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Editorial.

Sugar. Today, sugar has become a primary necessity and "is recognized as a stratagic military requirement in wartime furnishing about 13 per cent. of the total energy we obtain from foods". The investigations of numerous chemists, biologists, plant breeders and technologists have made the growing of sugarcane and manufacturing of sugar one of the most efficient industries. In providing sugar at reasonable prices with due regard for a decent living for the sugarcane farmer, the most important part of the task devolves upon the plant-breeder. The continuous procession of varieties of sugarcane that we see emerging from the Coimbatore Sugarcane Breeding Station, amply demonstrates that the cane-breeders are ever alive to meet the challenge of diseases, pests and altered environmental and economic conditions.

We invite the attention of our readers to an article on "Sugar Tangle" in the current issue of the Journal. The author has referred to two important issues that India will have to face in the near future.

The recent expansion in the cultivation of the sugarcane and in the manufacture of sugar has been so rapid that there is an imminent danger of the supplies of sugar over-reaching the Indian demand, creating the complex problem of adjusting sugar supplies to requirements. In this connection attention may be drawn to the system of production-adjustment contracts which prevail in the United States of America, Philippine Islands, Porto Rico and Hawaii. The farmers who curtail the area are paid compensation for the losses consequent on the reduction of the area. The adjustment programme is largely financed through the income from the processing taxes on the industries which in sugar, is one half cent (3 pies) per pound of sugar. It is claimed that the corresponding reduction (one half cent per pound) in the import duty prevented an increase in the cost of sugar to the consumer. It may, however, be pointed out that limitation of production either through competition or co-operation, restricts the employment. In eliminating surplus of goods a surplus of labour and capital is created.

The only other alternative is to export the surplus of sugar with the aid of the subsidies. With the production unchecked, such subsidies involve presenting to foreigners at less than its value. There would then be an ever increasing gap between domestic and world prices. The world has already given clear indications that it would interpose effective barriers to dumping.

In April, the Tariff Board will enquire into the problems of sugar industry. Maximum benefit must accrue to the producer with the imposition of minimum cost on the consumer. Whether this obtains at present or not is a point to be looked into by the Board. When the internal competition is very keen the tariff is generally not effective in maintaining returns to the growers. This is an additional point in favour of limiting the area under cane. In most of the modern countries, the unemployed are supported by the tax-payers and when the consumer expends more for the goods manufactured by the tariff protected industries, he actually pays to maintain the employment and thus prevents the increase among the unemployed.

The interest of the consumers can be protected against excessively high prices, by adjusting the excise duty or the import duty in accordance with the difference between the average wholesale price of sugar and the price based on the fair margin to the grower and the manufacturer.

We are glad to announce that a book on "Livestock of Southern India" by Captain R. W. Littlewood, Deputy Director, Livestock, has been published and is available for sale at Rs. 3—6—0 a copy either from The Superintendent, Government Press, Madras, the Principal Agricultural College & Research Institute, Coimbatore, or any of the Deputy Directors of Agriculture.

SUGAR TANGLE

BY RAO SAHIB V. MUTHUSWAMI AYYAR

Amongst the more important crops grown in India sugarcane occupies an honoured place. But no adequate attention had been paid to this crop until the sugarcane section was organised in Madras in 1911. Other countries like West Indies, Cuba, Mauritius, Java, Formosa and Hawaii which introduced sugarcanes later managed to forge ahead so much so that Java was able to export large quantities of sugar to India for several years. Java's position in 1930 could be summed up in the statement: acreage 484,984; tons of cane harvested 25,292,273; tons of sugar exported to India alone 351,735 (metric), in 1929–30 the area under cane in India was 2,677,000 acres. "From this," says Sir Bryce Burt "was produced 21150 tons of sugar refined from gur, 89,768 tons of sugar produced direct from canes by modern factories, and some 200,000 tons of sugar manufactured by the indigenous open pan or Khandsari process, so that allowing for setts for planting and cane for chewing, 1,837,000 tons of gur were produced for consumption as such."

Although Coimbatore seedlings had established their name throughout the sugar world, there was still a gap—a wide gap between production and consumption in India itself. In 1929–30 these varieties were grown on an area of 549,025 acres. The imports into the country were enormous. India was not self-sufficient. She was at the mercy of Java. Public feeling asserted itself and government reciprocated with commendable alacrity. The question of fiscal protection was referred to the Tariff Board in 1930. Protection was decided upon in 1931.

There was in consequence phenomenal increase in sugar production in India. The area under improved varieties alone in 1934–35 exceeded 2,400,000 acres, while the total area under cane was over 3½ million acres.

Java to her utter discomfiture has had to reduce her area and production. Her area which was 489,984 acres and her tonnage of cane which was 25,292,273 in 1930 dwindled down to 93,613 acres and 5,152,122 tons respectively in 1934, and no tangible improvement has been recorded during the last two years. Other countries have adopted different measures of adjusting their production and sugar prices. Cuba decided to burn her surplus sugar. West Indies entered into a reciprocal understanding with Canada. Formosan sugar was largely absorbed by Japan.

Still the evolution of new types at the Coimbatore Imperial Cane Breeding Station from year to year covering a wide range of suitability and usefulness, the results of trials of promising Coimbatore canes in several provinces under varied conditions of soil, climate,

cultural and manurial treatment serve only to stimulate further increase. This is reinforced by the passing of the Indian Sugar Excise Act of 1935 and by the conviction that protective duties will be in operation for another eight years which gives sufficient time for consolidation of the industry and for making it stand on its own legs. That tendencies point in this direction is shown in the latest official sugarcane forecast for 1936—37. The figures are, area sown 4,431,000 acres, raw sugar (gur or jaggery) 6,717,000 tons." Imports into India have almost ceased.

For a population of 380 millions in 1937 the annual consumption at 18 lb. in terms of refined sugar per head is more than met by production in the country itself even assuming that 2 tons of raw sugar are needed to produce 1 ton of refined sugar. At the present rate of increase in area, a time will soon come when India will have to think of stimulating local consumption or of entering world markets and putting in large quantities of sugar in competition with other countries. Neither of these two methods would seem to offer satisfactory solution, under the present state of economic dependence of India on other countries.

With increased production and no outlet for surplus sugar, the alarmingly low economic condition of the people to which Sir H. P. Mody drew pointed attention in his speech on the Finance bill in the Indian Legislature in March 1936 and in support of which he quoted the following figures would become worsened.

Countries.	National income.	Industrial production.	Bank deposits.	Savings deposits.
	Rs.	Rs.	Rs.	Rs.
U. S. A.	2000	720	...	...
Canada	1300	470	...	..
United Kingdom	1100	410	700	270
Japan	270	158	250	90
India	100	20	7	2

In these circumstances therefore the institution next April of a Tarriff Board for enquiry into the problems of sugar which bristle with peculiar difficulties will be welcomed by all. The taxpayer looks forward however with hope that the terms of reference to this Board will be wide yet precise, that their enquiries will cover a wide field yet be exhaustive, and that their recommendations will come upto the expectations of the country which now feels that considerable improvement is desirable and possible without restriction of area or curtailment of activities of the scientific departments, but with due regard to adjustment and readjustment of cropping and regulation of tariffs. With increased and more effective voting strength vouchsafed under the Government of India Act of 1935 which comes into operation in April and which has introduced a tremendous revolution in his outlook, the villager would rest satisfied only when he feels his interests have not been made to suffer even to a small degree.

A NEW ENEMY OF THE INDIAN HONEY BEE

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Introduction. One of the obstacles for the rapid spread of apiculture as a cottage industry in South India is the presence of a number of bee enemies. The Indian Honey bee-*Apis indica* is often troubled by various enemies such as the Wax moth (*Galleria melonella*), the yellow banded wasp (*Vespa cincta*), the Death's head moth (*Acherontia styx*), ants, robber flies (Asilidae) not to speak of lizards, bugs, frogs, spiders, etc., which also levy a heavy toll. Recently a new enemy—*Palarus orientalis*—has been added to this formidable list and the present paper deals with the life history and habits of this wasp together with control methods for the same.

Description of the pest. *Palarus orientalis* belongs to family sphecidae, series sphecoidea, sub-order Petiolata of order Hymenoptera. The adult wasp is black in color with pale white transverse stripes on the dorsal surface of the abdomen.

The prothorax has basal transverse yellow line and the mesothorax two median longitudinal stripes. The metathorax has a pair of oblique yellow patches.

The female wasp is 12 mm. long with a wing expanse of 20 mm. The male is smaller in size than the female with a length of 9 mm. and wing expanse of 15 mm. A detailed description of the wasp will be found in Fauna of British India; Vol I; 1897 and in the Annals and Mag. Nat. Hist. Vol. 7 (1911) page 483.

Habits of the wasp. Both females and males appear during sunny hours of the day and perform a series of small flights from one place to another, copulation generally taking place at this time, Meanwhile the female pitches upon suitable places for digging tunnels. She sits upon the loose sand and begins to make holes by throwing up sand particles by the action of her legs and mandibles. She burrows into the sand and continues the process of throwing up sand particles. For some time the wasp is visible but as it goes deeper and deeper the loose sand from above falls into the narrow gallery thereby making it impossible to trace it. After finishing the burrow the wasp comes up making an opening in about an hour. First she flies to and fro with her head always towards the hole, then in circles with slight turnings, gradually widening them until, all on a sudden she changes her direction towards the hive. While going in search of prey, she does not close the mouth of her tunnel.

*Paper read at the Agricultural section of the Indian Science Congress 1937.

Preying. The scene is now shifted to the hive entrance. The wasp sits upon the alighting board with its back towards the hive entrance and looks alert and busy by vibrating its antennae and wagging its abdomen. She attempts to pounce upon every flying bee. Generally it catches hold of outgoing bees. But bees with pollen loads have also been observed being made victims. Bees are held on the dorsal side, by the front legs of the wasp. Bees writhe and struggle for release, but they are incapable of stinging in that position. When the bees struggle much the wasp drops them down but in a few moments takes them up again.

Stocking bees. Within about 5 to 10 minutes the wasp returns to her tunnel with her victim. She hovers for sometime and dropping the bee just at the edge of the tunnel, shoots inside it and then drags it into the tunnel. After about 3 to 5 minutes she again appears and repeats the process of gathering bees. This she continues to do for a period of 1 to 1½ hours collecting as many bees as possible. Till that time the tunnel is left open; afterwards she pushes up some quantity of moist sand from inside to close the tunnel and remains in her nest for about 2 hours after which she reappears and begins preying in a similar manner as she did in the forenoon. Afterwards she goes inside the tunnel closing it once again. When the conditions are unfavourable the wasp stops the work temporarily and remains inside by closing the tunnel and the work is resumed after the expected bright weather starts again.

The tunnel. In the moist sand (below the loose sandy layer) there are three or four separate apartments or pockets about 3 to 4 inches apart from each other in which are stored groups of bees varying from 2 to 6 in number. All these lie within a surface area of one square foot.

The egg. In each group of bees there will generally be one egg deposited on one of them but sometimes none may be found in a group of even three or four bees. The egg is seen thrust between the head and throax of the bee, the free end curling a little over the ventral side of the thorax and passing between the front and middle legs. The egg is white in colour, about 3 mm. in length and 1 mm. in cross section.

The larva. The egg hatches on the second day and the small larva is more or less of the same size but its color is slightly dull. Naturally the grub begins to consume the first victim on whose body it hatches. It takes about two days to consume the first bee. In the first five days the larva feeds on all the bees in the pocket leaving only the outer shell of the abdomen, throax, head, wings and legs as remnants. The length of the full grown larva is about 15 mm. On the 6th day it begins to spin its cocoon and on the 7th day it completes spinning. Hence the active larval period is five days.

The cocoon is made of sand and the remnants of the bees. It is a neat oval shell about 12 mm. long and 3 mm. in cross section. In about two days the cocoon becomes hard.

The pupa. The pupa when fresh is pale white in color and later becomes brown. It is about 10—11 mm. long and 3½ mm. broad. Adult wasps emerge from the pupae in due course.

How the wasp affects the bee colony. The loss caused by these predatory wasps is serious since each wasp is capable of robbing about 15—20 bees in a day. If there are more than one wasp preying in a day and if this repeated for a number of days the loss to the colony will be severe. Apart from the actual loss due to the visits of these robbers the routine work of the colony is disturbed. Most of the bees become guards and thus the number of bees going out foraging decreases. The colony therefore never works well and consequently brood rearing becomes slack. Moreover there is an increased tendency for bees to sting freely.

Localities. The wasp has been observed in the following places:- Tirur, Edappal and Ponnani in Malabar District, Tiruchengode in Salem District; and Telungapalayam in Coimbatore District.

Remedial Measures. One of the methods of dealing with the wasp is to locate its nest and destroy it. The location of the nest is not a difficult matter as the wasp as soon as it catches the prey carries it to the tunnel. The direction of its flight can be observed and the nest located without difficulty. It is also possible to handnet the adult wasps during the bright hours of the day. By these two methods the pest can be controlled satisfactorily.

THE STORY OF COFFEE

BY S. DORASWAMI AIYAR, B. A.,

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According to some botanists, the Coffee plant is indigenous to Arabia, while some think that it may have been indigenous to Abyssinia and carried from thence to Arabia. Coffee is not mentioned in the Koran. It is believed that the Arabs knew of coffee only in the 14th century and even then it was probably viewed as a medicinal plant. It is also probable that the Arabs were then only preparing a decoction from the succulent rind or pulp of the coffee-cherry, which, as it contains sugar, was liable to ferment and become alcoholic on standing for some time. It was therefore associated with wine and so the zealous followers of the Prophet discouraged the use of it.

The art of roasting the coffee beans and making a decoction from this was probably discovered in Persia in the fifteenth century. A Mohammadan priest of Aden had an occasion to go to Persia where he

found his co-religionists partaking coffee. When he returned to Aden he tested its value in several ways, and, as he specially found it exhilarating and as a preventive against drowsiness, he recommended its use to his followers with whom he used to spend the nights in prayer.

From Aden the knowledge of coffee seems to have spread to Mecca and Medina where it was adopted first by the pilgrims and then by the rest of the people. It is said that within a century after its introduction to Aden the use of coffee, as a beverage, spread to Cairo, Damascus, Aleppo and Constantinople.

However, in Mecca the more orthodox were objecting to the public coffee-houses as they tended to gaming, singing, dancing etc. In 1511, the Governor of Mecca, who was the Viceroy of the Sultan of Egypt, prohibited coffee drinking on the ground that its exhilarating effects were intoxicating and so contrary to the things permitted in the Koran. But the Sultan of Egypt revoked this and reproved his Viceroy "for venturing to prohibit an article of daily food used by the people of the capital of the Empire (Cairo) and by the Sultan himself." In 1524, however, the coffee houses of Mecca had become the scenes of so much rioting that they were closed by the order of the Sultan himself. In Cairo also there were some who considered coffee drinking as lawful and some who did not think so.

In Constantinople attempts were made by some zealots to raise a religious prejudice against coffee drinking by pointing out that the roasted berry was charcoal and that charcoal was not "of the number of things created by God for food". In consequence of this the coffee houses of Constantinople were ordered to be closed in 1554. But, later on a decree was issued declaring that coffee was not charcoal and thereupon the business of selling coffee was resumed. But still later, the Grand Vizier, Cuproli, suppressed the coffee houses on the war breaking out with Candia. This was done under the pretence that its exhilarating effects induced the people to talk with too much freedom about the politics of their country. In course of time, however, the religious and political prejudices subsided and Turkey is now one of the most important countries consuming coffee.

In 1615 coffee drinking was prevalent in Venice. In 1644, it was taken to Marseilles and in 1652, Mr. Daniel Edwards, an English merchant of Smyrna, took to England a Greek servant, by name, Pasqua, who made his coffee. Shortly afterwards Pasqua set up a public coffee house in Cornhill. In 1675, Charles I characterised the coffee houses as seminaries of sedition and endeavoured to close them and it is said that he actually issued a proclamation which, however, was suspended a few days later. By 1688, London had rivalled the Grand Cairo in the number of its coffee houses.

In 1657, the Turkish Ambassador made coffee drinking fashionable in Paris and by 1670 roasted coffee berries were sold even at £5 per pound in Paris. By 1680, coffee drinking was quite popular in Paris.

It is said that even in Europe there was religious opposition to the drinking of coffee. Many sermons are said to have been preached against coffee and in one of them coffee is characterised as "a poison which God made black, that it might bear the Devil's colour".

Until 1690, the world's supply of coffee came from Arabia and Abyssinia. In 1690, live seeds had been conveyed to Batavia. A plant was then taken to Amsterdam and it is said that the Dutch presented a seedling from this to Louis XIV and that seedlings from that plant were sent to Martinique in 1720. During the voyage, the story runs, the ship's supplies of water ran short and the man in charge of the seedlings gallantly saved them by depriving himself daily of the greater part of his allocated portion of water. He had, in consequence, the good fortune to see the plants arrive in safety and a new source of wealth thereby added to the island.

In 1723, coffee was taken by the Portuguese to Java. In 1728 it was introduced into Jamaica and in 1770 to Rio de Janeiro. In all these places the production of coffee increased year after year.

Regarding the introduction of coffee in India it is believed that it was brought to Mysore over two centuries ago by a muhammadan pilgrim named, Baba Budan, who, on his return from Mecca, brought seven seeds with him. By 1825, coffee was growing in the Botanical Gardens at Calcutta. The first systematic plantation of coffee was established in 1830 near Chickmaglur in Mysore state. About the same time coffee was grown in the Shevaroys and the Wynad. In the Nilgiris, plantations were organised only in 1846.

As the cultivation of coffee spread in many countries in the tropics, its consumption also increased rapidly and coffee is now one of the most popular of all beverages and may even be considered as having passed from the position of an occasional luxury to that of a daily necessity, rivalled only by the sister beverage tea.

As a result of the legislative measures prevalent in many countries and as a result of the abnormally high taxation on coffee at various times, recourse was made to adulterate coffee and to find substitutes for coffee. It is even said that no other article of diet is so much and so persistently adulterated as coffee. The principal substances used for this purpose are roasted chicory and roasted beans and corn. Among others of less importance are acorns, dried beet-root, dandelion, mangold-wurzel, turnips, carrots, peas, date stones etc.

When the duty on coffee was high in many consuming countries, there had always been a large number of substitutes for coffee which were more or less satisfactory and some of which even replaced

coffee. But the importance of these substitutes waned as the duty was reduced. Among the more important substitutes for coffee were the following:—*Acron Coffee*, from acrons deprived of their shells, husked, dried and roasted; *almond coffee*, rye or wheat roasted with a few almonds; *bean coffee*, horse-beans roasted along with a little honey; *beet-root coffee*, from the yellow beet-root, sliced, dried in a kiln or oven and ground with a little coffee; *Egyptian coffee*, from chick-peas; *German coffee* from Chicory; *lupin coffee*, *rice coffee*, *rye coffee* etc.

During the Great War, the high price of coffee occasioned an increase in the trade of coffee substitutes and when the importation of coffee was rendered impossible for Germany and Austria on account of the blockade, the manufacture of substitutes for coffee developed there to an enormous extent. Numerous seeds, roots, fruits etc. were tested and even such materials as fruit stones, nut shells and sawdust were used. According to a writer, "there is no materials which has not been made into coffee substitute, from the wild radish to sawdust". It is said that during the War, the number of authorisations granted by the National Food Ministry in Germany for the manufacture of substitutes for coffee was 511.

After the War, however, conditions changed so thoroughly that during the past few years the world production of coffee has been considerably in excess of the demands and that during the past seven years some millions of pounds of coffee have been allowed to be destroyed by burning or otherwise, especially in Brazil, on account of over-production and with a view to secure a reasonable price for coffee.

In our own country, South India is the seat of the coffee planting industry and it is here that coffee drinking is also more popular. The production of coffee in South India is far more than what is required for local consumption and so the surplus is exported to the European countries. In recent years the demands from these countries have not been encouraging and the prices obtainable have also been declining. During the past three years the price of coffee has been low. In order to improve the prospects of trade, a cess is levied on the coffee exported from the country and the amount realised is being utilised for propaganda in this country and abroad for the more extended use of South Indian coffee.

Many virtues have been attributed to coffee drinking. It is said that Sir John Floyer was cured of asthma, after 60 years' suffering, by drinking coffee freely. It is also said to cure gout to promote digestion, and exhilarate the spirits. It has a stimulating effect on the system by rousing the nervous system to fresh activity. The sense of hunger is suppressed and the desire to sleep is driven away. When taken strong, it causes sleeplessness. It is said to dispel flatulency, to remove dizziness of head, to cause biliousness. Drunk in moderation, and especially with sugar and milk, it is perhaps the most wholesome

beverage known. Very strong coffee is said to produce palpitation of the heart, congestion of blood in the brain, trembling of the muscles and similar affections of the nerves.

To produce the beverage in perfection it is necessary to employ the best materials in its preparation. The berries must be carefully roasted by a gradually applied heat until the aroma is well developed and the toughness is destroyed. Too much heat must be avoided, as the volatile and aromatic properties of the coffee, and, consequently, the flavour, are thereby injured; on the other hand, if the berries are roasted too little, they produce a beverage with a raw, green taste, and very liable to induce sickness and vomiting.

The use of berries of uniform size is very important in order to ensure uniform roasting. Nothing injures coffee more than a percentage of small berries that become charred before the others are sufficiently roasted and as charcoal absorbs completely the aroma of coffee, charred berries are objectionable.

The roasted coffee should be kept dry and excluded from air as much as possible. It loses flavour by keeping and it also absorbs moisture from the atmosphere. It is advisable to use freshly roasted and freshly ground powder for preparing the coffee. Boiling water should be poured over the powder in the coffee-pot. This will extract the useful and agreeable matter in coffee and all its flavour and aroma. Boiling the coffee is quite unnecessary and long or violent boiling might even be injurious.

AN ACCOUNT OF THE TOUR OF THE SECOND YEAR B. Sc. (Ag.) STUDENTS

BY P. K. S. MANI

On the third of January we met at Ernakulam. The most striking thing that drew our attention here, was the extent to which the human labour had supplanted cattle labour; even huge waggons were drawn by teams of men. We visited the Tata Oil Mills; we were much impressed on seeing the intricate processes by which oils, particularly coconut oil, are transformed into various articles of luxury and necessity. We next visited the Palace Orchards of His Highness the Maharaja of Cochin. We also went to the Government coconut farm wherein we learnt the details of the cultivation as well as those of several experiments conducted. The next item of interest that we saw here, was the manufacture of coir and coir articles in the firm of W. M. Goodacre & Sons. The fundamental processes are all done by

hand and it was very interesting to watch the dexterity with which the workers made the mats and other articles of high value.

From Ernakulam we went to Trichur where we saw the cultivation of various crops and horticultural plants in the Central Farm. The next day we went to a rubber plantation and learnt the practices and difficulties of a rubber planter. We also studied the ingenious methods of kole cultivation of paddy. We learn that this system of growing paddy was as remunerative as the ordinary method.

Our next halt was at Pattambi. The superintendant took us round the farm and gave us a general account of the cultivation and agricultural practices of Malabar and also explained the work of the station in evolving the various paddy strains. We were also told the details of Pine apple cultivation.

We next moved on to Taliparamba. Being a hilly tract and climatically suited to the cultivation of pepper it was one of the chief pepper growing centres.

Our next visit was to the coconut stations Kasargode and Nileshwar where we learnt the proper methods of coconut cultivation as well as the details of some elaborate experiments carried on by the Oil seeds specialist.

Leaving the coconut farm we went to Mangalore. Here we visited a cashewnut factory and saw the details of curing, grading and preparation of the commodity for the market.

The next place of our visit was Udipi. We saw here a dairy farm and were greatly impressed with the efficient management of the concern. It looked a paying proposition for any of us to take up such a work when we completed our course at the Agricultural College.

We next went to Coorg where we visited orange and coffee plantations and acquired at first hand the details of the cultivation of the two crops.

From Coorg we moved on to Mysore. Here we saw the Kannambadi Dam, the horticultural gardens and the palace dairy. In the last of the places we saw the various breeds of cows. We also went to Mandhiya and studied the cultivation of sugarcane. We took this opportunity to visit Seringapatam as well as the Chamundi Hills.

On the 19th we reached Bangalore, and with a visit to the Indian Institute of Science our tour came to a close. The same night we took train to Coimbatore.

The success of the tour was solely due to the able guidance of Mr. K. Raghavachariar our lecturer and Mr. S. V. Doraiswamy Iyer, the assistant lecturer. We tender our grateful thanks to them.

UNIVERSITY OF MADRAS

MAHARAJA OF TRAVANCORE CURZON LECTURES ON

AGRICULTURAL ZOOLOGY

By Dr. T. V. RAMAKRISHNA IYER, B.A., Ph. D.,

Retired Government Entomologist, Madras.

President:—R. C. BROADFOOT Esq., N. D. A., C. D. A.,

Principal, Agricultural College, Coimbatore.

Mr. President, Ladies & Gentlemen,

I feel it my first duty this evening to express my thanks to the Madras University for the honour they have conferred on me by selecting me to deliver this year's lectures on agriculture under the Maharaja of Travancore Curzon foundation.

I certainly consider it a unique honor to be granted the previlege as an old graduate of the University of being associated with its many distinguished *alumni* who have left their mark as University lecturers; nor can I restrain my feelings of pride and pleasure at my being associated with the lectures endowed in memory of the famous viceroy Lord Curzon; for, little did I dream of such an association with this great personality, when in the spring of 1905, as a raw recruit in the newly started Agricultural Research Institute, Pusa, I had the previlege of witnessing Lord Curzon laying the foundation stone of the first Agricultural Research Institute in India.

I am particularly thankful to the University for graciously allowing me to deliver the lectures on the prescribed agricultural subject at this place (Coimbatore) where, in my opinion, subjects on agricultural topics are sure to command perhaps a better or at any rate an audience which can better evaluate the performance of the lecturer for obvious reasons. And this has given me an opportunity of coming into contact and renew acquaintance with the many officers and students of this institution with which I was intimately connected for over 25 years and from which I retired only a couple of years ago. The previlege therefore of allowing me to deliver the Curzon memorial lectures have enabled me to recall the days when I first entered the Agricultural Department and that of being allowed to deliver the same in this institution has helped to remind me of my connection with it until recently. I beg to be excused for this personal note. Coming to the subject prescribed for the lecture viz.: "Agricultural Zoology", I have again to thank the University authorities for giving due importance to a subject which has received scant attention from any of the Indian Universities; until about the middle of the last century biological (Botanical and Zoological) studies were persued more with the idea of discovering and elucidating scientific

phenomena than with the object of utilising the knowledge so gained towards the every day needs and practical affairs of humanity; in other words very little attention was paid to the applied aspects of biology as compared with the purely academic and intellectual sides of it. This has been the case with all the Indian Universities which have biological subjects included in their curricula of studies. To add to this, there have been existing in recent years among many scientists, especially among many men trained in or connected with the famous universities of the west some short-sided and unfortunate ideas regarding the applied aspects of the natural sciences. Many of them have been feeling that pure Botany or pure Zoology is of higher scientific status than applied Biology and that the Economic Zoologist or Botanist occupies a lower caste. At the International Conference of Botanists in London 1930 one of the leaders exclaimed thus. "At this conference let us have pure botany, real botany; we do not want all that applied stuff"; another said that "we discover facts and principles and you merely apply them to particular problems and nothing more". The late Dr. Barber one of our pioneer agricultural officers in Madras, under whom I had to serve for some time, has more than once taunted me with the remark that Economic Entomology is all a bundle of methods. In certain quarters there is often a three cornered fight between the research worker, the university professor and the applied biologist. The research worker is looked upon by some as an inoffensive but curious member of the social order moving in his own rut and knowing hardly anything of the outside world; the teacher is snubbed as an academic automaton whose place can be easily replaced by a gramaphone, and the applied biologist is regarded as a boorish plug of a farmer or mechanic with neither culture nor status. I have worked in all the three capacities and in my opinion all the arguments are but half truths. It is however gratifying to note that all this snobbery and mutual bickerings especially those between the pure scientist and the applied scientist are gradually disappearing and that they are beginning to realise that it is the proper balance between the two aspects that should be maintained. In the words of professor, Coulter "The physical needs of man great as they may be, must never obscure the intellectual needs of man, especially as the trained intellect is the speediest agent in meeting physical needs. On the other hand the intellectual needs of man, noble as they may be must never lose sight of the fact that the speediest results are obtained by the enormous increase of experimental work under the pressure of physical necessity." The rapid strides of civilisation, the general growing rivalry among the more advanced nations in the exploitation of the rich tropical regions, the frequent wars in that connection and the consequent economic needs of human communities all over the world—all these are compelling man to look for the applied aspects of the different sciences for his future needs. Nor has it to be

forgotten that it is on the foundation of agriculture that all human activities and thoughts depend in the last resort and that agriculture is mainly applied biology. Above all the late war and the events that have followed have demonstrated with great force the absolute dependence of all phases of industrial life upon the single industry agriculture, which, with its associated activities forms the one primal all essential requsite in the successful prosecution ofany enterprise, be it war or peace. The realisation of these stern facts has within recent years given a stimulus to the advance of the applied science. Applied chemistry, applied physics, and economic biology have nowadays begun to loom large in scientific circles and experts in responsible quarters have begun to feel that the motto of applied science and pure sciences should be the same viz. " A practice based on the science and a science that illuminates and extends practice ". It may also be concluded generally that all science is practically one though for conveniences it is divided into different aspects that pure science is often immensely practical that applied science is often very pure, and that between the two there is no dividing line, both being essential for the intellectual and material needs of man. My idea in giving experience to the above remarks was just to indicate the past and present status of applied sciences especially, of applied zoology in India and elsewhere.

Let us now pause for a while and see what the terms applied zoology, Agricultural zoology etc.—terms which are of comparitively recent origin—connote, and comprise in their relation to the science of zoology. As we all know, Zoology is the science of animals—the unravelling of the problem of the origin and nature of animal life—a problem whose complete solution will be the crowning achivement of humanity; and this has been attacked in many ways from the days of Aristotle. Until about the middle of last century however zoological studies were mainly devoted to the following lines.

Different aspects of zoological study. 1. *Morphology.* The study of the form and the structure of bodies of animals. This includes Anatomy, Histology, Cytology and Embryology.

2. *Physiology.* The study of the fuctions of the different parts of an animal separately and in relation to the organism as a whole. This deals with the process of feeding, waste repair, etc : studies on the physics and chemistry of protoplasm may also be included here.

3. *Evolution.* Study of the process which has brought about the great variety and wealth of animals and their distribution and space. Includes Zoogeography, Palaetonomy and Genetics.

4. *Taxonomy.* Classification of animals (Systematic Zoology).

5. *Ecology.* Study of the relations of animals to their environments both living and nonliving, and the various adjustments.

Though investigtions on these lines have been fairly comprehensive and exhaustive, have formed the foundations for all aspects of

zoological studies in the future and have produced remarkable results in the past, aspects of zoological studies regarding animals in their relation to man—in other words—the economic or applied aspects of the science began to receive serious attention only within the past two hundred years or so. Of course, from the very early days when half civilised man gave up his hunting and predatory habits for a settled life and began to grow crops and tend cattle, the various forms of life associated with these early activities also became his life long companions for weal or woe; gradually during ages of civilization as man began to clear wild jungle and grow crops in large areas for his food, clothing and other material needs, his relation with different forms of life became more and more pronounced. But excepting perhaps some of the higher animals like cattle and domestic animals the rest of the animal world interfering with man hardly ever received our serious attentions till recently.

What is economic or applied zoology and what is its scope? It is the study of such animals which are, in brief the friends and foes of man; in other words it is the subject of animals' and human welfare. Human welfare may be briefly brought under three main headings—Health, Wealth, Social and intellectual welfare. Applied or economic zoology therefore is the study of the relations of animals to man, and the utilisation of such knowledge in his endeavours to satisfy the above aims.

Table I.

Important Group of animals.

Animal Kingdom divided into Phyla.	Phylum.	*Protozoa.* One celled animals.
	do.	*Porifera.* Sponge.
	do.	*Coelenterata.* Jelly-fish, corals etc.
	do.	*Echinodermata.* Starfish, Sea urchins etc.
	do.	*Plathyhelminthes.* Flukes, tapeworms etc.
	do.	*Nemathelminthes.* Round worms, worms etc.
	do.	*Annulata.* Earthworms, leeches etc.
	do.	*Mollusca.* Snails, oysters, slugs etc.
	do.	*Arthropoda.* Insects, Crustacea, myriapoda, arachnida etc.
	do.	*Chordata.* Higher animals. (Vertebrata). Lower animals. (Invertebrata).

Table II.

Applied or Economic Zoology (groups).	1. Mammalogy. (Higher animals)	Agricultural Zoology.
	2. Orinthology. (Birds)	
	3. Entomology. (Insects)	
	4. Helminthology. (Worms)	
	5. Protozoology. (Protozoa)	
	6. Carcinology. (Crabs prawns etc.)	
	7. Malacology. (Mollusca)	
	8. Ichthyology. (Fishes)	
	9. Herpetology. (Reptiles)	
	10. Hydrozoology. (Corals etc.)	
	11. Poriferology. (Sponges)	

The two tables might give us some idea of (1) the main subdivisions of the Animal Kingdom and (2) of those groups which possess some economic importance. Of the 11 divisions shown, which in my opinion, play a good part in economic zoology, those from 1 to 7 can be conveniently grouped as animal communities which have something to do with agriculture. If however we employ the term farming or farmer in the wider senses that they are at present used, there is hardly any group of animals which cannot be brought under the above category, for, we hear of ostrich farms, snake farms, coral farming etc. Thus practically Agricultural zoology comprises almost the whole of the field of economic zoology.

Economic Zoology in India. Zoological work in India has been persued in different parts of India from very old times and numerous valuble works have been published till now on Indian animals. Most of these latter, though extremely useful to modern workers in numerous ways were generally of a descriptive, systematic or faunistic nature. From about the middle of the 18th century numerous zoological workers came into prominence. Such were Dr. Koenig of the Tranquebar mission—who wrote about white ants—Drs. Kerr and Anderson of the E. I. Co., who wrote on the lac insects and Dr. Buchanan the famous traveller who wrote on the silk worms. By about the second half of the last century considerable facilities and encouragement were afforded for the study of natural history subjects by the starting of institutions like the Asiatic Society of Bengal, The Bombay Natural History Society and the Indian Museum. The publications issued by these bodies ever since their birth, have included numerous valuable papers on the natural history of India. The real incentive however, for intensive investigations on agricultural zoology came from the interest shown by the Government of India in agricultural matters and the creation of the Imperial Department of Agriculture in India in 1901 and the appointment of the Imperial Entomologist to the Government in 1903. The first Imperial Entomologist was the late Professor Maxwell Lefroy who died under tragic circumstances in the cause of science and under whom I had the previlege of getting my ABC in Agricultural zoology. Our previous knowledge of agricultural or economic zoology was very scanty. Chief among those which devoted some attention to animals of economic importance was the periodical known as the "Indian museum notes" from 1890—1902 which confined its activities chiefly to Economic Entomology. "The pests and Blights of Tea" by Watt and Mann was another. The Fauna of British India volumes on various animal groups published by Government during these years have been of very great service to Zoologists, though they were purely systematic and faunistic. The first really important work on Agricultural Zoology in India was issued in 1906 viz. Prof. Lefroy's "Indian Insect pests". Mr. Stebting of the forest

department published his "Manual of Forest Zoology in India" in 1908 and the next important work on applied Zoology was Fletcher's book "Some South Indian Insects" published in 1914. Since that year considerable work has been done on the various aspects of applied Zoology in different parts of India, especially on Agricultural Entomology. A some what detailed account of this history may be found in my paper published in 1926 on the "Rise and Progress of Entomology in India".

I shall now proceed to give you as briefly as possible some account of the different aspects of Agricultural Zoology with special reference to South India with the help of some lantern slides, I had prepared in this connection. The subject can be dealt with in one or more ways; one method is to dwell on the work of the Economic Zoologists on the different animal groups having relations to agriculture, in their natural order, another way is to treat the economic aspects of animals under different categories such as animals concerned with plants, food, clothing, diseases store-products, livestock etc. I am taking up the former method with slight modifications and shall rapidly refer to each of the important economic groups of animals, indicating their relations to human welfare, especially in relation to South Indian Agriculture. Anything like doing full justice to a large and growing subject of this nature is far beyond the possibilities of even half of a dozen lectures; as such, my idea is to place before you in these two lectures a brief and succinct survey of the more important aspects of the subjects which might perhaps create in some of you at least, some interest on an important subject like this which affects human interest to a very great extent. I may tell you at the outset that among animal groups, which I just pointed out to you as economically important, there is one division viz. insects which is far more important from an agricultural point of view than many others and which has received very great attention at the hands of Economic Zoologists. I hope to deal with this subject of Agricultural Entomology which deserves some special attention after I finish with all the other groups. Starting from the lower ranks of the animal kingdom we have the protozoa or unicellular organisms. It will be seen that in no group of animals has work of such remarkable nature and magnitude been done in such a comparatively short period of time as in this group, and the branch of protozoology having advanced by leaps and bounds, has almost outbeaten many other branches of biological study, in its economic importance. The wonderful researches in the ætiology of malaria, yellow fever, and sleeping sickness, the study of their causative organisms and their life histories in different hosts—these alone of the many other discoveries with the protozoa will be sufficient to indicate some of the outstanding triumphs of modern biological investigations.

Pathogenic.

Protozoa (Agricultural).

Malaria	*Plasmodium spp.*	In man and cattle
Pebrine	*Nosema bombycis*	In silk worms
Cattle Disease	*Trypanasoma spp.*	In horses and cattle
Yellow fever	*Leptospira icteroides*	In man.

There is possibly no greater source of loss to the tropical farmer than that occasioned by the inroads of insidious malaria. It has been shown more than once by competent authorities that in many fertile areas of the world, the progress of agriculture has been greatly retarded by this one factor. The actual loss in money, lost time, employers liability and depleted energy due to active and latent malaria are almost beyond powers of computation. Any one knowing of anything of our hill plantations can testify to the troubles and loss caused to coffee and tea planters during certain seasons in the year when whole gangs of coolies are down with malaria, completely upsetting the work in the estate. Other studies worth noting are the researches in connection with the protozoan organisms causing Pebrine in silk-worms, Kala Azaar in man, Surra in horses and Texas fever in cattle. Though most of the investigations are relating to veterinary and medical branches the application of such knowledge in the alleviation of pain and the treatment of some of the deadly diseases to which man and beasts are subject to. has gone a great way in helping agricultural progress. According to Dr. Balfour of the London Tropical School of medicine the deaths due to malaria may be put down roughly at 2 million people every year. Malaria, yellow fever and kala azaar are considered as rural diseases and levy a heavy tax on the human and cattle strength of many countries which depend for their prosperity mainly on agricultural progress. Pebrine affecting silkworms is the earliest known of protozoan maladies, and this disease was on the point of completely ruining the silk industry of France when Louis Pasteur the farmer bacteriologist saved the same by his studies of the pebrine organism (*Nosema bombycis*) and suggested his method of microscopic selection of seeds. Further recent studies on pebrine by Hutchinson in Pusa have considerably helped the silk rearer in India in combating this dire disease of silkworms found in South India Bengal and other provinces. The investigation on the protozoan pathogenic organisms connected with the various protozoan cattle diseases in India are being carried out by experts at the Imperial Veterinary Institute, at Mukteswar.

Before leaving the protozoa it may be interesting to make a passing reference to the recent researches in soil protozoa and their effect on field crops. The biology of the soil fauna and especially, the microbiology—a knowledge of the activities of soil protozoa is a branch of zoology which has not as yet progressed sufficiently in India to enable us to know its economic value. It is believed that some of these

protozoa in combination with bacteria produce certain beneficial and injurious effects on the soils. Russel and Hutchinson have propounded a theory to the effect that many soil protozoa are injurious to the growth of plants and that a partial sterilisation of the soil yeilds better crops; this new theory is likely to lead into interesting avenues of investigations.

Leaving unicellular animals we come to the lowest of multicellular forms, the group porifera including the sponges. It is probably not known to many that sponges are of animal origin and that they have some economic importance. The bath sponge of commerce used for toilet and other purposes is the fibrous skeleton (called spongin) of a colony of minute sponge organisms; this skeleton is rough when dry and smooth when wet. The studies on these creatures have shown that they can be artificially cultivated from cuttings of the live colonies in shallow water and at present sponge farming on a large scale is carried on in parts of the Florida and the Mediterranian Coasts. Of course not having direct agricultural relations we need not dilate on these creatures.

Worms. From sponges we go to the next higher group the Worms, which constitute a very important division of animals both from the purely scientific and the economic points of view. This branch of zoology which is known as Helminthology has received considerable attention from very early times, and latterly the economic importance of these creatures to both higher animals and man has received special attention both from medical men and agriculturalists. From an economic point of view Helminthology can be studied in three important directions viz. in relation to man and livestock in relation to Agriculture and in connection with what is known as Biological control of pests.

The relation of worms to man and livestock consists in many worms living as internal parasites in higher animals and seriously affecting their health. In this respect worms form a very important group to constitute the subject of Animal Parasitology. The most important of these parasitic worms are what are known as tape worms, flat worms and round worms, and the well known representatives are the liver fluke (*Fasciola spp*), the tape worms of sheep, ox, pig and man (*Taenia spp*), the human pin worm (*Enterobius*) the filariasis worm (*Filaria*), the guinea worm (*Dracunculus*) and the notorious hook worm (*Ancylostoma*). According to Cameron " the liver fluke costs Great Britain at least a million pounds yearly and about 10 % of all sheep die yearly from worms. It is well known that numerous diseases and bodily troubles are caused by many of these helminth parasites to cattle and farmers and great loss is caused by their passing their lives in two or more hosts. It may be emphasised that as in the case of malaria, the trouble caused by the hook worm parasite in the different areas of the world is something very serious and noteworthy causing

considerable reduction in industrial efficiency in tropical farms, plantations and factories. The humanitarian work that the health board of the Rockfeller foundation is doing in the direction of alleviation of diseases, especially in relation to malaria and hook worm trouble in various parts of the world is one which cannot be sufficiently admired and appreciated by the world at large. The representatives of the foundation have been and are still doing work on malaria and hookworm in Ceylon and South India. To quote from their report for 1925 " An intensive study of the results of hookworm, treatment of coolies on a tea estate in Ceylon showed that treatment was followed by a rise in the number of red corpuscles in the blood and of the haemoglobin index and by a reduction in the number of coolies at the dispensary and in the hospital and also in the number of working days lost." Speaking of helminths affecting livestock many are the ailments caused to milch and work cattle, horses, sheep and other farm animals, the common ones being liver rot, gastritis, intestinal troubles, lung troubles etc. The Imperial Bureau of Agricultural Parasitology in England and the Animal husbandry wing of the Imperial Council of Agricultural Research in India are now dealing with this aspect of Helminthology seriously affecting livestock which forms the back bone of agriculture and it is hoped very substantial results will follow.

As regards the direct relation of Helminths to agriculture we have the Eel worms which play a very important part. These are minute round worms living as plant parasites and occuring in thousands in the soil with great diversity in form and habits. Though many of these soil forms are harmless some of them cause very serious disease on plants. It may be surprising that the larvae of some of them (*Angiullulina sp.*) revive when moistened after remaining in a dessicated state for seven years, and that some (*Hoterodera sp*) can lie dormant in the soil for a period of ten years or more. Three genera of this group form the most important of these plant pests (*Aplenchoides spp.*) attacking chrysanthemums, strawberries, currants. etc. and causing leaf blotches, galls, bud rot etc. This is not recorded in India as far as I know.

Anguillulina (Tylenchus) a species of this genus—*A. angusta* is known to cause the Ufra disease of paddy in Bengal ; other species are known to cause cockle in wheat and galls in rye and grasses and diseases in potato, clover etc.

The third genus is Heterodera including the most notorious of these plant eel worms. The root knot eel worm (*H. marioni* C.) is the best known of these, causing galls in root and stems, of many plants. According to Goodey more than 850 plants as hosts of this creature have been recorded and numerous workers have carried out substantial investigations on this group all over the world. In South India many of our common garden plants, vegetables and crops like

pepper, betelvine, tea, pulses, etc. have been found subject to the attacks of this eel worm. Mr. P. N. Krishna Iyer of this Institute has recently studied the subject and has published some very good papers on this eel worm. The Imperial Bureau of Agricultural Parasitology, London, is also engaged on intensive studies in this direction. One other aspect of nematode activities in connection with agriculture is the discovery that some genera of these parasites are acting as natural agents in pest control; some of these nematodes have been found infesting pests like locusts, leaf and bark beetles, leaf hoppers etc. Well known genera of worms in this direction are Mermis, Gordins and Monnonchus. Though sufficient work has not been done in this direction, the subject offers a new and excellent line of pest control with the help of worm parasites as natural enemies, especially in the control of insect pests of crops. Before we leave the group of worms reference may be made to two other subdivisions belonging to this great group viz., the *Earthworms* and the *Leeches*. It is common knowledge that earthworms and their earthern casts are very familiar objects in our garden and fields and that they are useful to the soil in various ways though unfortunately they sometimes get mixed up as doubtful agents of mechanical mischief in company with eel worms as in the case of the trouble in the betel-vine gardens near Coimbatore. It is found that earthworms make some of the manures more assimilable by the soil, ventilate the latter and bring up large quantities of earth which has passed through their gut. Darwin's studies on earthworms is perhaps well known to most of you and according to him "the level of an acre of soil in England is raised by earthworm casts by one tenth of an inch each year." In some of our ever green and moist forest areas and foot hills, very long earthworms are found measuring upto a foot and a half or more in length. Our commonest genus in South India is *pheretima*. Flat worms (Turbellaria) like *Bipalium* and centepedes (Lithofires etc.) are found to be the special enemies of these earthworms. Leeches, which are well known from very ancient times as having medicinal properties, also play their part in relation to agriculture. Those who have visited any of the hill estates, in the Nilgiris, Anamalais, Coorg or Travancore might have experienced the trouble caused to men by leeches in the coffee, rubber and cardamom plantations. Hardly anyone entering any of these moist plantations in the forest valley escapes from the attentions of those blood suckers. Their work is so cleverly done that their attack is hardly ever felt or noted until long after the creatures have sucked sufficient blood from the host. Coolies working in such plantations suffer a good deal though they occasionally resort to various devices and local drugs to check the trouble. The common hill leeches in S. India belong to the genus *Haemadispa*.

I may also just touch one other fact in connection with the economic aspect of worms, though it is not of any direct agricultural

importance viz. the relation of some larvae of marine worms in pearl formation. Pearls inside oysters are now believed to be caused among other ways by the deposition of nacreous matter around the larvae of parasitic worms attacking oysters; and in Japan after Prof. Mitsukuru's studies they have started production of pearl by artificial introduction of foreign particles inside the bodies of oysters.

Mollusca. Regarding the group of mollusca or (shelled animals) the study of which forms the science of *Malacology* we have not much to note from a purely agricultural point of view. Most of these are aquatic animals and include the oysters, the proverbial slow moving snails and slugs, cuttle fish etc. Many of these are used for food but some of them are occasionally noted as pests of crops. These latter include land snails or breathing forms (*pulmonata*) which are occasionally found attacking aloes, hedge plants and even some cultivated crops like vegetables and flowering plants. The common ones I have found in S. India belong to the genera *Xesta*, *Rhacis* and *Ariophanta*. During the summer months hundreds of these are found attached to hedge plants apparently hibernating. In parts of the Tanjore and Godavari Deltas occasional trouble is also caused by some molluscar forms, to growing paddy. These have to be further investigated for correct information as to the real damage done if any. Snails are a delicacy in France—in restaurants snail dish " Escargot " is sold. Snaileries (farms) also exist around Paris. Slugs are, as you all know fleshy, slow moving creatures, which leave a trail of shining slime behind, often met with in our gardens. Though in some other countries they are noted to cause damage to plants such as rubber, tobacco, sweet potato etc. we have not yet noted any slugs with real pest propensities. *Limax* and *Parmarion* are the well known genera of these slugs. It will be interesting to note that the larvae of glow worms (*Lampyrids*) are very effective enemies of these land mollusca. Before leaving this group, I might invite your attention to the close relations existing between the liver fluke (*Fasiola*) mentioned under worms and snails (*Limnoea spp*) and to the fact that the former passes part of its early life in the body of the latter as an intermediate host.

We will now come to the consideration of the economics of the higher or vertebrate groups of animals, especially in their relations to agriculture. There is hardly any necessity here to dwell on the well known mutual relations of man and many higher animals like cattle, horses, sheep, dogs, poultry etc. which have become his life long companions from very ancient days—such subjects are generally treated under separate branches like Animal husbandry, Stock raising, Sheep breeding, Poultry farming, Pig rearing etc. etc. I shall therefore refer only to those higher animals which are known to be harmful or beneficial to agricultural interests in different ways, about the economics of which our knowledge has been very scanty till lately.

The studies on fishes (Ichthyology) especially those relating to the recognition of edible and poisonous forms, their breeding, spawning and migrating habits and the methods of artificial propagation (Pisciculture) preservation and canning—have all within the last few decades progressed so much as to create various famous and flourishing fisheries all over the world. In India we have fisheries departments under most provincial governments to attend to this important aspect of applied zoology. From the farmers' point of view the discoveries of fish, feeding on malarial mosquito larvae are of great importance. In South India species of *Heplochilus*, *Marcrones* and *Barbus* have been noted as such and trials are being made in different places to introduce such useful forms in malaria ridden areas. It may be interesting to note that among fishes one creature, an eel, a snake like fish (*Opichthys boro*) known in tamil as the "Anaikuthu pampu" is now and then found doing some appreciable harm to paddy fields and salt pans along the coastal areas of the Bay of Bengal from Ganjam down to Negapatam. The damage it really causes (known in telugu as 'Ramasuli') is not like that caused by other animals any direct harm to the growing plants; the injury done is indirect caused by numbers of this eel burrowing into and making wide passage across field and irrigation bunds and connecting the paddy fields containing fresh water on one side and the salt water channels or coastal tidal streams near the sea on the other. This causes the salt water of the estuaries to enter the paddy fields and affect the growth of the plant which, due to the ill effects of the salt water, wither and often die. The damage done to salt pans by this same creature, often in company with crabs, consists in causing the brine collected in the pans for salt to pass away through the openings made and thus leaving the pans empty before the salt has crystallised out. A short account of the creature will be found in a paper of mine published in the Bombay Natural History Society Journal in 1932.

Another point in connection with the economics of fish is the manufacture of fish oil soap from sardines for insecticidal purposes. It is perhaps not well known that while shoals of sardine are caught during certain years these disappear for a long time like locust plagues. This is an important industry along the Malabar Coast and our cheap contact insecticide for crop pests of different kinds is got from the factories in that tract.

Some of us would naturally doubt as to whether such creatures as frogs and toads have any mission or economic importance in this world. As a typical animal for experimental purposes and dissection in science institutions the frog has been found very handy and it is practically the 'martyr' for zoological studies. It is perhaps not widely known among us that the frog is used as an article of food in many western countries, and I had occasions to find them being sold alive for food purposes in the markets of California. Regular frog

farming is carried on in different places and there is said to exist in Ontario a farm in operation for the past 30 years, producing every year 7000 living frogs, in addition to 500 lbs. of dressed frogs' legs which is regarded as a special delicacy; zoologists are employed by these farms to investigate into the life history, breeding season and habits of different frogs so as to keep the industry flourishing. All of us are familiar with the tadpole stage of the frog and it has been found by frog farmers that the tadpole does not change into the tailless frog unless the edge of the natural or artificial pond has a sloping side, and in its absence remains as a tadpole for months together! Another interesting and important problem, with which these frog farmers who have to keep thousands of frogs alive all through the year, is said to be that of feeding them; for, the frog does not eat anything that is not moving though the tadpole in the water eats anything. I have referred to these apparently unimportant facts just to give examples of how small points in zoological studies often become important economic problems. Toads and frogs are very useful as insect destroyers as is found by their presence in numbers near lights especially around electric lights in the streets which attract numerous small insects. Kirkland in his account of his observations on the American toad says that the toad's food is made of about 88% insects and 16% of these are cut worms, and counting these cut worms alone he has estimated the annual saving to the farmer by each toad as 20 dollars or nearly Rs 60. During a pest of army worms he found in toad's stomach 55 worms; so that, as an insect destroyer the toad has few superiors. The common toad of our plains is a Bufo and of our frogs *Rana*. It will be interesting as has been done to some extent in the case of insectivorus birds, to study the nature of the insect food of frogs and toads so as to properly appraise the help they render in checking insect pests.

Coming to the higher group Reptiles, the study of which is known as Herpetology it is found that many of them such as lizards, blood suckers, chameleons etc. are decidedly beneficial in that they are all mostly insectivorus. The amusing and clever work of the wall lizards (*Geckos*) around our lights during nights shows their insectivorus habits. The clever manner in which the green chameleon catches its animal prey is also pretty well known, how it suddenly throws out its long tongue and gulps the prey with the help of its secretion. Though snakes and crocodiles are known to us as dangerous forms to be taken care of in the fields and lakes, some of them are responsible for doing some indirect good, since some of them feed on rats and mice. It will be a very useful thing if the cultivator especially in snake ridden areas near the hills and forests gets some ideas as to the features of harmless and poisonous snakes so as to avoid risks and danger from these creatures. The cobra, the viper, the krait and the ecis are the really dangerous forms, one is likely to meet with in different parts of

South India. The Russel's viper is a common form found in Coimbatore and during the early days of this college, hundreds of these have been killed from prickly pear bushes and field bunds. It will also be helpful if the cultivator knows something about the habits of crocodiles, since in some parts of Malabar and Travancore domestic animals cattle etc. and even he himself often run the risk of being attacked by these in the rivers and tanks. The turtles and tortoises belong to this same group but are not known to play any important part in relation to agriculture, though some of them are edible creatures.

The study of the next higher group of birds (Orinthology) offers us a very wide field of economic possibilities. It is one of the most important of animal groups which affect the farmer and the layman in various ways. Many birds are used as food as we all know such as fowls, duck turkeys, snipe etc. From the layman and farmers' point of view birds are generally classified into useful and injurious forms. Among the latter well known forms are the two species of crow, the Indian house crow and the jungle crow, *Corvus splendens* and *Corvus macrorhynchus*; these two are very troublesome and annoying near houses and on ripe cholam and other cereal crops, they are also insectivorus and do some good when they occasionally feed on crop pests like catterpillars, white grubs etc. It is a common sight to find the crow following the harrow in fields devouring soil insects such as white grubs, cut worm, etc. Of the other birds which may be classed as pests in South India we may note among the well known ones the house sparrow, (*Passer*) Bee eaters, (*Merops*), the green barbet (*Thereicery*), the parrots (*Palaeornis*) the weaver birds (*Ploceus*) the pigeon (*Columba*) the dove (*Turtur*) and the munias (*Munia*). There are also number of extremely useful and beneficial birds which help the farmer in not only destroying insect pests but also acting as flower pollinators in many cases. Among these the well known ones are the larks (*Alanda*) the drong (*Dicrurus*) the mynah (*Acridotheres*) sunbird (*Arachnechthra*) wood peckers (*Brachypternus*) the roller (*Coracias*) the shirks (*Lanius*) the tailor bird (*Orthotomus*) the paradise fly catcher (*Terpasiphone*), the night jar (*Caprimulgus*) the cattle egret (*Bubulcus*) the spotted owlet (*Athene*) the bulbul (*Malpastes*) the seven sisters (*Crateropus*) the tree pie (*Dendrocitta*) the common heron (*Ardea*) etc.

There are again some birds which are of doubtful value as they do not stick to one particular kind of diet; such are the oriole (*Oriolus*) the crow pheasant (*Centropus*) the partridge (*Francolinus*) etc. The birds of prey including the kites, falcons and vultures are also beneficial to a certain extent in that they are sometimes scavengers and offal feeders; but often some of them are dangerous to poultry and small domestic animals. The brahmini kite (*Haliastur*) is a highly insectivorus bird and feeds on also crabs in paddy areas. On the whole birds do a considerable amount of good work in helping the

farmer to get rid of insect and other vermin affecting his crops. A good deal of work has yet to be done however in verifying correctly the food habits of Indian birds, classifying them correctly as friends or foes of the farmer, and then utilising to the best of our ability the good work done by the former and devising ways and means to control the latter.

Though not directly connected with agriculture, a passing note may be made of birds like the egret and the ostrich which are reared for their feathers and plumes which often fetch fabulous prices. The African ostrich, the largest of living birds (*Struthio*) sometimes reaching 8′ in length is reared in ostrich farms in South Africa chiefly for its plumage. Its flesh is not eaten but the egg is relished and is said to contain as much food as two dozen hen's eggs. In North India similarly there are farms for rearing the Egret (the cream white wading bird,) for similar purpose. In India we have also the peacock (*Pavocristalus*) which is not only noted for its valuable feathers, but is regarded as a sacred bird as well.

We now come to the consideration of the higher group of animals the Mammals including man himself and some of his oldest companions the cow, the sheep, horse, cat, dog etc. As I have already told you the economic importance of these higher animals is studied under special branches called Animal Husbandry, Stock rearing etc. Let us see which of the other mammals have become friends or foes of the farmer. Unlike the lower animals the higher animals generally frequent only jungle and grassy areas and enter cultivated fields only occasionally but the harm they sometimes cause is very serious. Some of the commonest of these higher animals which often give a good deal of trouble to the farmer and fruit grower in South India are the jackals, wild pigs, the monkeys, squirrels, and rats. The jackal (*Canis aureus*) causes appreciable damage to coffee berries and sugarcane and frequents hills and plains, forests and open country. It is probably known to some of you that coffee seeds collected from the excreta of jackals in the coffee estates is said to be of the best quality, since the animals eat only the well ripened berries. Nor is the nocturnal howl of the jackals during certain seasons unfamiliar to most of us, even in this college. Sugarcane and root crops also suffer from jackal attack. The depredations caused by monkeys in certain districts is well known and often found very serious. The commonest and the cleverest of the monkey pests we have in South India is the macaque (*Maccacus silenus*). It is found in the plains and the lower hills and is the one led by showmen and street beggars and the one infesting sacred shrines like Tirupathi, Palni etc. According to Jerdon "this is the most inquisitive and mischievous of its tribe and its powers of mimicry unsurpassed". It is easily bred in confinement and docile when young. It has capacious cheek pouches and feeds on insects, roots, nuts, fruits,

cereals, and sometimes even crabs. I am experiencing great trouble from this creature in my small farm in South Malabar. These monkeys generally appear in gangs of 10 to 15 of all ages led by one or two hefty males which previously reconnoitre the area and lead the gang. The creatures destroy much more of the crop than actually use as food. The halo of sacredness attached to this creature as the 'Hanuman' or his kinsman and the consequent fear of becoming a sinner by killing him has helped it a good deal to multiply and carry on its injurious work in fields and gardens with impunity. Occasional shooting of one or two of them or trapping them in cages and transporting them far away beyond rivers or hill ranges will be found to give some relief. It may be added that in some countries monkeys are trained to gather fruits and nuts and help man. The langurs (*Semnopithecus*) or the bigger monkeys which have no cheek pouches and which make a loud howling noise generally infest only thickly wooded hill country and only confine their attacks to hill estates. The squirrels and rats are the chief representatives of the rodent mammals causing wide spread damage in various ways. The striped squirrel (*Sciurus palmarum*) is often found on all fruit trees and even steals grams and other food stuffs exposed for drying in the open. The damage done by rats, one of the most notorious and terrible pests among animals is too well known to receive any detailed record here. The commonest and most destructive of field rats is the southern mole rat (*Gunomys Kok* Gr). It attacks paddy, ragi, tapioca, lucerne, vegetables, and a variety of other cultivated plants. The domestic rat which belongs to one or two varieties of the (*Rattus* H), is a domestic pest all over S. India. The recent further notriety the rat has gained as the medium carrying the plague bacillus (*Bacillus pestis*) has added to our dread of this rodent pest not only as a field and domestic pest but as a disease carrier as well.

The injury caused to man and his belongings like crops, cattle etc. by such wild animals as the tiger, the leopard, the bear, the elephant, the wild pig, the porcupine are well known especially in areas adjacent to hills, and forests. In some parts of South Canara and Malabar elephants cause very serious damage to growing crops during certain seasons; one can easily imagine the nature of the damage caused when even one or two elephants spend a half hour or so in a banana, sugarcane, cardomamom, tea or coconut garden—The bear (*Melursus*) and the Porcupine (*Hystri*) are fond of roots and tubers; in addition the former is destructive to bee hives on trees and even to toddy pots in palms. The tiger, leopard and the cheetah are to be considered only as dangerous to the safety of man, cattle and poultry and not as crop pests. The toddy cat (*Paradoxurus*) is well known in South India as causing damage to palm trees and sometimes even to household things in dwellings near palm groves. The civet cat (*Viviera*) is a common creature found along the Malabar coast; it is however a beneficial

animal not only as an enemy of snakes and insects of sorts but also gives the civet, a secretion which has some commercial value. The Indian mungoose (*Herpests*) is also a beneficial creature having carnivorous and insectivorous habits; but it often attacks poultry. That bats are mammals, I am sure most of you are aware of; some of them are of economic importance both agriculturally and otherwise. Many of us are I believe familiar with the flying fox (*Pteropus*) which is sometimes found in thousands hanging from some big trees. The trees in which these roost are heavily loaded and completely hidden by hundreds hanging on to every branch. Very serious damage is caused by these creatures to all sorts of fruit trees for miles around their roosting tree. These are the biggest of bats and have faces like the fox, hence the name. There are species of smaller bats also some of which often fly about our houses feeding on mosquitoes and moths and doing some good work. Artificial enclosures known as "*Bat towers*" are made in some countries to give convenient homes to some of these bats and help their insectivorous activities especially mosquitoe feeding. Bat's dung or guano is also a very valuable manure used by fruit royetalle growers; I know that the melon growers of parts of Cuddappah use this stuff.

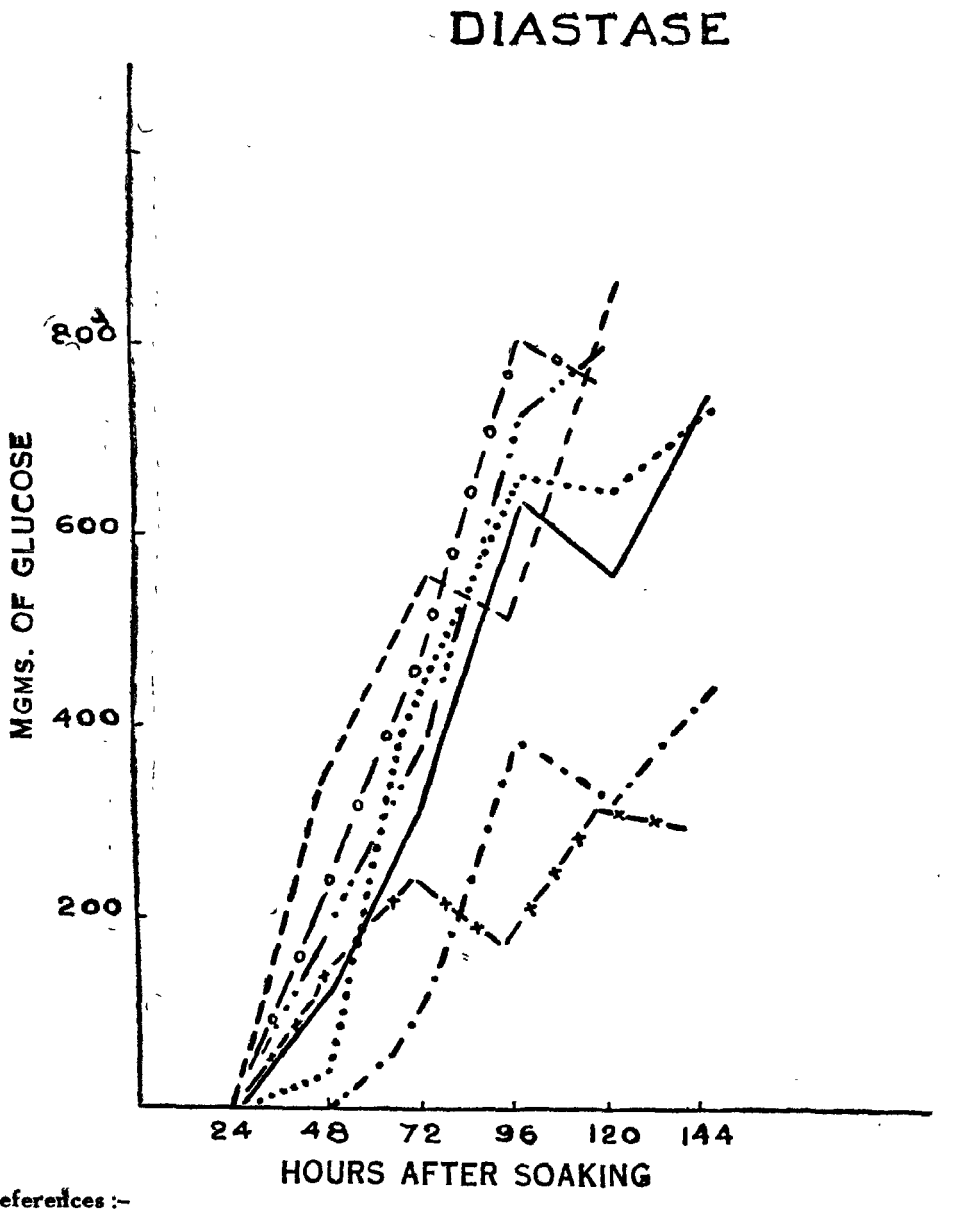
One member of the mammalian group the Pangolin or scaly ant eater (*Manis*) with a curiously plated body, a long prehensile tail and pointed snout is a very beneficial creature. It is nocturnal in habits and feeds on insects especially white ants the nests of which it tears open with its powerful claws. The economic zoology of the mammals includes besides the above groups which are of agricultural imporatance some others which have also begun to show great economic value; more important of these are the whales which give valuable substances like whale oil, whale bone, spermaceti, ambergris and guano; the seals which are hunted for their seal skin (Pelt) and oil and the fur bearing animals especially of the polar regions such as Weasels, artic fox, otter skun (Beaver etc.)

This concludes my necessarily brief survey of the various groups having relations to agriculture excepting the Arthropoda which I shall deal with next. Compared with the work done on the arthropoda, especially on the insects the agricultural zoology of other animal groups in India has received practically very little attention. I need hardly tell you that I have only touched the fringe of the subject. A good deal of further work awaits us in many branches especially in Helminthology, ornithology and mammalogy. I can only conclude this lecture by adding that intensive investigations on the food and breeding habits of many of these higher animals, their interrelations and their relations with members of the other groups of animals will add to our knowledge considerably and will help us to utilise to the best advantage the knowledge so gained, not only for agricultural purposes but also for several other needs of humanity.

Research Notes.

Diastatic Activity in Germinating Paddy.

Although the method of assessing the viability of seeds by their percentage germination has much to commend it on account of its simplicity of technique and convenience, it possesses certain defects—the chief of which is that it fails to give any indication of the vigour of the seedlings. As this latter is the true criterion of the fitness of any strain for propogation, any test, however empirical, which would furnish information on this aspect would be a valuable weapon



References :-

——— 1. In darkness.
– – – 2. In absence of Co_2
..... 3. In absence of Co_2 & O_2
-·-·- 4. In Excess of Co_2
—x—x— 5. In reduced pressure.
—o—o— 6. Submerged in 80 ccs. of water with 5 cc. of H_2O_2
——·——· 7. Soaked in Fusarium Extract throughout.

in the hands of the economic plant breeder. In recent years with the advent of the concept of vernalisation, great significance has been attached to the "germination" phase of plant development, and it is now well recognised that by appropriately treating the seed during germination the developmental phase can be profoundly modified. If it were possible to correlate the physiological activity during germination with vigorous after-growth, the geneticist would be saved much time and labour in plant selection.

With this object in view, an investigation was undertaken on the changes taking place when the paddy grain is allowed to germinate under a variety of controlled conditions. The individual role of embryo and endosperm and of the enzymes diastase, maltase and catalase have been studied. The accompanying graph shows the changes in the diastatic activity of the whole seed during germination under the condition studied. It will be seen that carbondioxide has a marked effect on diastatic activity. If germination is under water, the oxygen content and volume of water, and the degree of submergence influence enzyme activity. Growth-promoting substances cause a small increase of diastase.

The experiments, full details of which will be published shortly, show that growth as indicated by weight of seedlings or morphological measurements does not bear any strict relationship to the quantity of diastase produced during germination.

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ABSTRACTS

Preservatives for wooden and bamboo posts against ground-inhabiting termites. (*The Philipine Agriculturalist* Vol. XXV No. 8). In an attempt to find some cheap and effective preservative against the attack of termites which quickly destroy posts, fences, and other structures that are in contact with the soil, bamboo posts and ipil-ipil (leuciena Glanca) were treated with coal tar, salt and paris green. Two hundred grams of salt and about sixtytive grams of paris green were put into the holes into which the posts were fixed. In the case of coal-tar, the parts of the posts to be set in the ground were dipped in coal tar. Controls were also run side by side.

All the three preservatives were found to be generally effective in wooden posts, salt coming with 66·7 % attack, followed by paris green ((70%) and coal tar (90%) on bamboo paris green showed 40 % attack, salt 60 % and coaltar 70 %.

Regarding the economics of the treatment. coal tar is the cheapest. in the cost of treatment being annas five ; followed by salt with annas ten for 100 posts Paris green treatment was prohibitively costly, as the figure came to about three annas and a half.

The fungicidal effect of salt and coal tar was not significant. In this, paris green was the most effective. K. S. R.

Broiler Factories by Philip-H. Smith. (*Scientific American*, 1937 pt. 12). The article deals with the mass production of eggs and broilers in the factories situated in the heart of cities. The growth of the factory idea may be gauged from the fact that there are more than 10,000 installations and that one hundred of the bird population of the United States has been thus caged. Poultry branch of the farm activities has been industrialised, moved bodily into heart of big cities and great economies in the matter of transport accomplished through the new system of 'battery brooding'. The birds are confined from the first day of their life in wire cages and pass through three stages of (1) starting (2) growing (3) developing. After the last stage the males are sold as broilers and females are carried to the fourth stage as egg layers. The number of birds is successively

reduced at each stage till the laying hen has a cage of her own. The eggs as soon as laid roll out of reach, are recorded and collected, and when the egg production falls below a standard, the birds are sold, and the places occupied by better workers. The arrangements are perfected so that no litter is scattered and no food or water is wasted. The lack of sunlight resulted in rickets and this was overcome by feeding with cod-liver-oil. The problem of cannibalism was overcome by a trick. Ruby coloured glass windows and coloured light bulbs solved the trouble. The cannibalism was suspected to be due to the sight of blood where the pin feathers came through the skin and the red light neutralised the effect. The freedom of the birds from soil and litter results in a disease-free condition. A controlled ventilating system is designed to give a plentiful oxygen supply to each bird. Prolonged tests have shown that under these controlled conditions of temperature, light and humidity, the seasonal fluctuations of a neutralised bird are eliminated. There is no scattering of rations and hence feed-cost is reduced. Under natural conditions 100 birds is the limit of bird density per acre and beyond which, it will breed diseases due to crowding. As an example of the efficiency of battery brooding, M. H. Arndt experimental plant houses 16,000 birds on less than one acre and all labour is performed by two men only. The revenue from the droppings amounts to roughly the cost spent on labour. The freshness of products and lower breakage losses due to reduction in the distance transported, are other points in their favour. Breeding for confinement-minded birds are being done and among other incentives tried music has been found to induce better laying. Attempts to make better use of the dropping as fertiliser are being made. The volatile products like ammonia of the litter are being captured by placing chemicals on the belts, and if successful will result in a better utilisation of the waste and by-products. The factory idea will be improfitable, if new structures are to be erected, but the establishment chiefly depends upon the ability to rent or purchase obsolete structures which do not posses any economical value for other enterprises. R. B.

Agricultural Fottings

BY THE DEPARTMENT OF AGRICULTURE, MADRAS

Cattle Breeding. A Dairyman or ryot who owns a herd of cows and supplies milk all the year round to his customers has to regulate the calving of his cows throughout the year to fulfil his orders and keep up a uniform supply. It is therefore important that he should know something about the "Oestrum" in cows or "the period of heat." This is the time when the cow calls for the bull.

A heifer will come on 'heat' for the first time any time from the age of 2 to 4 years according to the state of her maturity, condition, environment and feeding, i.e., an early matured heifer reared under good conditions will take the bull much earlier than one which is underfed and undersized. In temperate climates, cows come on heat about 3 weeks after calving and every 3 weeks after that until they conceive; but in India, the indigenous cows vary from 3 weeks to a year or more after calving and their periods are very irregular. On the average the Indian cow in good condition will conceive about 3 to 4 months after calving. Some people are under the impression that a cow will conceive at any time if covered by the bull. This is not so, a cow must be properly "on heat" if she is to conceive. It is therefore waste of time taking her to the bull unless she shows the signs of "Oestrum."

It is very easy to see how a heat period in a cow might easily be missed. There are often no apparent preliminary symptoms of approaching heat, such

as are observable in the bitch. which bleeds extensively for several days (pre-oestrum). External haemorrhage in the cow or heifer, if it occurs at all, does so 2 or 3 days after the beginning of the heat. This is far more common in heifers than cows; in the latter it is rare, but in heifers the appearance of blood-stained mucus at the vulva is quite frequent; it forms a useful indication as to when the animal may be again on heat. On the average, heat lasts about 16 hours in heifers and 19 hours in cows. In the cold season a heat period may only last 6 hours as against 16 or more hours in hot season. It is easy to see therefore, that a period occurring in the night is overlooked. Again it is more difficult to detect the heat when the cow is tied in the stall than when she is allowed to run about.

In some cases ryots will not allow their cows to be taken to the bull whilst they are in milk and suckling their calves in the belief that if the cow is served by the bull, the cow will immediately go dry. This is not so; the cow will continue to yield milk if properly fed.

The following signs of "Oestrum" in cows will benefit cow owners in discovering the proper time to send their cows to the bull.

(i) The cow will be restless and will switch its tail frequently from side to side and will turn her head towards its hind quarters.

(ii) It will go off its feed for a day or so.

(iii) The external genital organ (vulva) will be slightly swollen and there will be a slight discharge of a white slimy mucus.

(iv) It will stand with its tail raised and ears erect and will stare at individuals.

(v) Frequent passing of urine.

(vi) Milk yield will decrease for 2 or 3 days and does not allow calf to suckle properly.

(vii) If tied in a stall, will be restless and will bellow frequently.

(viii) If allowed to graze or exercise with other cows, she will be seen to jump on them or allow others to hump her.

All cows should be taken to the bull immediately these signs appear. It is no use waiting until the next day as this may be too late.

The above symptoms become more pronounced in an adult cow than in a heifer or first calving cow.

Breeding Bulls and their Management. There are occasional complaints that some breeding bulls are slow servers and others refuse to serve at all. It is therefore necessary that the agriculturists should be informed of some of the reasons why this happens.

1. Slowness of service is not necessarily an indication of infertility. It is true, however, that they are often associated and notably so in animals which are too fat or alternatively, in those which are going back in condition. The best condition for breeding in males is a hard one produced by sufficient exercise to work off a surplus of fat, but favouring the retention of nitrogenous substances and vitamins. However it cannot be sufficiently stressed that with the male, as well as with the female, a rising condition is always more conducive to the proper discharge of the reproductive functions than a falling one. A breeding bull can be worked for half a day in a single bullock cart or can be used as a work animal in agricultural operations. The bull should be well fed and given green fodder whenever available, its muscles should be fairly hard and there should be very little fat on its body; but do not allow it to lose condition and become too lean. Groom it daily and pick off all ticks as these reduce its vitality and irritate it.

2. Slowness in service is sometimes psychical in nature due to strange surroundings or to the nature of the control to which the animal is subjected. Hesitation in service is also sometimes the result of sores or warts on the prepuce, penis or feet and males are in best condition for service a few hours after they have been fed when they are more active than directly after a meal. It is sometimes noticed that stud animals which have travelled long distances and are introduced into fresh surroundings are temporarily infertile, especially when the new conditions are less favourable than those to which the animals have been accustomed. This, however, is usually only a temporary result and full fertility can generally be restored by favourable treatment in the way of diet and surroundings. When a new bull is purchased and brought to the homestead, feed it on the same ration, if possible, as it was formerly fed on, allow it time to become accustomed to its new surroundings and do not ill-treat it. House it in a comfortable shed, give plenty of exercise as stated above and allow it to rest for two or three weeks before it begins its service.

3. It is of great importance that a male animal should be used regularly. It should not be used too much at one time and too little at another. It should be remembered also that prolonged periods of disuse may be as injurious to the bull as over-use since undue accummulation of semen in the generative passages may result in back pressure and deleteriously affect the spermogenetic capacity of the testes and possibly also interfere with the functional activity of the accessory sexual glands. In India this is difficult as a large nnmber of cows come on heat after the rains and when good grazing is available and breeders are apt to permit the bull to perform too many services in a short period. This is undesirable; the number of services in a month should be limited to 10 or 12 at the most in these heavy seasons. If possible the services should be spread out evenly throughout the year.

4. With any young males it is inadvisable to allow service to occur too often, even though the service may be fertile, as frequent service, when performed too early, is likely to result in undergrowth of the sire and to impair its breeding capacity in later life. Young males are most liable to suffer from underfeeding and over-use. whereas old males suffer from overfeeding and under-use. Many young early matured bulls are ready for work at 2½ years old but as the bull is not fully grown until about 4 years old, its services from 2½ to 3 years should be limited to 3 per month, from 3 to 4 years to 4 per month or 50 in the year. If a young bull is allowed to serve a great number of cows in its early life, the length of its breeding life will be considerably reduced. See that a young bull is well-fed and kept growing. It the case of matured bulls, the rations can be decreased if it is seen that they are becoming fat.

5. In general, the males of the lighter breeds are able to serve more females successfully than those of the heavier breeds. Kangayam and Hallikar bulls are much quicker at service than the bulls of the heavier breeds such as the Ongoles and Sinds.

6. Onanism or sexual abuse is sometimes a source of trouble, more especially in young animals that are given little service. This is often seen in India and to avoid it as far as possible, give the bull some hard work to do if there are no services to perform.

A bull will refuse to serve a cow which is not properly in heat and will not stand. This is a very common complaint unnecessarily made against the bull. It must be remembered that the period of heat (Oestrum) in cows only lasts for about 16 hours and it is essential that the cow shonld be taken to the bull at once before the heat subsides; otherwise the cow will not stand and the bull will not serve it.

Crop & Trade Reports.

Receipt of raw cotton at press and spinning mills.

Total cotton presaed and unpressed.

	Bales of 400 lbs. against an estimate of 540.700 bales for 1935-36.	Figures for corresponding period in the previous years.
1—2—36 to 8—1—37	621,566	466,742
1—2—36 to 15—1—37	626,009	470,479
1—2—36 to 22—1—37	629,854	473,234
1—2—36 to 29—1—37	635,700	478,597
1—2—36 to 31—1—37	636,154	478,597
	Bales of 400 lbs. against an estimate of 412,000 bales for 1936-37.	
1—2—37 to 5—2—37	2,064	4247
1—2—37 to 12—2—37	6,314	8033

	Cotton bales received at mills.	Exported by Sea.	Imported by Sea.
1—2—36 to 8—1—37	399,245	264 552	101,217
1—2—36 to 15—1—37	403,381	265,634	101,315
1—2—36 to 22—1—37	409,714	268,661	101,673
1—2—36 to 29—1—37	418,329	27 ,202	107,307
1—2—36 to 31—1—37	420,185	274,389	108,564
1—2—37 to 5—2—37	2,524	821	1,438
1—2—37 to 12—2—37	6,741	1,531	1,447

Statistics—1936—37—Cotton—Fourth forecast report. The average of the areas under cotton in the Madras Presidency during the five years ending 1934—35 has represented nine per cent of the total area under cotton in India.

The area under cotton up to the 25th January 1937 is estimated at 2.461,400 acres. When compared with the area of 2,601,400 acres estimated for the corresponding period of last year, it reveals a decrease of 5·4 per cent.

479,300 acres have been reported as sown since the last December forecast was issued. This extent is made up of 253,400 acres under Tinnevellies, 99,900 acres under Cambodia, 87,500 acres under Northerns and Westerns, 32,200 acres under Salems, 8,100 acres under Cocanadas and 1,200 acres under other varieties of cotton. The area sown in December and January exceeds that sown in the corresponding period of the previous year by 78,800 acres or by 19·7 per cent.

The decrease in area in the current year as compared with the area in 1935—36 occurs in all the important cotton growing districts outside East Godavari, Anantapur, Coimbatore and Madura. In the Deccan, the area fell from 1,221,700 acres to 1,048,500 acres i.e. by 14·2 per cent owing to want of timely and sufficient rains.

The area under irrigated cotton mainly cambodia is estimated at 247,600 acres as against 266,400 acres for the corresponding period of last year, a decrease of about seven per cent.

Pickings of the *mungari* or the early sown cotton crop in the Deccan have concluded. The yield was below normal.

Yields below normal are reported from the Cocanadas tract and the northerns and westerns tract and from Salem and Trichinopoly.

The seasonal factor for the Presidency works out to 96 per cent of the average as against 94 per cent for the corresponding period in the previous year. On this basis, the total yield is estimated at 533,100 bales of 400 lbs. lint as

against 545,000 bales for the corresponding period of last year. It is however, too early to estimate the yield with accuracy as the harvest has not yet commenced in the major portion of the area and much will depend upon the future weather conditions and the toll taken by insect pests.

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

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

Variety.	Area from 1st April to 25th January		Corresponding yield	
	1936-37. Acs.	1935-36. Acs.	1936-37. Bales.	1935-36. Bales.
Irrigated cambodia	2,352	2,528	1,455	1,531
Dry cambodia	2,765	3,115	594	668
Total cambodia ...	5,117	5,643	2,049	2,199
Karunganni in Coimbatore ...	1,284	1,366	293	297
Uppam in the Central districts ...	356	336	55	53
Nadam and Bourbon	177	33	9	2
Total Salems ...	1,817	1,735	357	352
Tinnevellies*	5,644	4,806	1,454	1,238
Northerns and Westerns ...	10,485	12,240	1,199	1,389
Cocanadas	1,459	1,509	260	263
Others	92	81	12	9

* Includes uppam, karunganni and mixed country cotton in the South.

The wholesale price of cotton lint per imperial maund of 82 2/7 lbs. as reported from important markets on the 1st February 1937 was Rs. 19—12—0 for Cocanadas, Rs. 19—0—0 for early crop westerns, Rs. 19—7—0 for late crop westerns, Rs. 25—5—0 for Cambodia, Rs. 25—6—0 for Coimbatore Karunganni and Rs 21—13—0 for Nadam cotton. When compared with the corresponding prices towards the close of December 1936, the prices reveal a rise of about 3 per cent in the case of Coimbatore-karunganni and a fall of about 2 per cent in the case of cambodia while the prices of Cocanadas, Westerns (early crop) and Nadam are stationary.

Statistics—Paddy—1936—37—Final forecast report. The average of the areas under paddy in the Madras Presidency during the five years ending 1934—35 has represented 13·4 per cent of the total area under paddy in India.

The area sown with paddy in 1936—37 is estimated at 9,796,000 acres as against 9,615,000 acres for the corresponding period of last year and the finally recorded area of 9,796,280 acres in 1935—36. The present estimate is practically the same as the final area of last year but falls short of the area of 9,999,000 acres in an average year by 203,000 acres or by two per cent.

1,292,000 acres have been reported as sown since the last December forecast was issued. The extent so sown was large in the East Godavari, West Godavari, Anantapur, Nellore (110,000 acres) Chingleput (88,000 acres) South Arcot (93,000 acres), Chittoor and North Arcot (90,000 acres in each), Tanjore, Madura, Ramnad (200,000 acres) and Tinnevelly (115,000 acres). The area sown in December and January was greater than that sown in the corresponding period of last year by 87,000 acres or by 7·2 per cent.

The area under second crop paddy is expected to be below normal.

The harvest of paddy is in progress.

The yield is expected to be slightly above normal in Vizagapatam normal in East Godavari, Kistna, Kurnool, Cuddapah, the South, the West Coast and the Nilgiris, and below normal elsewhere, notably in Chingleput where it is estimated to be only 85 per cent of the normal. The seasonal factor for the Presidency works out to 98 per cent of the average as against 99 per cent in the season and crop report of last year. On this basis, the yield works out to 94,322,000 cwt. of cleaned rice. This represents a decrease of 494,000 cwt. of cleaned rice or 0·5 per cent when compared with the estimate of 94,816,000 cwt. of cleaned rice in the Season and Crop Report of last year. The yield in an average year is estimated at 98,676,000 cwt. of cleaned rice.

The wholesale price of paddy per imperial maund of 82 2/7 lb. as reported from important markets on the 8th February 1937 was Rs. 2—9—0 in Nellore, Rs. 2—3—0 in Guntur and Madura, Rs. 2—2—0 in Bezwada and Masulipatam, Rs. 2—1—0 in Ellore, Rs. 2—0—0 in Rajahmundry, Rs. 1—15—0 in Cuddalore and Tinnevelly, Rs. 1—14—0 in Cocanada and Trichinopoly, Rs. 1—13—0 in Mangalore, Rs. 1—12—0 in Kumbakonam and Rs. 1—8—0 in Negapatam. When compared with the corresponding prices towards the close of December 1936, the prices reveal a fall of 14 per cent in Negapatam, 13 per cent in Madura, 10 per cent in Rajahmundry, 9 per cent in Cocanada, 8 per cent in Trichinopoly, 5 per cent in Tinnevelly, 4 per cent in Kumbakonam, and Nellore, 2 per cent in Masulipatam and 1 per cent in Bezwada.

Statistics—Crop—Sugarcane 1936—Third or Final Report. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1934—35 has represented 3·6 per cent of the total area under sugarcane in India.

The area planted with sugarcane up to the 25th December 1936 is estimated at 121,530 acres. When compared with the area of 118,520 acres estimated for the corresponding period of last year, it reveals an increase of 2·5 per cent. The estimate of the previous year was less than the final area of 121, 066 acres by 2·1 per cent.

The present estimate of area exceeds the second forecast by 11,840 acres. The excess occurs mainly in Vizagapatam, East Godavari, Bellary, South Arcot, Chittoor, Salem and Coimbatore.

The increase in area in comparison with the final forecast of 1935 occurs in all districts outside Kistna, Guntur, Nellore, South Arcot, Salem, Coimbatore, Trichinopoly, Madura, Ramnad, Tinnevelly and Malabar.

The harvest has just commenced and yields below normal are expected in all districts outside Vizagapatam, East Godavari, West Godavari, the Deccan (Bellary excepted), Ramnad, Tinnevelly and South Kanara where the yield is expected to be normal and in Salem where it is expected to be above normal by 10 per cent. The seasonal factor for the Presidency is calculated at 97 per cent of the average as in the previous year. On this basis, the yield is estimated at 338,790 tons of jaggery as against 328,770 tons estimated in January 1936, as increase of per cent. The final estimate for 1935—36 was 348,760 tons.

The wholesale price of jaggery per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1936 was Rs. 7—7—0 in Madura, Rs. 5—12—0 in Tuticorin, Rs. 5—9—0 in Nandyal, Rs. 5—4—0 in Kumbakonam, Rs. 5 in Calicut, Rs. 4—15—0 in Bezwada, Rs. 4—12—0 in Masulipatam, Rs. 4—8—0 in Mangalore, Rs. 4—5—0 in Coimbatore, Rs. 4—4—0 in Rajahmundry, Rs. 3—15—0 in Cuddapah, Rs. 3—11—0 in Bellary and Salem, Rs. 3—10—0 in Cocanada, Rs. 3—4—0 in Trichinopoly, Rs. 3—2—0 in Vellore and Rs 2—14—0 in Vizagapatam. When compared with the prices in November 1936, these prices reveal a rise of 29 per cent in Madura, 21 per cent in Tuticorin, 15 per cent in Vizagapatam 13 per cent in Cuddapah, 7 per cent in Calicut and 6 per cent in

Kumbakonam and a fall of 24 per cent in Rajahmundry, 11 per cent in Salem and 8 per cent in Mangalore, whilst they remained stationary in the other centres.

Statistics—Crop—Groundnut—1936—Fourth or Final Report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1934—35 has represented 45·4 per cent of the total area under groundnut in India.

The area sown with groundnut in the Presidency in 1936 is estimated at 3,426,500 acres. When compared with the corresponding estimate of 2,480,500 acres for the previous year and the actual area of 2.519,965 acres according to the Season and Crop report of the previous year, the present estimate reveals an increase of about 38 per cent and 36 per cent respectively. The estimated area for this year, exceeds the average area of 3,268,550 acres by 4 8 per cent. The areas reported in respect of Vizagapatam, West Godavari, Kistna and Malabar districts are the highest on record.

The increase in area is general outside Tinnevelly and is marked in the Deccan (+ 476.900 acres).

The harvesting of the summer and early crop of groundnut had concluded by the end of October. The harvesting of the winter or main crop is proceeding.

The crop is expected to be above normal in Kistna (125 per cent), normal in Vizagapatam, East Godavari, Chittoor, Coimbatore, Ramnad and Tinnevelly and below normal in the other districts notably in Trichinopoly. where it was affected by drought and caterpillar attack and the seasonal factor was reduced in consequence to only 75 per cent of the normal which is about the lowest reported in recent year. The seasonal factor for the Presidency works out to 94 per cent of the average as against 95 per cent in the previous year according to the Season and Crop report. On this basis, the yield is expected to be 1,652,200 tons of unshelled nuts as against 1,201,860 tons in the previous year, an increase of 37 5 per cent. The yield in an average year is estimated at 1,636,390 tons.

The wholesale price of groundnut shelled, per Imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1936 was Rs. 6-5-0 in Cuddalore, Rs. 6-1-0 in Cocanada, Rs. 6-0-0 in Vizagapatam, Rs. 5-14-0 in Negapatam, Rs. 5-10-0 in Cuddapah, Rs. 5-9-0 in Guntur, Rs. 5-8-0 in Vizianagram and Nandyal, Rs. 5-7-0 in Vellore, Rs. 5-6-0 in Bellary, Rs. 5-3-0 in Salem and Rs. 4-3-0 in Tinnevelly. As compared with the prices for October 1936, these prices reveal a rise of 21 per cent in Nandyal, 15 per cent in Cuddapah 10 per cent in Vizagapatam and Vellore, 6 per cent in Cuddalore, Salem and Negapatam and 5 per cent in Vizianagram and a fall of 3 per cent in Cocanada whilst they remained stationary in Guntur and Tinnevelly.

Statistics—Crop—Gingelly—1936—37—Third Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1934—35 has represented 11·6 per cent of the total area under gingelly in India.

The area sown with gingelly up to the 25th December 1936 is estimated at 511,900 acres. When compared with the area of 449,100 acres estimated for the corresponding period of last year, it reveals an increase of about 14 per cent.

The increase in area is general outside West Godavari, Kistna, Kurnool, Nellore, Trichinopoly, the South (except Tanjore) and South Kanara. The increase is marked in Vizagapatam (+37,000 acres) and Chingleput (+ 11,400 acres).

The main crop has been harvested except in the south where the harvest is in progress. The crop suffered from drought to some extent and the yield is reported to be below normal except in Kistna, Guntur, Kurnool, Cuddapah, Nellore, Taniore, Ramnad, Tinnevelly and South Kanara.

The seasonal factor for the Presidency works out to 91 per cent of the average as against 92 per cent for the corresponding period of last year. On this

basis, the yield is estimated at 62,800 tons as against 55,900 tons for the corresponding period of last year, an increase of about 12 3 per cent,

Statistics—1936—Pepper Crop—Final Report. The area under pepper in 1936 in the districts of Malabar and South Kanara is estimated at 94,000 acres in Malabar and 8,500 acres in South Kanara as against the final area of 89,453 acres in Malabar and 8,528 acres in South Kanara in the previous year.

The condition of the crop is generally fair. The early outbreak of the south-west monsoon affected the flushing of the crop to some extent and there was shedding as usual. The seasonal factor is estimated at 90 per cent of the average in Malabar and 95 per cent in South Kanara as against 90 per cent in each district in the previous year. On this basis, the yield is estimated at 12,700 tons for Malabar and 1,210 tons for South Kanara as against 12,200 tons for Malabar and 1,150 tons for South Kanara estimated in the previous year.

The wholesale price of pepper per imperial maund of 82-2/7 lb. as reported from important markets towards the beginning of January 1937 was Rs. 16—10—0 in Calicut, Rs. 17—7—0 in Tellicherry and Rs. 18—3—0 in Mangalore. As compared with the prices in August 1936, these prices have risen by about 33 per cent in Calicut, 49 per cent in Tellicherry and 38 per cent in Mangalore.

Statistics-1936-Ginger Crop-Final Report. The area under ginger in 1936 is estimate at 10,000 acres in Malabar as against the actual area of 9,913 acres in the previous year.

The yield is estimated to be normal as against 80 per cent of the normal in the previous year. On this basis, the total yield is expected to be 3,580 tons of dry ginger as against 3,370 tons in the previous year.

College News & Notes.

Students' corner. During the first week of February Rao Sahib Dr. T. V. Ramakrishna Iyer B. A. Ph. D. delivered the Maharaja of Travancore Curzon lectures for 1936—37, on "Agricultural Zoology" when Mr. R. C. Broadfoot the Principal of the college presided.

Club day celebrations. The twentyeighth club day of the Agricultural College students' club was celebrated on 27th February 1937 with M. A. T. Coelho Esq., B. A. B. L. Additional Sessions Judge, Coimbatore, in the chair.

After a light tea and fancy dress competeton guests and members adjourned to the Freeman Hall. After the annual reports were read the various prizes were distributed by Mrs. Coelho. Then the guests were entertained by the members. This was followed by the presidential address. Mr. Coelho dwelt upon the value of club life. With a vote of thanks by Mr. R. C. Broadfoot the pleasant function came to an end.

Economic Biologists Assosiation. Under the auspices of the above association Rao Bahadur M. R. Ramaswamy Sivan, retired principal of the college, delivered an interesting lecture on Malayan Agriculture.

Officers' Club Under the auspices of the club Rao Bahadur M. R. R. Sivan gave a very lively talk on his visit to Malaya. He gave a very vivid description of the places he visited, of the men and things he saw and of the social life obtained there.

Mr. K. Ramiah was entertained at tea on the eve of his departure for Indore.

Weather Review (JANUARY 1937.)

RAINFALL DATA

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

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Eight fresh western disturbances entered the country during the month, many of them causing falls of rain or snow in Kashmir, Punjab, Baluchistan, North West Frontier Province and the hills of the United Province.

During the first half of the month local rain were reported from South East Madras on 1st, 2nd and 13th to 16th and from extreme south of the Peninsula on 7th. During the sccond half dry weather conditions prevailed in South India and other parts of the country except for falls of snow or rain in North West India., due to western disturbances and scattered thundered showers in Assam and Tennassim.

Rainfall was in defect through out this Presidency and in Mysore.

Weather Report for the Research Institute observatory.

Absolute Maximum in shade	...	90·5 F.
Absolute Minimum in shade	...	57·8 F.
Mean Maximum in shade	...	86·0 F.
Departure from Normal	...	Nil.
Mean Minimum in shade	...	64·0 F.
Departure from normal	...	- 0·40 F.
Total rainfall	...	0·03"
Departure from normal	...	- 0·45"
Heaviest fall in 24 hours	...	0·03
Total number of rainy days	...	Nil.
Mean daily wind velocity	...	1·5 M.P.H.
Mean humidity at 8 hours	...	72·8%
Departure from normal	...	- 2 7

Summary. Dry weather prevailed during the month. Rainfall was in defect by 0·45". Day temperature remained normal. Humidity was in defect by 2·7%.

Departmental Notifications.

Transfers and Postings. Mr. M. Narayana Iyer, A. D. Jammalmadugu to IV circle. Mr V. Visvanatha Iyer, A. F. M. C. F, Coimbatore to IV circle; Mr. Edwin Amirtharaj Prob A. D. Ramnad to be A. D. Manamadura; Mr. K. M. Jacob, A. D. Palghat to be F. M. Taliparamba; D. V. Krishna Rao, Asst. to G. A. C. to to be junior asst. for soil survey work in the Gundalakama Project.

Leave. A. Kondiah Sarma, A. D. Naraspur, l. a. p. on m. c. for 3½ months from 14 - 2 - 37; Mr. Alur Vengobachar A. A. D. Van duty l. a. p. for one month from 2 - 2 - 37; Mr. K. Krishna Menon, Assistant, Mycology Section, Coimbatore l. a. p for one month and 16 days from 8 - 2 - 37 with permission to avail the holidays from 23 - 3 - 37 to 30 - 3 - 37; Mr. S. Viravaradharaju, A. D. Co. 2 Scheme l. a. p. for one month from 5 - 2 - 37; Mr. P. S. Suryanarayanamurthi, Assistant Mycology, Aduthurai l. a. p. for one month from 24 - 2 - 37. Mr. B. S. Narasimha Iyer, Chemistry Assistant, Coimbatore l. a. p. for two months on m. c. from 5th March 1937; Mr. A. Krishnaswamy Iyer, A. D. Kurnool l. a. p. on m. c. for six months from 26 - 2 - 37.