fruits are used in the preparation of curry especially for invalids.
22. Venneettin Kunnan (<i>Musa paradisiaca</i> , L. var., <i>Kunnan</i> , sub-var., <i>Venneettin kunnan</i>). <i>Venneettin kunnan</i> of Calicut.	Do.	Same as <i>Kunnan</i> but with ashy coated skin with the flesh softer.

<p>23. Adakka Kunnan (<i>Musa paradisiaca</i>, L., var., <i>Kunnan</i>, sub-var., <i>Adakka kunnan</i>). <i>Chera kunnan</i>, <i>Adakka kunnan</i> of Kongad; <i>Vonnitte kunnan</i>, <i>Mutti kunnan</i> of Perintalmanna; <i>Dekunnon</i> of Manjeri; <i>Mundi kunnan</i>, <i>Vennir kunnan</i> of Pulamthol; <i>Chera kunnan</i> of Trichur Farm.</p>	Do.	Same as <i>Kunnan</i> but fruits are very short and stout.
<p>24. Then Kunnan (<i>Musa paradisiaca</i>, L., var., <i>Kunnan</i>, sub-var., <i>Then Kunnan</i>). <i>Then Kunnan</i> of Perintalmanna and Pulamthol. 24(a). Thattilla Kunnan (<i>Musa paradisiaca</i>, L., var., <i>Kunnan</i>, type; <i>Thattilla kunnan</i>). <i>Thattilla kunnan</i> of Calicut; <i>Rundu Bore</i>, <i>Rundu Bole</i> of Moodbidri; <i>Mambilla</i> of Kasaragod; <i>Mambilla kunnan</i> of Kuttuparamba; <i>Maniyilla¹ kunnan</i> of Kongad; <i>Kodappilla kunnan</i> of Trichur Farm; <i>Maniyilla kunnan</i> of Ponnani; <i>Bundi</i>; <i>Aratti</i> of Piridi; <i>Godavari kati</i> of Vizagapatam; <i>Chitrachalam</i> of Rajahmundry; <i>Pooovilla vazhvi</i> of Mayavaram.</p>	Do. Do.	A very sweet and delicious variety with dry and mealy flesh. Peculiar to West Coast. It is a bud variant of <i>Then Kunnan</i> ; often all the flowers developing into fruits and sometimes male flowers are produced as in <i>Then Kunnan</i> .
<p>25. Karimkadali (<i>Musa paradisiaca</i>, L., var., <i>Vettan</i>). <i>Karin kadali</i> of Alwaye; <i>Karin kadali</i> of Trichur Farm; <i>Irachchi kai</i> of Kurumathur; <i>Irachchi katti kai</i>, <i>Chodari</i> of Kuttuparamba; <i>Vettan</i> of Manantoddy; <i>Kari vazha</i> of Nilambur; <i>Anai konchan</i> of Kulitalai.</p>	Do.	Peculiar to West Coast. Unripe fruits are often used to soften meat and are cooked along with it and it is also a cure for dysentery. Easily susceptible to Cigar and disease.
GROUP VIII.		
<p>26. Surya Kadali (<i>Musa paradisiaca</i>, L., var., <i>Surya kadali</i>). <i>Surya kadali</i>, <i>Austration</i> of Trichur Farm.</p>	Do.	Stem and leaves are very light coloured. Fruits are delicious but few in a bunch. It is said to have been introduced from Australia.
GROUP IX.		
<p>27. Thiruvananthapuram (<i>Musa paradisiaca</i>, L., var., <i>Thiruvananthapuram</i>). <i>Thiruvananthapuram</i>, 'West Indian' of Trichur Farm.</p>	Do.	A good table variety. It is said to have been introduced from the West Indies. This variety has the biggest heart.

Name of variety.	Nature of axis.	Remarks.
X. PEYAN GROUP		
28. Peyan (<i>Musa paradisiaca</i> , L. var., <i>Peyan</i>). <i>Peyan</i> of Mayavaram; <i>Kottia vazhai</i> of Tanjore; <i>Ney vazhai</i> of Peruvemba; <i>Sapota bontha</i> of Samalkot Farm; <i>Nokala bontha</i> of Simbachalam.	Variety with axis naked above normal fingers and terminating in a "heart" (cone-like flower head).	Fruits distinctly angled. Ripe fruits are considered highly medicinal.
29. Boothi Bale (<i>Musa paradisiaca</i> , L., var., <i>Peyan</i> . sub-var., <i>Boothi Bale</i>). <i>Boothi Bale</i> of Puttur; <i>Bonya Bare</i> of Moodbidri; <i>Bonka Bare</i> , <i>Gobra Bare</i> of Mangalore; <i>Onakkan mannan</i> of Nileshwar.	Do.	Fruits not distinctly angled and are slightly acid. It produces larger bunches than <i>Peyan</i> .
30. Fey Ladan (<i>Musa paradisiaca</i> , L. var., <i>Peyan</i> , sub-var., <i>Pey Ladan</i>). <i>Pey Ladan</i> of Kulitalai; <i>Mada vazhai</i> of Erode; <i>Pey monthan</i> , <i>Pey vatai</i> of Trichinopoly; <i>Peyan</i> of Coimbatore.	Do.	Fruits not distinctly angled. Apex warty. Base of lamina truncate.
31. Kostha Bontha (<i>Musa paradisiaca</i> , L. var., <i>Peyan</i> , sub-var., <i>Kostha Bontha</i>).	Do.	Fruit of inferior quality and occasionally with a few normal seeds.
32. Ney Mannan (<i>Musa paradisiaca</i> , L. var., <i>Ney Mannan</i>). <i>Thiyyan mannan</i> of Tellicherry; <i>Mala vanna</i> , <i>Kallu vanna</i> of Calicut; <i>Ney vanna</i> of Kongad; <i>Malamundi</i> of Nilambur; <i>Patinharan</i> of Perintalmanna; <i>Nattu vazhai</i> of Pannakkadu.	Do.	Used both for table purpose and for cooking. Considered not a good fruit but reputed to have very cooling effect.
33. Venneettu Mannan (<i>Musa paradisiaca</i> , L., var., <i>Ney Mannan</i> , sub-var., <i>Venneettu Mannan</i>). <i>Venneettu mannan</i> of Pattambi.	Do.	Same as <i>Ney Mannan</i> but the skin is thickly ashy coated.
XI. MONTHAN GROUP		
34. Monthan—Apexed (<i>Musa paradisiaca</i> , L., var., <i>Monthan</i>). <i>Monthan</i> of Coimbatore; <i>Silanthi</i> of Moodbidri;	Do.	This variety also has the largest fruits. Almost exclusively used as vegetable.

- Kilandi Banga Bale* of Udipi; *Manga Bale* of Kundapur; *Aundi Bale* of Mangalore; *Manga kai* of Kasaragod; *Manga vazha* of Nileshwar; *Sodari* of Kurumathur; *Thazhuthani* of Tellicherry; *Thenali* of Calicut; *Ponthan* of Kongad; *Ponnan karya* of Perintalmanna; *Ponnan* of Nilambur; *Chetti karya* of Ponnani; *Nalangi monthan* of Erode; *Erode monthan* of Kulitalai; *Kondai monthan*, *Yendra monthan* of Trichinopoly; *Trichinopoly monthan* of Negapattam; *Yenthaik monthan* of Tanjore.
- 34(a). **Pacha Bontha Bathees** (*Musa paradisiaca*, L., var., *Monthan*, type; *Pacha Bathees*).
Pacha Bontha Bathees of Vizagapatam; *Batheesa* of Gopalpur; *Nalla Bathees* of Piridi; *Nalla Bathees*, *Pacha Bathees* of Palteru.
35. **Sambrani Monthan—Apexed** (*Musa paradisiaca*, L., var., *Monthan*, sub-var., *Sambrani Monthan*).
Sambrani monthan of Erode; *Bonya kilandi* of Udipi; *Vennittu Manga* of Nileshwar; *Vennitta thezhuthani* of Manantoddy.
- 35(a). **Booditha bontha bathees** (*Musa paradisiaca*, L., var., *Monthan*, type; *Booditha bathees*).
Booditha bontha bathees of Vizagapatam; *Thella bathees* of Piridi; *Thella bathees*, *Booditha bathees* of Palteru; *Booditha batheesa* of Panchadharia.
36. **Nalla bontha—Blunt Apexed** (*Musa paradisiaca*, L., var., *Monthan*, sub-var., *Nalla bontha*).
Nalla bontha of Vizagapatam; *Pacha bontha* of Gopalpur; *Bontha* of Panchadharia.
37. **Thella bontha—Blunt Apexed** (*Musa paradisiaca*, L., var., *Monthan*, sub-var., *Thella bontha*).
Thella bontha of Piridi; *Booditha bontha* of Gopalpur and Vizagapatam.

Peculiar to the Circars. Used only as vegetable. Often this variety has as many as 25 hands with about 250 fruits. Appears to be bud variant of *Monthan*—Apexed. Has produced normal *Monthan* bunches at Coimbatore. Same as *Monthan*—Apexed but the skin of fruit is ashy coated.

Do.

Do.

Do.

Do.

Do.

Appears to be bud variant of *Sambrani Monthan*—Apexed. Has produced a normal bunch of *Sambrani Monthan* at Coimbatore.

Same as *Monthan* but fruits are angular.

Same as *Nalla Bontha* but the skin of fruit is ashy coated.

BEES AND BEEKEEPING IN SOUTH INDIA

BY T. V. RAMAKRISHNA AYYAR B.A., Ph.D., F. Z. S..

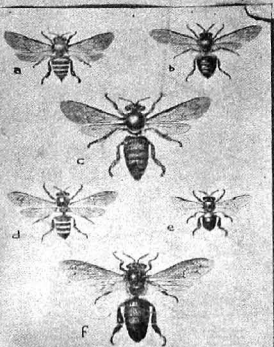
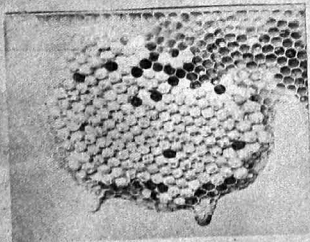
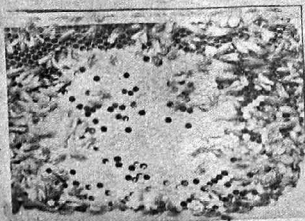
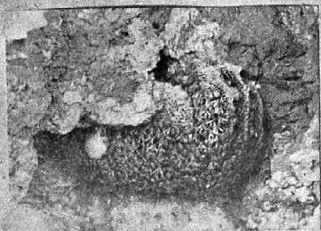
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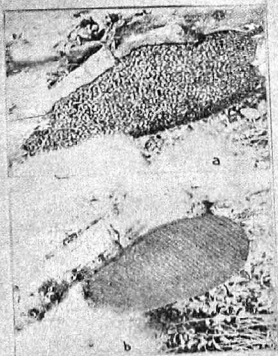
Introduction. Among insects, in fact, among the numerous lower animals, the honey bee occupies a unique position. It has been man's associate practically from prehistoric days. In view of the honey it yields and in consideration of the various virtues displayed by the creature in its social life this creature was not only held by the ancients in high esteem but was even endowed with divine powers and became the centre for many myths and superstitions. It was probably due to such ideas that the bee was added as an insignia by great men it is said to appear on the crowns of the Egyptian kings, on the arms of the Pope and on the imperial robes of Napoleon! Honey and wax were attributed divine properties and in Christian rituals honey was given to babies in baptism and the church candles were to be of pure wax! In India, the existence of bees and the usefulness of the products we get from them are facts well known to almost every layman. But very few among us possess any clear and definite ideas regarding the natural history of bees or about the aetiology and purpose of the useful products man gets from them. There is, of course, reference in different Indian literary and medical works to honey as *Madhu* and to the honey bee as *Madhu makshika*, (literally honey fly) the exact term by which it is known in the vernaculars, though it is scientifically incorrect to call it a fly. The little that is known of them may be more or less summed up in these statements (1) that bees abound in forests, (2) they give us some very valuable and useful products, (3) they are a proverbially hard-working and industrious lot, and (4) that they sting. All the rest regarding them has been practically a sealed book to most of us. The honey bee is, therefore, one of our familiar creatures and yet one about which we really know very little!!!

The primary object of this paper is to present in a very compact and popular form a very brief account of the honey bees we have in S. India and the native methods now in vogue in the different tracts in artificial beekeeping and honey gathering, and secondly, to give a very short summary of the attempts now being made by the Entomological section at the Coimbatore Agricultural Research Institute to carry on investigations in this line with a view to demonstrate and popularise the modern methods of beekeeping as is practised in many of the Western Countries. One important excuse for publishing this paper with all its inevitable imperfections is the fact that we have

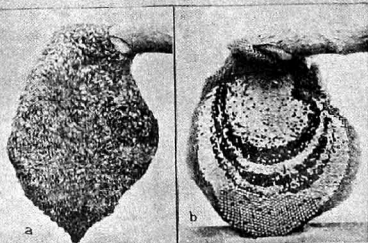
* Paper read before the Association of Economic Biologists, Coimbatore, on 4th September 1933.



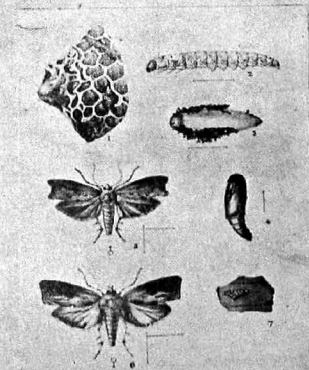
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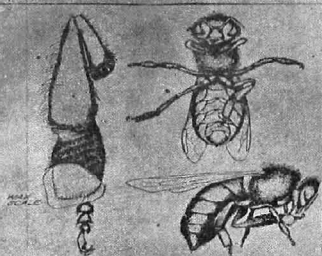
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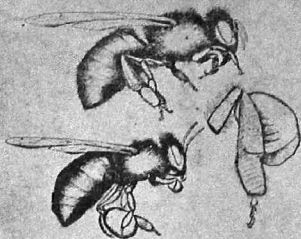
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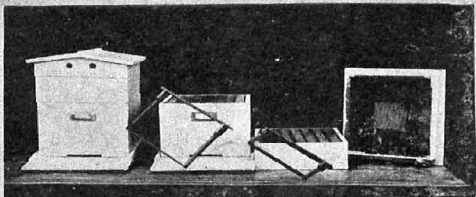
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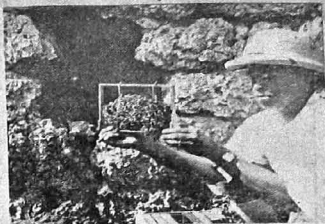
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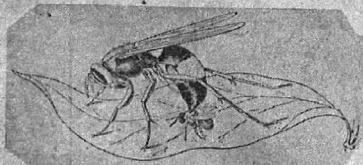
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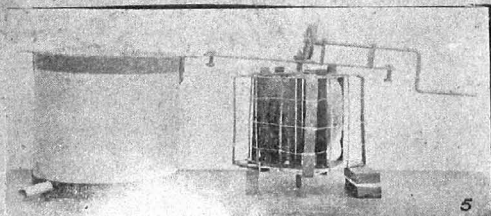
5



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PLATE I

1. Wild colony of *A. indica*.
2. Sealed worker brood of *A. indica*.
3. Sealed drone and queen cells.
4. Indian honey bees.
 - a) *A. indica*—Worker.
 - b) „ Drone.
 - c) „ Queen.
 - d) *A. florea*.
 - e) *Melipona* sp.
 - f) *A. dorsata*.
- 5 a) Colony of *A. dorsata*. (Reprint from the Agrl. Zoology of the Malay Archipelago —Dammerman.)
 - b) do. without bees. (Reprint from Pusa Bull. No. 46.)
- 6 a) Colony of *A. florea*. (Reprint from Pusa Bull. No. 46.)
 - b) do. without bees. (Reprint from Pusa Bull. No. 46.)
- 7 The wax-moth and its different stages (Reprint from Pusa Bull. No. 46.)

PLATE II

1. Removal and moulding of wax. (Reprint from "Social life among insects" Wheeler.)
- 2 & 8. Fixing a comb of *A. indica* with plantain fibre.
3. *Vespa cincta*. (Reprint from J. Bom., Nat. Hist. Soc. Vol. XXVII.)
4. An apiary of *A. indica*.
5. The bee hive and its parts.
6. The honey extractor and its parts.
7. Collection of pollen and packing the same. (Reprint from "Social life among insects" - Wheeler.)
9. *Phyllanthus ramakrisnae*.

absolutely no previous records of a connected form relating to bees in S. India and that there is a demand from many people nowadays for a publication of this kind.

II. General Facts Regarding Bees & Honey Bees. Before we enter into the main theme of Beekeeping it will be advantageous to get some clear ideas regarding the position of the honey bees in the animal kingdom, their nearest relatives and some general facts regarding their natural history. Though popularly the term 'Bee' has been understood to refer to the domesticated honey bee, because of its long and intimate association with man, the name can be applied without mistake to a number of other insects; in fact, over four thousand different insects are known which come under this designation and all of them including the honey bee being classified as a group called *Apidae* (Bee family). The various bees, numerous wasps and different kinds of ants constitute the three important sub-divisions of the well-known insect order *Hymenoptera*. Very familiar examples of bees other than the honey bee are the carpenter bees and the leaf cutting bees. A common example of the former is the stout bluish black insect (*Xylocopa*) found flying about houses and gardens with a strong bussing noise and frequently seen boring into wood work (hence its name); the leaf cutter bees (*Megachile*) are generally smaller than the carpenter bees and these have the habit of cutting and removing away portions of leaves from rose and other garden plants. Most of the members of the bee family share some common features, the most important of them being the habit of visiting flowers to collect pollen and nectar (hence called *anthophila*), the possession of a long tongue which helps them in probing into flowers and the presence of plumose branched hairs on the body. In the matter of growth and development also they are similar—the pregnant female lays a number of single eggs; these hatch into helpless fleshy grubs which have to be fed by others until they pupate and from the pupa the adult bee emerges. Thus every bee passes through a complete metamorphosis during development as in beetles or butterflies. As against these similarities numerous differences are noted between different kinds of bees especially in their habits which enable us to classify them into such groups as under-ground nesting, surface nesting, tree nesting, parasitic, solitary and social bees. The honey bees come under the last group.

In India, we have over thirty genera included in the bee family (*Apidae*) including over two hundred known species of bees and the insects known as honey bees constitute but one of these genera (*Apis*) including three species. These three species which are the chief sources of honey in India and another minor insect the *Melipona* (Dammar or stingless bee) constitute the four genuine honey bees found all over the Indian region. (Fig 4, Pl. I). All these bees are social insects

and live in colonies. The three species of *Apis* and their fundamental features are (1) *Apis dorsata*, F., (Fig. 5, Pl. I), Rock bee. This is the largest of the Indian honey bees and gathers plenty of honey; it builds long big open single combs which may often be four feet long on tall forest trees, along sides of precipitous cliffs and occasionally on the walls and other parts of buildings. (Fig. 3.) The honey got from these hives in the forest forms the bulk of the material collected by hill people and sold in our bazaars. The irritable and ferocious temper of this bee and its confirmed nomadic habit of deserting its hives frequently have made it impossible to domesticate it; (2) *Apis florea*, F. This is the smallest of the three species and is known as the little bee. This also builds single combs which are, however, very small and often found hanging from bushes and corners of roofs; (Figs. 4 d & 6, Pl. I): each comb usually gives but a few ounces of honey; (3) *Apis indica*, F. This is the common Indian honey bee, very commonly found both in the plains and forests all over India. In size this is larger than *florea* and smaller than *dorsata*. This bee unlike the other two builds several parallel combs generally in hollows of trees, caverns in rocks, on the walls inside wells and similar protected spots. (Fig. 1, Pl. I). This is the typical Indian honey bee and the only one which has so far been found to be capable of domestication. In the different hill tracts of S. India the common bee found is a dark race of this *indica*. The only other known species of *Apis*, besides these three Indian forms, is the European bee *A. mellifica*, L., which is the honey bee domesticated and extensively reared all over Europe and America and this species, except in a few minor features, is very closely similar to *indica* in structure, size and habits and hybridises freely. With regard to the affinities and phylogeny of these honey bees, though many entomologists like Linnaeus, Friese and Buttel-Reepen regard *mellifica* as the original species and the other three as its descendants, recent workers consider that the Indian form *indica* is the real ancestor. Professor Wheeler of Harvard, an eminent authority on social insects, in arguing out this point, adds the following very interesting and noteworthy remarks in favour of *indica*.—"Had a Hindoo entomologist preceded Linnaeus, *indica* would be the type of the species, and the Hindoo, aware of the existence of two other species of *Apis* in his own and neighbouring countries and nowhere else in the world, would properly regard the genus as of South Asiatic origin and the species *indica* as having spread to Europe and Africa and produced the dark race *mellifica*."

III. The Members of a Bee Colony. As stated before the honey bees live in colonies. In an average thriving colony of the common Indian bee (*indica*) there is generally found a population of about forty to fifty thousand bees. This large number is, however, made up of three different kinds of individuals inhabiting the colony. (Fig. 4, a, b, c, Pl. I).

* "Social Life among Insects," p. 131, 1923.

These are the *Workers*, the *Drones* and the *Queen*—the workers making up the great bulk of the population (over 90%). The worker bee is an immature female smaller in size than the queen or the drone; on her devolve most of the important domestic duties of the colony such as gathering of honey and pollen, building of the combs, rearing the brood, defending the colony from enemies, attending on the queen and keeping the home sanitary and warm. To perform these duties satisfactorily the workers are also provided with the necessary structural adaptations. The tongue is comparatively long, the hind legs have basket like hairy structures to collect pollen, (Fig. 7, Pl. II) the abdomen has glands to secrete wax which is the material used for house building, (Fig. 1 Pl. II) and they have a powerful sting for defence at the tail end of the body. The drone is the male bee and comparatively heavier built than the worker; its eyes are very large and meet at the middle of the head (this is a feature found in many male insects). It has no pollen basket, wax producing structures or a sting. The duty of the drone simply consists in acting as the husband of the virgin female bees. Very few drones are generally found in a healthy and vigorous colony, and at times there may be no drones in the colony at all. In every colony, usually any one healthy mother insect or queen is found. It is a mature female and is bigger and longer than the worker; she has no pollen baskets or wax plates but has a conspicuous combined sting and ovipositor, the latter to deposit eggs. The only function of the queen in a colony is to lay eggs and thereby add to the population of the colony and keep it strong. This egg laying machine is known to deposit two to three thousand eggs a day and under satisfactory conditions lives for two or three years.

It is thus found that in a bee colony there are three kinds of individuals or castes with different functions which contribute to the welfare of the colony, and each one of these is specially adapted structurally also to attend to its respective duties. The workers as their name implies, attend to all the material needs of the colony and the queen and drone play the parts of wife and husband keeping up the strength of the colony. The following passage regarding the bee colony is, therefore, quite apt "The bee colony is a wonderful republic with many kings and only one queen, the citizens do all the governing without voting; the kings are powerless and the queen works as hard as and longer than any of her subjects." A few words as to the way in which the three bee castes arise in the colony may be added. Starting with a young queen who has just emerged from the pupal cell, we find her one fine afternoon emerging out on her virgin flight. She very usually meets a drone and they mate. This nuptial ceremony which generally takes place outside a hive is unfortunately attended by a tragedy; in the act of union the queen carries with her the generative organs of the husband and he is killed; (it may be added by the way

that among many lower organisms the husband shares this unfortunate fate as a result of mating). The pregnant queen returns to her hive very soon and as a result of this union she carries the spermatid fluid received from the male retained in her spermathecal bag. In a day or two after her return from the wedding trip she starts laying eggs, practically her only function for the rest of her life; in each empty cell of the hive she lays one egg and she is found capable of laying three to four thousand eggs per day. One very striking peculiarity with the queen bee is that she is able to lay either fertilised eggs which will produce workers or non-fertilised eggs which produce only drones. This is due to the peculiarity in her generative mechanism which gives her a control to allow or not allow an egg which passes out through the oviduct, to get impregnated by allowing a particle of the sperm from the sperm sac. This is a very remarkable capacity in the queen and fortunately or unfortunately it is absent in the higher animals and man! There is no difference, however, in the nature of the egg that will produce a worker or a queen and it is only food and other conditions which determine the production of either. Generally the queen lays fertilised eggs out of which the numerous workers which are essential to the needs of the colony emerge after a development period of 21 days. When a queen has to be raised and not otherwise, the workers build a few large cells and feed the baby grubs in them with special food, and from among these grubs an adult queen emerges in about 16 days; this special food "royal jelly" and the provision of larger cells to the chosen grubs appear to make these otherwise worker grubs fully developed queens! The drone egg takes about 24 days to develop into an adult bee. The difference in the period to attain maturity in the three different individuals is apparently due to the quality of food supplied to each. Various and marvellous are the numerous activities of these individuals, especially of the workers which go to regulate and to maintain the multifarious normal and abnormal needs and the domestic economy of a colony. It is hardly possible in this short paper to deal with the numerous facts and theories connected with the sex relations, the development of the sexes and other allied phenomena connected with the multiplication and maintenance of the normal strength of a colony.

IV. The Domestic Life and Activities of the Honey Bee. *Beehive.*—As stated at the beginning the common Indian honey bee in the natural haunts lives in what are called *hives* made of combs constructed by members of the colony in well protected places. Each hive is made up of a number of combs generally remaining parallel to each other (fig. 1 Pl. I). The combs, which are made of wax, are divided up into thousands of hexagonal cells, each comb having a double set of them, one on each surface; and these cells serve as receptacles for the storage of honey and pollen and as chambers for the developing brood. The

bee hive, with its remarkable architectural and economic arrangement, is one of the wonders in the insect world. In the words of the great poet Mactérinck "No living creature, not even man, has achieved in the centre of his sphere what the bee has achieved in her own; and were some one from another world to descend and ask of the earth the most perfect creation of the logic of life, we should needs have to offer the humble comb of honey." The mathematical accuracy with which the cells are arranged and the way in which the whole hive is constructed are features always evoking wonder and admiration. Adult bees of all the three different kinds when at home simply remain clustering to and moving along the surface of the combs and do not have any special lodgings. Usually the cells in the upper part of the combs are made use of for the storage of honey and the lower ones are utilised for brood rearing. While the worker cells (figs 2, and 3, pl. I) when closed are capped flat, those of the drone and the queen have different shapes; the drone cells which are usually found along the edges have a convex capping and the queen cells stand out from the margin as elongated conical projections (fig. 3 pl. II). Wax which is the material with which these combs are built is a secretion which exudes as a semi-fluid substance, through some of the ventral plates of the abdomen of the workers and which solidifies into the plastic wax so ideal a material for constructing the comb. The best stone mason or bricklayer will simply marvel at the way in which the bee removes the wax from its belly, kneads it with the help of its mouth parts and uses it for comb building (fig 1, pl. II). During the busy season when cells have to be built at a rapid rate workers gorge themselves with honey and this stimulates wax production. It is said that to get a pound of wax, bees have to consume about 10 to 15 lbs. of honey; as such, comb building and brood rearing go on vigorously when there is plenty of honey available.

Food of the Bee.—The food of bees, as stated before, consists usually of nectar and pollen, from flowers. The adult bees chiefly feed on honey while the young ones have to be fed mainly on pollen, although it is often mixed with honey and water forming a paste called 'bee bread.' The developing grub in each of the brood cells is unable to find its food and has, therefore, to be fed with these materials by the nursing workers of the colony until they are full grown and about to pupate. Since the food of bees in all stages consists of materials from flowers of different kinds they generally thrive well in jungles, flower gardens and orchards where flowers of various kinds form their pasturage for both nectar and pollen. Occasionally, however, bees have been noted lapping up the honey dew of some plant bugs and it is said that they seek sugar in other places than flowers.

Honey. Speaking of honey it may help us to have some clear ideas as to what it really is. The honey that we get from bee hives is not the actual nectar which the insects collect from various flowers.

This nectar collected by them from all sorts of flowers is swallowed by the creature and afterwards regurgitated into the honey cell. In the honey stomach of the bee in which the nectar remains before regurgitation, certain chemical changes take place and it is this changed stuff which is called honey. The bees, knowing very well that pasturage may not be available during all the seasons in the year due to climatic variations, collect very briskly when there is plenty of pasturage and store quantities of honey which will serve them and the brood during the rainy or very chill months when no pasturage is sufficiently available; during these months their outside activities are also very much curtailed. On the other hand, during spring and summer months, when there is plenty of pasturage available the workers are found very industrious and busy, not only gathering stores of provisions but also actively engaged in comb building and brood rearing; the queen also is very active during this season of plenty and adds to the population of the hive by laying numerous eggs day after day. In view of the fact that the length of life of the worker bee is not more than three or four weeks and that many of them are liable to be killed in various ways, a proportionate increase in brood is thus quite necessary to keep up the normal strength of a colony. However, when due to very favourable conditions, the population of a colony increases enormously and there is a general feeling that there is not sufficient room or convenience for all the inmates, preparations for a family partition become evident. The reigning queen and a good number of workers from the hive fly out of the colony and start a fresh one in a new spot. This family partition is called *Swarming* and is often much more peaceful and harmonious in striking contrast to what often happens in human families. This appears to be a natural instinct on the part of all the members of the colony in helping the dispersal and distribution of the species. This habit is occasionally persistent in the bee; and has to be watched and proper precautions taken by the apiarist. There are numerous other points in the behaviour of bees which are problems that will repay investigation.

Enemies of bees. Before we conclude this brief account of the remarkable family arrangement of the honey bee a few words may be added regarding some of the factors that often interrupt the machine like working and organisation of these remarkable insects. There are some enemies in the shape of diseases and pests. The Indian bee, unlike the European *mellifica* is so far free from the two notorious bee diseases—the 'Isle of White disease' and 'foul brood.' In the shape of active enemies we have the bee eater among birds; but it is among insects we come across some of the dreadful enemies of bees. A few years ago, the senior author discovered in the Bababuddin hills in Mysore a wasp* which behaves as a typical bee hunter—attacking and

* Recently described as a new species *Philanthus ramakrishnae*, T.

carrying away bees. (Fig. 9, Pl. II). Some of the common hornets (Fig. 3 Pl. II) also occasionally attack bees. The common hawk moth¹ attacks the hives and feeds on the stored honey. An inveterate pest of the hive is the wax caterpillar² which often devours the wax combs and causes very serious damage especially in weak colonies (Fig. 7 Pl. 1). The other enemies of bees are miscellaneous animals of different kinds which rob them of their provisions; under this category, of course, comes *man*. The workers that defend the colony from such robbers and trespassers have, of course, their defensive organ in the sharp and poison inoculating sting. The writers believe that, but for the possession of such a protective weapon, man and other animals would have by now made the honey bee a creature of the past like the Dodo or the Mammoth!

V. Bees and Man. We have so far gathered some information regarding the natural history of bees. Let us now come to the relations between bees and man. Man's association with the honey bees dates from time immemorial and the primary object of this relation has evidently been to take advantage of their labours and appropriate the honey from the bee colony for his use. We will just survey briefly how these products have been and are still being gathered by man in different parts of India and in what way these could be considerably improved with advantage. Since bees are more abundant in the jungles it is the people in the forest tracts that are more familiar with their activities and conversant with the methods adopted to procure these products. In spite of the fact that these honey mongers of the hills are very familiar with bees and their products, they have absolutely no knowledge of the elementary facts in the natural history of bees. All they know is that there are certain seasons when bee colonies increase in numbers and when bee hives get filled with honey which they have to appropriate promptly. The methods adopted to get honey are crude, wasteful and barbarous and these apply to gathering of honey from both the rock bee (*dorsata*) and the common bee (*indica*). During nights when the bees are inactive and generally remain clustered on the surface of the hive, burning torches are applied to the hive and in this process most of the bees are killed and many of them badly suffocated; in order to save himself from possible stings during the operation, the man covers his body with a thick sheeting and closes his face with a veil or smears it with ashes to make the stinging ineffective. When the bees are thus killed or disabled, the combs are removed and the process of honey gathering starts. This consists in cutting the combs into pieces and then pressing and squeezing every bit of them with the hands and securing the juice thus obtained as honey. Any one with a smattering of insect lore can easily

1. *Acherontia styx*. 2. *Galleria melonella*.

form some idea as to what the components of this liquid are and the degree of its purity. In addition to honey it contains, among other things, the body juices of the developing grubs in the brood cells, lumps of pollen and pieces of wax from the crushed combs. This stuff constitutes the great bulk of what we get from our bazaar grocers as pure honey, though there are worse substitutes often sold as honey. Gradually as half civilised man realised the value and good properties of honey, it occurred to some that, instead of searching and locating bees for honey in the different parts of the hills, the bees may be attracted into some trap chambers and made to build their combs and store honey in them. With this idea the crude pot hives, log hives, straw hives (skeps), beer casks and other improvised contrivances came into vogue to breed the bees and this was the beginning of what may be called beekeeping by man; but the methods of gathering the honey continued in the same old crude ways sacrificing the bees and their combs. It was not until the middle of the last century that some bee keepers in the West realised the cruelty, the economic loss and the impurity caused by the inhuman methods of obtaining honey from the combs. Robbing the honey bee of their stores of honey, which is never intended for man's use, is never a commendable act, but by getting the stuff without smoking and crushing the bees is certainly more humane and the better evil of the two. As a result of the gradual realisation that the existing methods of honey gathering were more or less like killing the goose that lays the golden eggs, hives with movable frames were devised, by the use of which the bee keeper could gather honey in a pure state and without sacrificing the bees. The introduction of the hive with movable frames is chiefly associated with the name of a clergyman Langstroth the inventor of the well known standard hive known after him; and if only the bees could talk, they would with one voice express to him their eternal vocal gratitude for rescuing them from practical extinction. Since the introduction of different kinds of hives with movable frames the crude methods of honey gathering have almost disappeared in the Western countries. In S. India, on the other hand, wherever anything like beekeeping has been existing, the primitive methods still prevail as in the hill districts of Coorg, Mysore and Wynad. Hollow logs or earthen pots smeared with wax are used as artificial hives and when these are colonised by the bees and sufficient honey becomes stored the bees are smoked out and the honey squeezed out in the same old way. Interesting accounts of such methods that have been in vogue in the different hill districts of India and samples of colossal ignorance displayed by revenue and forest officers regarding the natural history of bees could be found in a Government of India publication¹ on the subject. Within the past two or three decades, however, attempts have been made here and

¹ *Agricultural Journal of India*, XII, pp. 44-57, 1917.

there to rear Indian bees on modern scientific lines. The Jesuit fathers of Trichinopoly have done some very valuable pioneering work with *indica* and Father Newton's paper¹ on this work contains some valuable information. The bulletin and another paper² on beekeeping by Ghosh³ though mainly compilations from works dealing on the European bee *mellifica* also deal with the *indica* bee adding to our knowledge of this local species; the author does not, however, seem to encourage the keeping of the indigenous bees! A few enthusiasts here and there in recent years have tried importing colonies of the European bee *mellifica*, but the success so far attained by such attempts do not appear to be very encouraging. While on this subject of trials with the European bee, two or three important points have to be noted. In the first place it is not an easy task to transfer a species acclimatised to a temperate region to the plains of tropical India; of course, trials may be made on the hills. Secondly, the European bee is subject to two or three destructive bee diseases called 'foul brood' while our *indica* has not been found susceptible to any such maladies. From this aspect it is not at all advisable to import the exotic bee and stand the chance of infection being carried to India. In the third place, the cost of transferring a colony from a European country is prohibitive and can never be within the reach of the ordinary farmer. Who can say that the exotic bees, with all their original superiority, will not deteriorate like European univoltine silkworm when introduced into the warm tropics; that they will is the opinion of Maeterlinck. In this connection it will not be inappropriate if I add the following unanimous resolution passed at an All-India Entomologists' meeting at Pusa in 1919⁴ on this subject—"This meeting considers that there is considerable danger of the introduction into India of bee diseases by the unrestricted importation of bees, beeswax and honey from countries infected with such diseases and that such importation should therefore only be permitted under necessary restrictions". In the opinion of the writers, therefore, the best thing to do is to try the local indigenous bee *indica* and effect all possible improvements by research and experiments in various directions. This is quite in consonance with the views experienced by two apiarists who have each had a long experience of over two decades with *indica*, viz., Father Newton of Trichinopoly and Lieut. Cousins⁵ of the Punjab. The following remarks of the former are worth quoting—"It would be regrettable if people in the plains of India where *Apis mellifica* does not thrive were to be for ever deprived of such a fascinating pursuit as beekeeping from a mistaken notion that the Indian

1. Collection of papers on Beekeeping in India—Calcutta, 1883.

2. Beekeeping in India—Report of 3rd Ent. Meeting, Pusa 1919 p. 770.

3. Bulletin No. 46, Pusa, 1915.

4. A Guide to Successful Beekeeping in the Hill Districts of N. India—1916

5. Report of 3rd Ent. Meeting, Pusa, 1919, p. 782.

bee is not worth cultivating. I firmly believe that, given a good locality where honey yielding trees and crops are to be found in sufficient quantity, with proper hives and modern methods, the Indian bee in spite of its small size might prove sufficiently productive to justify its cultivation". As early as 1926, the junior author, out of curiosity, was having a few hives of *indica* under observation for some time and had opportunities to gather some practical knowledge of the art, and this little start has stood him in good stead since 1931 when agricultural work was started by the Entomologist, and he was put in charge of the work. Besides the work at Coimbatore, trials with the Indian bee are going on in different parts of S. India, and the Y. M. C. A. authorities have encouraged this industry as a part of their rural reconstruction scheme and actual rearing work has been going on in their important centre, Ramanathapuram, near Coimbatore since the year 1926. Such trials are also carried out at present in the Mysore and Travancore states not to speak of many private educated parties who have taken to this hobby in different places in S. India.

VI. Work at the Coimbatore Farm. The more important ideas with which work on rearing the Indian bee (*indica*) was started at the Coimbatore College were, in the first place to definitely ascertain by experiments and research in various ways as to whether the common bee of the Indian plains (*A. indica*) can be successfully domesticated, secondly to work out all possible means which would improve the quality of the bees and the yield of honey, thirdly to work out thoroughly the economic side of bee-keeping and finally to recommend keeping of this bee and give the necessary instructions and advice to those who are interested in the industry and who intend starting bee keeping either as a hobby or as a cottage industry. With these basic objects, work was started in 1931 with 12 colonies hived from local wild swarms. In 1932 the hives increased in number to about 35 and now we have 25 hives in flourishing condition excluding a good many sold out. It is generally found that the general health and prosperity of the bees depend on a good many factors, the most important of which are (1) availability in the vicinity of sufficient pasturage for gathering honey and pollen, (2) the climatic conditions prevailing, and (3) absence of enemies like the wax moth. We have hardly any previous records on these points with regard to S. Indian conditions.

Pasturage. On the Coimbatore farm we found that, during the South-West monsoon months of July to October, the pasturage becomes rather scanty and the activities of the bees become considerably minimised; on the other hand, from January to June plenty of pasture becomes available and this period may be considered the 'honey season' in this area. Among pollen yielders in this locality, cholam and maize are found the best; next in the order of their value come cumbu, castor, garden Zinnia, *Peltophorum* and others. Regarding the nectar

bearing plants combodia cotton and tamarind have been found to be the best in the locality ; the former appears to be a very good honey yielder and on a rough estimate an acre of this crop is found capable of giving nectar production of ten pounds of honey during a season. Tamarind also appears to be almost as good as cotton. Further investigations are made in this line with regard to the suitability of other trees like nim, citrus, plantains and field crops like lucerne, coriander, etc. Bees are found to use considerable degrees of discrimination in the selection of pasture and it appears that there are many factors which guide them besides smell, color, shape, etc., of flowers. *Strobilanthus* flowers are considered to be the best honey yielder in the sholas of the Nilgiris and it is intended to try these in due course. Investigations are being made and some data have also been collected as to the time of the day when the bees visit the different flowers and their preferences.

Honey. As regards the quality of the honey gathered from the different main sources, cotton, tamarind and nim, each has its special taste, color, aroma and degree of sweetness, and the apiarist after some experience is able to easily detect the special quality by its appearance and aroma. Nim honey, though not available in large quantities, is regarded to possess high medicinal properties. As to the yields of honey, our experience has shown that during an average year of normal seasonal conditions favouring good pasturage, and with sufficient care, one can get from a healthy hive from 10 to 12 pounds of good honey. It is not the honey value alone of these hives that one has to consider. Such a healthy hive gives out swarms periodically and if these latter are properly hived, these also begin to yield their quota in a few months. Thus a good deal of the success depends upon the practical skill of the apiarist in taking advantage of the proper opportunities in various ways. Some of the various items that are now engaging our attention in the matter of honey production are— studies on the comparative food value of the different kinds of honey by analysis, fermenting and ripening of honey, the proper season for honey gathering, temporarily moving bees to better pasturage, swarming and various phenomena connected with them, artificial queen rearing, artificial partition of colonies, different methods of hiving wild colonies and various incidental details in connection with bees.

Appliances— A few brief remarks may be added regarding the appliances we use in the work. The hives used by us are of the pattern advocated by Father Newton with one brood chamber and one or two supers, and we have been able to get it made locally at Rs. 4 each and there has been a very good demand for these hives during the past two years. (Figs. 4 & 5, Pl. II). Regarding the honey extractor also it may added that after some trials we have been able to devise a fairly cheap and efficient honey extractor (Fig. 6 Pl. II) costing about Rs. 6.

Trials are also proceeding in the matter of reducing the cost of all such outfit so that we may bring it to the lowest possible minimum for suggestion to poor ryots. The proper use of these appliances and the careful handling of the bees in the combs will considerably add to the health and safety of the bees? Our work in Coimbatore has now spread into the districts and some of our men are carrying on trials in this work under our guidance in the mofussil research stations like Anakapalle, Samalkota, Taliparamba and Coonoor, and it is hoped that in course of time this industry will become very popular in S. India.

VII. Economics of Beekeeping. Before concluding, some definite data may be added on the economics of beekeeping as far as our experience has shown. During one year, from eleven healthy hives we got 118 lbs. of honey which at Rs. 1/4/- per lb. comes to Rs. 148/-. As stated before, each of these hives gave out a swarm which, in turn, yielded about Rs. 77/- worth of honey. Thus, in a year out of eleven hives we were able to get Rs. 225/-. These 22 hives at Rs. 4/8/- each and the honey extractor costing Rs. 6/- come to Rs. 105/-. The initial cost of hiving the original eleven wild colonies comes to Rs. 22/-. Thus the outlay comes to Rs. 127. The interest on this outlay at $7\frac{1}{2}\%$ comes to Rs. 9/12/-; the hives and the extractor are expected to be useful for at least 15 years and as such the depreciation on these will be about Rs. 7/. The labour charges which are practically nothing, since the keeper is expected to attend to the work, may however be put down at Rs. 10/- for the year. The total annual expenditure therefore, comes to Rs. 30/- roughly and deducting this amount from the outturn the profit realised comes to Rs. 195/-, thus making an average net profit of nearly Rs. 20/- on each hive.

A farmer, with some initial training and experience and particularly with the aptitude and enthusiasm really necessary for this kind of work, can easily manage about 20 hives provided pasturage and other conditions are satisfactory. But, for an amateur it is advisable to start with a few hives which would effect considerable saving in the initial outlay and from the experience and profits gained from these, he can expand his work. Further trials are being made in these various directions.

Other aspects of great importance in connection with the honey bees are their different relations to numerous plants and their economic importance in orchards, etc., as pollinators of different kinds of flowers. Observations and investigations in this direction on these habits of the bee have not been sufficiently made in India and as such would offer unexplored fields for study.

VIII. Conclusion. In concluding this necessarily brief account of this interesting subject we may add that, with some propaganda

and advertisement, the demand for pure honey, as an article of daily consumption, is bound to increase. The Indian, with his proverbially spiritual mentality and aversion to taking life, will surely appreciate the modern methods of honey gathering and as he gets sufficient and correct information regarding the natural history of the bees, bee keeping on modern scientific lines in S. India is sure to have a bright future. But it must be mentioned here that keeping bees is certainly not a short cut to fortune, but as a cottage industry coupled with other items such as poultry keeping, silkworm rearing, etc., it would go a long way to supplement the ryot's scanty income from agriculture.

Apart from the material benefits we can secure by keeping bees it is needless to add how educative and inspiring the life activities of the bees are in various ways. Their sense of duty and co-operation for the common good, their unceasing diligence and industry, their wonderful architectural and sanitary instincts and their marvellous sense of domestic economy and forethought, bordering on intelligence, are some of the many features which have, from time to time, been pointed out by poets and philosophers as worthy of imitation by many an erring and wayward man.

ABSTRACTS

Composition of Egg-plant. (*Brinjal*.) C. W. Culpepper and H. H. Moon. (*J. Agri. Res.* Vol. 47, No. 9, Novr. 1, 1933, pp. 705—17). The authors analysed the egg plant fruit (*Solanum melongena*) in America. They found the protein content of the fruit is very low. This they calculate by finding out the amount of total nitrogen in the fruit. The percentage of total nitrogen is highest in young fruits, decreases gradually and reaches a constant level as the fruits approach maturity. Hence one can easily conclude that the younger the fruit, the more protein it contains. If the fruits are allowed to stand in the air after they are peeled and sliced they become brown, but the addition of salt prevents this to some extent. This discolouration increases when exposed to air after cooking. This darkening is not objectionable unless the material had come in contact with iron. The discolouration is due to the presence of tannin in the fruit. This tannin material is coloured when it comes in contact with iron. The compounds so formed turn dark, because of the oxidising action of the air. In order to prevent this the material must be kept away from iron or iron salts. Addition of lemon juice might aid in preventing any objectionable discolouration. The authors point out that the bitterness in some fruits is not due to the variety—as one may conclude—but to seasonal conditions and the method of cooking. They are of opinion that salting removes the bitter substances from the fruits to some extent. The softening during cooking is the result of the change of protopectin found in the fruit into pectin by heat. They finally conclude that fruits about two thirds grown appear slightly superior when all points are considered. The age at which this size is reached varies with the earliness of the variety; but it is generally between 25 and 40 days from the date of flowering under American climatic conditions.

T. E. K.

Vitamin B₁. Lack of vitamin B₁ causes, according to *Science*, nervous disorders, one of them being beri—beri. The necessary amount can be added to diet by whole grain cereals. For experimental work large supplies are necessary.

These supplies are difficult to get. Drs. William and Eddy of the Columbia University are perfecting a method by which they hope to obtain this vitamin B₁ in large quantities from Rice. They have secured yields from 250—300 milligrams in crystalline form from 50 kilograms of Rice. G. N. R.

The Coconut Industry in Mysore. A. K. Yegnanarayana Ayyar, *Mys. Econ. Journal* Jan. 1934 pp. 11—13. The area under coconuts has risen from 90,000 acres to 147,509 acres during the last 15 years. Coconuts are grown in two ways, viz., (1) in gardens commanded by irrigation tanks, and (2) in wide shallow valleys and on the banks of the rivers which systematically overflow and inundate wide stretches of their margins. In (1) which implies irrigation facilities the scope for expansion is limited, except in the Irwin canal and Marikanive areas. Quite 75 per cent. of the total area is under the second system and is concentrated in a narrow strip of country running through the districts of Hassan, Kadur and Tumkur.

The coconuts are marketted (1) as fresh coconuts, and (2) as dry coconuts or Copra. Large quantities of fresh coconuts are exported outside the state averaging 175,000 maunds, the bulk of which is railed to Hyderabad and as far as Poona. The writer is of opinion that if these are classed and charged as perishables further inland markets could be secured.

The Mysore Copra is quite different from the copra of commerce which is obtained by husking the coconuts and after letting out the water, and drying the meat either in the sun or over smoke fires. In Mysore the nuts are allowed to remain in the husk till they are dead ripe and all the water is absorbed by the meat and the meat detaches itself from the shell and almost rattles inside the nut. The nuts are then split open and the copra rolls out round and entire. This copra does not require any special care in the storage and packing for preventing moulds and rancidity and is sent even to long distances like Lahore and Peshawar only in gunny bags. The product commands a special market and is used solely for direct consumption either as such or for mixing in special preparations. It is too costly to be used for crushing for oil and large quantities of oil are imported into the State from the neighbouring British Districts. The author thinks that if the possibilities of manufacturing oil locally is investigated into, it may benefit both the agriculturists and the industrialists of the State.

Coir making in the State is of little importance for, the special methods of copra making precludes coir-making altogether as the coir would have become highly lignified and coarse. At present some 1500 maunds of coir worth Rs. 75,000 is imported into the State. The author opines that in places where water is available for retting of the husks such as the Vani Vilas Sagar area work must be started to find out possibilities for expanding the coir-making industry and also that work must be started under proper guidance to see if the fibre of the ripe coconut could be softened and used for industrial purposes.

The trade in coconut and copra in the Tiptur and Arsikere markets is of the value of 40 lakhs of rupees per year and goes on all through the year. Both markets deal in other important produce like jaggery and groundnut to a large extent. They are both important railway stations, taluq stations and municipalities. The author is of opinion that the two markets possess many of the important requirements to bring into force any marketting act to deal with coconut and copra, groundnut, and jaggery, which would remove many of the disabilities under which the ryots are suffering and give an impetus to the trade in the products. He further suggests that any opposition to such an act may be got over if simultaneously an organisation or agency to push on the trade in Mysore copra and coconuts into other foreign markets is started by suitable Government assistance.

Gleanings.

Locust Control. The survey shows, for example, how in a period comprising only about five generations, the migratory Locust crossed the continent of Africa from East to West and also during the next two generations well south of the equator. The enormous scale of the out-break showed the futility of attempts to control it and so the policy of large-scale campaigns in east Africa was abandoned and it was decided to concentrate on measures aiming only at the immediate protection of threatened crops. The practical results of this were very satisfactory so far as saving standing crops, but the spread of the swarms as well as their size and number were almost unaffected. One reads that the only hope for its cessation lies in the change of general conditions (climate in the first instance) in a direction unfavourable to the reproduction of the insect. Thus the lesson has been taught that it is impossible to control an outbreak once it has started. *Science Progress*, Vol. XXXVIII. No. 110. October 1933.

A Study of Coconut Seedlings in Relation to Shape of nuts. The investigations here reported deal with the relation between certain characters of coconut seedlings and shape of the nuts which produced them. The data on hand obtained from 1000 individual nuts of Laguna type and 902 seedlings seem sufficient to warrant the establishment of the following generalizations:

1. With equal volume, round nuts germinated earlier than the oblong nuts.
2. No difference in percentage of germination between oblong and round nuts was found.
3. The length of leaves of coconut seedlings is not influenced by the shape of the nuts.
4. The seedlings from the round nuts produced more leaves than seedlings from the oblong nuts.
5. The seedlings from the round nuts were heavier than the seedlings from oblong nuts.
6. The seedlings from round nuts produced a greater number of roots than those from oblong nuts.
7. The length of roots of seedlings did not depend upon the type of nut used.

(*The Philippine Agriculturist*, Vol. XXII. No. 6, November 1933).

By-Products and Wastes. The conservation of surplus stocks and the utilization of agricultural wastes by the recovery of valuable by-products or by manufacture of such wastes into useful and marketable products is receiving intensive study in many laboratories. Work in this bureau on the waxlike covering of apples, pears, grapes, and cranberries indicates that certain components of these coverings can be removed from such waste materials as peels and pomace. One fraction is urolic acid, which is resinous and exceedingly water repellent; when combined with glycerin and phthalic anhydride, it forms an artificial resin which appears to add superior hardness and water resistance to lacquers. Another fraction is a low-melting hydrocarbon which has commercial possibilities if the cost of production can be made sufficiently low. It has been estimated that nearly 50,000,000 pounds of apple peels and pomace are produced each year, principally at canning, cider, and vinegar plants; from this material approximately 500,000 pounds of each of the two fractions could be recovered, if commercial demand for them could be stimulated. (*U. S. A. Year Book of Agriculture*, 1933.)

Tomatoes Without Seeds. Tomatoes without seeds have been grown by a Texan. This was achieved by crossing plants which bore tomatoes with only a few seeds and re-crossing the offspring until with lessening of seeds at each stage, the unique seedless tomato plant was evolved. It is claimed that this seedless variety has a better taste than the tomatoes with seeds. (*Sunday Times* 21-1-34).

Paddy manuring. There is a special practice in vogue in parts of Malay Peninsula known as "*chellupping*". It consists in giving a special manurial treatment to paddy seedling soon after they are removed from the nursery. The roots and the lower portions of the seedlings are dipped in a soft paste of *batgnans* and water. Sometimes earth is added. The seedlings are then stocked in a shady place for one to three days, during which time numerous adventitious roots, copiously covered with root hairs, push through the thin coating of paste adhering to the plants. [Extracted from *Malayan Agri. Jrl.* Vol 21, page 631—1933].

Research Items.

A Note on the Occurrence of Sterility in Bengal Gram (*Cicer Arietinum*).

C. Jagannatha Rao B. A., Cotton Assistant in charge of Agricultural Research Station, Nandyal, writes:—

The article entitled "Occurrence of sterile plants in Bengal Gram by V. Ramanatha Ayyar and R. Balasubramanyam which appeared in the September issue of the Madras Agricultural Journal has been of special interest to the author of the present note as a similar case of sterility has been met with here at the Nandyal Agricultural Research Station during the season 1932--'33. One out of the four hundred Single-plant Selections of Bengal Gram in the 'Row yields' viz. Selection No. 176, exhibited complete sterility in a portion of its population—in eight plants out of a total of twenty-four. These sterile plants were green but the leaves were slightly small, more rounded and somewhat crinkled compared to the normal population. They were observed producing flowers in all of which all or most of the stamens were transformed into petaloid structures of a purer color than the normal corolla. Stray normal stamens and a few antheriferous petaloid structures were noticed here and there in the flowers. Another interesting feature was that the petaloid structures were about twice the number of stamens in the normal flower. In the majority of the flowers the stigma was absent and the ovary was abnormal in size and shape. The characteristic multicellular glands and the unicellular hairs were present all over the ovary. The color of the ovary had a greater depth or green than the normal one. None of the flowers set seed though the plants appeared vigorous and the number of flowers produced was far in excess of the normal plant.

Apparently the causal factor was not due to any fungus or insect attack. A noteworthy feature about the occurrence of the sterility lies in the proportion of plants affected in the selection, the ratio being 1:3 (8 plants out of a total of 24). The sterility observed is suspected to be an inherited character and for purposes of further study seeds of the remaining sixteen single plants of the selection have been collected and will be sown for study during the current season.

Correspondence.

The Persian Water Wheel.

Mr. O. M. Menon, Indra Vilas, Tarakad, Palghat writes:—At page 458 of your Journal for November under the heading "Exhibitions and Demonstrations" you made mention about the Cooper Persian wheel water lift. I shall be glad if you will kindly let me know all about this pump—whether it is capable of pumping out water 25 ft below the ground level, discharge per hour, agents who stock the pump and the cost. I would like to know how many men are required to work the pump.

Mr. B. M. Lakshmiopathy B.E., M.E., M.R.A.S.E., Research Engineer answers the above query as follows:—

The lift is operated by a pair of bullocks, going round, driving a set of bevel gears which rotate the shaft of a wheel over which passes a chain of buckets which lift the water from the well. The lift is capable of lifting water from any depth in the well at the rate of 3000 to 6000 gallons per hour according to the depth of water level in the well and the size of buckets employed.

A sample lift was ordered and tried at the Koilpatti Agricultural Research Station, Tinnevely District. The performance of the lift is satisfactory, and the makers, Messrs. Cooper Engineering Works, Satara, have been asked to substitute $2\frac{1}{2}$ gallon buckets for the existing $1\frac{3}{4}$ gallon buckets and to submit their revised quotations for complete lifts for different depths.

If you are interested in this lift, please let me know:—

a) the depth of water surface in the well from the mhote ramp during the driest season;

b) if a space of about 30 ft. in diameter is available adjacent to the well to erect the lift, so that I may decide a suitable lift for you and let you know its cost.

The demonstration of the lift erected near the Agricultural College Estate, can be arranged, for any visitors to Coimbatore.

Crop and Trade Reports.

Gingelly Crop, Madras, 1933—34, Third Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1931—32 represents 12.3 per cent of the total area under gingelly in India.

2. The area sown with gingelly up to the 25th December 1933 is estimated at 608,000 acres. When compared with the area of 634,500 acres estimated for the corresponding period of last year, it reveals a decrease of 4.2 per cent.

3. The decrease is general except in the Circars, Kurnool, Trichinopoly, Ramnad and Tinnevely. The main crop has been harvested except in the South where the harvest is in progress. The yield is reported to be either normal or above normal in Ganjam, Vizagapatam, Kurnool, Cuddapah, Coimbatore, Ramnad, Tinnevely and South Kanara and below normal in the other districts. The seasonal factor for the Presidency works out to 96 per cent of the average as against 98 per cent for the corresponding period of last year. On this basis, the yield is estimated at 79,400 tons as against 83,600 tons for the corresponding period of last year, a decrease of 5 per cent.

Groundnut Crop, Madras, 1933, Fourth or Final Report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1931—32 represents 51.1 per cent of the total area under groundnut in India.

2. The area sown with groundnut in the Presidency in 1933 is estimated at 3,830,400 acres. When compared with the corresponding estimate of 3,494,100 acres for the previous year and the area of 3,516,679 acres as per season and crop report of fasli 1342, this reveals an increase of 9.6 and 8.9 per cent. respectively. The estimated area for this year is in excess of the normal area of 3,068,100 acres by nearly 25 per cent. The increase was general outside Ganjam, East Godavari, Kurnool and Cuddapah.

3. The harvesting of the summer and early crop of groundnut was finished by October. The harvesting of the winter or main crop is proceeding. The crop

was normal or above normal in the Circars (Guntur excepted), Nellore, Coimbatore and the South (Tanjore excepted) and below normal in the other districts. In South Arcot, the yield is expected to be only 55 per cent of the normal due mainly to insect attack and insufficient and unfavourable rainfall. The seasonal factor for the Presidency works out to 89 per cent of the average as against 98 per cent in the previous year. On this basis, the yield is expected to be 1,710,900 tons of unshelled nuts as against 1,728,910 tons in the previous year, a decrease of one per cent. The yield in an average year is estimated at 1,534,050 tons.

4. The wholesale price of groundnut shelled, per imperial maund of 82—2/7 lb. as reported from important markets towards the close of December 1933 was Rs. 3—10—0 in Cuddalore, Rs. 3—6—0 in Vizagapatam and Nandyal and Rs. 2—10—0 to Rs. 3—5—0 in the other districts. When compared with the prices of October 1933, these prices reveal a rise of 17 per cent in Nandyal and a fall of 12 to 15 per cent in Vellore and Salem, 2 per cent in Adoni and 8 to 9 per cent in the other stations.

Sugarcane Crop, Madras, 1933, Third or Final Report. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1931—32 represents 3·6 per cent of the total area under sugarcane in India.

2. The area planted with sugarcane up to the 25th December 1933 is estimated at 120,250 acres. When compared with the area of 125,220 acres estimated for the corresponding period of last year, it reveals a decrease of about 4 per cent. The estimate of the previous year was in excess of the final area of 120,921 acres by about 3·4 per cent.

3. The present estimate of area exceeds the second forecast by 6,750 acres. The excess occurs mainly in Vizagapatam, Chittoor, Salem and Trichinopoly.

4. The decrease in area in comparison with the final forecast of 1932 occurs in all districts outside the Circars. Bellary, Chingleput, Tanjore and the West Coast.

5. The harvest has just commenced, normal yields are expected in all districts outside Chingleput. South Arcot, the Central and the South where the yield is expected to be below normal. In South Kanara, the yield is expected to be slightly above normal. The crop was affected by the cyclone in December in Chingleput, South Arcot and Tanjore. The seasonal factor is calculated at 95 per cent of the average as against 93 per cent in the previous year. On this basis, the yield is estimated at 324,550 tons of jaggery as against 345,930 tons estimated in January 1933, a decrease of 6·2 per cent. The final estimate for 1932—33 was 339,440 tons.

6. The wholesale price of jaggery per imperial maund of 82—2/7 lb. as reported from important markets towards the close of December 33 was Rs. 5—5—0 in Nandyal, Rs. 5—2—0 in Erode. Rs. 4—8—0 in Bellary and Rs. 4—6—0 in Bezwada and Trichinopoly. It ranged from Rs. 3—6—0 to Rs. 4—2—0 in the other important stations. When compared with the prices of the previous month, these prices reveal a rise of 6 per cent in Ellore, Bezwada, Bellary and Cuddapah. The prices are stationary in the other stations.

College News & Notes.

Games. The Tadulingam Cup. The Inter-tutorial Cricket Tournament for the Tadulingam Cup was in full swing in January and February. It was decided to play the matches on the knock-out system this year. In the first match Mr. T. S. Ramasubramanyam's wards (112 for 4) met and defeated Mr. K. Ramaiah's wards

(101). In the second match Mr. Ramasubramanyam's wards (18 and 102 for 3) lost on first innings to Mr. S. Sundararaman's wards (62 and 38 for 5). In the third match Mr. V. Muthuswami Ayyar's wards (27) lost to Rao Bahadur Viswanath's wards (43 for 2) Mr. Narasimha Ayyangar's wards withdrawing from the tournament, the finals were played between Mr. Sundararaman's wards and Rao Bahadur Viswanath's wards. The former were all out for 81 runs and though the latter were at one stage 79 for 8 wickets and looked like passing their opponent's total, the whole side was dismissed for 79 runs, leaving Mr. Sundararaman's wards winners on the first innings by 2 runs. Though the matches went off without any hitch, some last minute withdrawals and the withdrawal of teams when the opponents passed their totals failed to reveal the spirit of healthy fight which every sporting team should try to cultivate even under adverse circumstances.

Match against the Brennen College. A cricket match with the Brennen College may be said to have become an annual feature. Last year we met this College on their grounds and lost the match. They paid a return visit to us and the match was played on the 8th instant. Though four of our regulars were unable to play, we elected to bat and made 157 for 8 when we declared. Ramanatha Rao played a capital innings for 80 runs and in partnership with Narasinga Rao who made 22 added 70 runs in one hour. For Tellicherry, Gabriel took 4 wickets for 26 runs. The visitors whose best allrounder was hurt early in the innings in attempting a high catch in the country, were severely handicapped by his loss and could collect only 56 runs. Narasinga Rao took 4 wickets for 39 runs, Ramanatha Rao 2 for 21 and Kulandai 2 for nil. Ananda's patient innings in the role of opening batsman which wore down the Tellicherry bowling and Kulandai's successful debut into first eleven matches were important features of the game.

Hockey. In the finals of the inter-tutorial tournament for the Krishnamurti Rao Memorial Cup, Mr. Ramasubramanyam's wards who were favourites annexed the trophy.

Excursions. About 20 students of the college and some members of the staff availed themselves of the week end holidays to witness the Cricket Test Match at Madras from the 10th to the 13th February. A party of officers went on a trip to Vellingiri hills situated to the west of Coimbatore.

Students' Club Day. It is learnt that the Annual Club Day of the Students' Club will be celebrated on Saturday the 24th instant. At a general Body Meeting of the Club, it was decided to present to the College an oil painting of Rao Bahadur C. Tadulingam, retired Principal, to be unveiled in the Freeman hall. A sum of Rs. 72-8-0 has been collected for the purpose.

Essay Competition. In addition to the annual elocution competition for students, an essay competition was organised and held under the auspices of the Students' Club. Thirty four students competed. The first, second and third prizes went to Sahadevan, Soundararajan and Balakrishnan Nayar. In the elocution competition, the 1st, 2nd and 3rd places were won by G. Satyanarayana, C. Balasubramanyam and Murahari Rao.

Weather Review (JANUARY—1934)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st	
Circars	Gopalpore	0.0	-0.2	0.0	South	Negapatam	7.3	-2.0	7.3	
	Berhampore *	0.0	0.4	0.0		Aduthurai *	5.0	+0.4	5.0	
	Calingapatam	0.0	-0.2	0.0		Madura	3.2	+3.2	3.2	
	Vizagapatam	0.0	-0.5	0.0		Pamban	10.6	-0.1	10.6	
	Anakapalli *	0.0	...	0.0		Koilpatti *	5.0	+3.4	5.0	
	Samalkota *	0.0	-0.1	0.0		Palamkottah	6.7	+6.0	6.7	
	Cocanada	0.0	-0.2	0.0						
	Maruteru *	0.0	...	0.0						
	Masulipatam	0.0	-0.2	0.0		West Coast	Trivandrum	4.4	+1.2	4.4
	Guntur *	0.0	...	0.0			Cochin	2.7	+1.3	2.7
				Pattambi *	2.2		+2.2	2.2		
				Calicut	0.4		0.0	0.4		
Ceded Dists.	Kurnool	0.0	+0.2	0.0	Taliparamba *		2.3	+2.0	2.3	
	Nandyal *	0.0	...	0.0	Kasargode *		1.7	+1.6	1.7	
	Hagari *	0.0	...	0.0	Nileshwar *		1.9	+1.8	1.9	
	Bellary	0.0	-0.1	0.0	Mangalore		1.2	+1.1	1.2	
	Cuddapah	0.0	-0.3	0.0						
	Anantapur	0.0	...	0.0						
Carnatic	Nellore	0.9	0.0	0.9	Mysore and Coorg	Chitaldrug	0.1	-0.2	0.1	
	Madras	2.1	+0.8	2.1		Bangalore	0.3	+0.0	0.3	
	Cuddalore	1.8	-0.4	1.8		Mysore	0.4	-0.3	0.4	
	Palur *	1.9	-1.0	1.9		Mercara	0.2	-0.1	0.2	
	Palakuppam *	3.7	+2.8	3.7						
Central					Hills.	Kodaikanal	14.0	+9.3	14.0	
	Vellore	2.6	-0.3	2.6		Coonoor *	12.3	...	12.3	
	Salem	1.3	+1.1	1.3		Kallar *	7.5	+3.3	7.5	
	Coimbatore	1.7	-0.8	1.7		Ootacamund *	5.9	+4.3	5.9	
	Coimbatore Res. Inst. *	1.6	...	1.6		Nanjanad *	4.6	+3.1	4.6	
	Trichinopoly	5.2	+4.4	5.2		Central	Hosur cattle farm *	1.5	+1.2	1.5

* Meteorological Stations of the Agricultural Department.

Summary of general weather conditions. In the Peninsula weather continued to be fine without any marked changes except for a few scattered light showers in South-east Madras which gradually developed into widespread rain in South Madras about the second week of the month. With the approach of the middle of the month South Madras experienced heavy showers and then the weather became dry by the 18th.

The conditions became unsettled in South Bay of Bengal to the East of Ceylon on the 20th which developed into a depression on the 23rd. It weakened itself on the 25th and passed away as a low pressure wave westwards to the South of Ceylon. The wave moved northwestwards into the South Arabian Sea off Malabar on the 26th and became unimportant on the 27th. Consequent on the formation of the depression there was nearly general rain, some places recording heavy falls, in South-east Madras and a few falls in Malabar and Mysore. After the 27th, the weather continued to remain dry till the end of the month.

Western disturbances were of much frequent occurrence as before but unlike the ones of the previous months, these profoundly influenced the general weather conditions in the North-west Frontier and also the major portion of Northern

India. The most noteworthy effect was the passage of a very intense form of cold wave from the extreme north-west to the far east up to Assam and its extension to parts of East Gujerat in the South, which lasted for well over a fortnight from 8th January 1934.

The western disturbance which originated on the 1st. moved eastwards through Kashmir affecting the weather along North-west Frontier causing falls of rain or snow in those localities. There was nearly general rain in East and North Punjab and widespread showers in and near Kumaon Hills till the 3rd. With the passing away of this disturbance eastwards, a secondary low pressure area appeared over the East Punjab and West United Provinces on the 4th and filled up there after causing widespread rain or snow in Kashmir and other parts of the Punjab near Kumaon Hills.

In the second week of the month two further disturbances were experienced which affected the weather over North West India. The first one passed away eastwards after causing rains in East Rajputana and West United Provinces on the 7th and 8th. The second disturbance of the week caused fairly widespread rain or snow in Baluchistan along the Western Himalayas on the 9th and moved rapidly Eastwards and lay as a depression over Southern Division of the United Provinces, East Central India on the 11th. After persisting there for a day it moved over to North Bengal on the 13th. and passed away eastwards on the 14th. During the movement of this depression widespread rain and snow falls were experienced throughout its course up to Assam.

In the rear of this western disturbance temperatures began to fall rapidly in North Baluchistan on the 13th. and the cold wave extended eastwards through United Provinces into North-east India, Southwards through central parts of the country to North Deccan, the temperatures being between 15° F to 20° F below normal and with abnormally low night temperatures in North-west India. This cold wave caused frost in Sind, Punjab, East Khandesh and the central parts of the country resulting in heavy damages to crops and cattle locally. The cold spell extended up to Orissa, Beugal and North Deccan till the 21st.

In the third week of the month two fresh disturbances entered North-west India which passed away eastwards through Kashmir causing only few falls of rain or snow in and near North Punjab Hills. Under the influence of northerly winds close on the occurrence of the above western disturbance, the temperature further fell, in and around North-west Central India, some stations recording minimum below the freezing point in West Punjab and in the plains of the Punjab, Sind, East Rajputana, West United Provinces, West Central India, East Gujerat on the 23rd. Later the temperatures began to rise under the influence of another Western disturbance approaching Baluchistan.

This disturbance persisted over the North-west Frontier causing an extension of cloud in the Punjab and developed into a deep depression over North Baluchistan, which further deepened on the 28th. causing fairly widespread dust storms in and around North Baluchistan and local falls of rain or snow in Kashmir and then weakened by filling up over the Punjab on the 31st.

On the 29th., a secondary depression formed over East Central Provinces and Orissa and continued to be active till the end of the month causing general rains in the United Provinces, Central India, Bihar, Chota Nagpur and filled up on the 31st. Temperatures began to fall markedly below normal and the cold wave extended eastwards on the 31st., the recorded temperatures being 12° F below normal.

The humidity continued to be generally in excess throughout the month in the Bombay, Deccan, Mysore, Malabar and parts of South-East Madras and

slightly in defect about the latter half of the month in Madras, Deccan and Hyderabad. The maximum was mostly below normal throughout the Peninsula and the minimum was above normal during the first fortnight and below normal throughout the rest of the month.

The rainfall was in moderate excess in Malabar and parts of South-east Madras and Mysore. The chief amounts received were:—Pamban 3·2" (15th.), Negapatam 3·4" (24th.), Karambakudy (Trichinopoly) 5·8" (25th.), Pudukottah 4·4" (25th.), Kodaikanal 5·1" (26th.), Coonoor 5·5" (27th.), Kodaikanal 4·6" (27th.)

The most memorable meteorological phenomenon of the month was the earthquake shock of very great intensity, at its origin with its epicentre in Nepal, which occurred on the 15th. at 2-25 p. m. lasting over 2½ minutes, extending over a vast tract in North India from Calcutta to Delhi and from Nepal to South Bihar. It has caused heavy and irreparable damage to human lives and property.

Weather Report of the Research Institute Observatory :

Report No. 1/34.

Absolute Maximum in shade	90° F.
Absolute Minimum in shade	60·5° F.
Mean Maximum in shade	84·6° F.
Mean Minimum in shade	65·4° F.
Total Rainfall	1·59"
Heaviest Rainfall in 24 hours	0·58"
Number of Rainy days	5
Mean daily wind velocity	2·8 M. P. H.
Mean 8 hours wind velocity	3·6 M. P. H.
Mean humidity at 8 hours	82·4 %
Total hours of bright sunshine	221·8
Mean daily hours of bright sunshine	7·2.

Summary of weather conditions. The pressure distribution for the month was normal but for slight fluctuations after the 21st. when sharp fall in pressure was noticed which persisted till the 25th. Later the pressure returned to normal. The disturbance was due to the effect of the depression in the Bay and was responsible for the rain fall of 1·24" in the course of three days from the 25th. Consequent on this the humidity was nearly 10 per cent. in excess as also the wind velocity which was slightly above normal. The rainfall was in excess, there being no rain during the corresponding month of the previous year. The maximum and minimum temperatures were quite normal. The weather was throughout fine but for the rainy days indicated and the nights were chill as usual.

C. V. R. & T. S. L.

Departmental Notification.

D. A's Office Orders. Postings and Transfers Etc:— Mr. V. K. Subrahmania Mudaliar to be officiating Superintendent in the Madras Agricultural Service from 3—1—34. Consequent on this Mr. S. M. Kalyanaraman, Cotton Assistant, reverted to V grade and Mr. M. Venkobarao to be officiating Assistant in the V grade. Mr P. Vishnu Somayajulu, Assistant, in the Mycology section is transferred from Anakapalle to Research Institute, Coimbatore. Mr. D. Marudaraja Pillai transferred from Research Institute, Coimbatore to Anakapalle.

The following reversions and appointments in the Madras Agricultural Subordinate Service are ordered:— 1. Mr. G. Jogi Raju 2. Mr. M. Veeraraghava Rao and 3. Mr. R. Swami Rao, Upper Subordinates I grade from 3—1—34 without prejudice to their provisional appointments in the Madras Agricultural Service. No. 1 will take rank below Mr. V. Muthuswami Iyer and Nos. 2 and 3 below Mr. S. Narayaniah in the I grade. (iv) Mr. L. Narasimha Acharya to be provisionally substantive in the I grade from 3—1—34 Vice Mr. R. Swami Rao seconded. (v) Mr. K. W. Chakrapani Marar to be provisionally substantive in the I grade from 3—1—34 Vice Mr. G. Jogi Raju seconded (vi) Mr. T. K. Venkaswami Rao to be provisionally substantive in the ii grade vice No. iv. (vii) Mr. K. Ramanuja Acharya to be temporarily substantive vice No. (v). (viii) Mr. K. Govinda Nambiar to be provisionally substantive vice No. (v). Mr. A. Gopalakrishnaya on relief by Mr. R. Swami Rao on 3—2—34 will revert as Upper Subordinate iii grade and is posted to ii circle, Guntur.

Postings. VI. Circle. Mr. K. Ramaswami Iyer A. D. on special duty Virudunagar to join duty at Koilpatti at once and relieve Mr. A. Ramalinga Iyer who will proceed to Tiruchendur. Mr. D. Shanmugasundaram Pillai, Probationary A. D. under training in Palni sub circle is posted to Madura sub circle and central depot.

Leave. Mr. K. Govindan Nair, Chemistry Assistant is granted extension of leave on half average pay on M. C. for 4 months from 26—1—34. Mr. P. S. Narayanaswami Iyer, Assistant, Entomology section is granted l. a. p. for 2 months and 3 days from 26—1—34 with permission to suffix the Easter holidays. IV Circle. Mr. K. P. Sankunni Menon, F. M. Palur, is granted l. a. p. on m. c. for 3 months from date of relief. VIII Circle. Mr. C. S. Namasivayam Pillai, A. A. D. is granted leave from 15—9—33 to 29—3—34.

