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

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THE PREPARATION IN THE HOME OF INFANT AND INVALID FOODS FROM *CHOLAM*

BY

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Synonyms for *Cholam* (*Andropogon sorghum*).

English	....	*Great millet.*
North Indian	....	*Juar.*
Tamil	....	*Cholam.*
Telugu	....	*Jonna.*
Kanarese	....	*Jola.*
Burmese	....	*Pyoung.*

Many people are acquainted with products of the types of Benger's Food, Mellin's Food, Horlick's Malted Milk, Grape nuts, Force and Malt Extract. These foods are called infant and invalid foods as they are predigested by a series of chemical and bio-chemical processes in the factory and put up in a form in which they are easily digested and assimilated by infants and people with weak digestive powers. The basis of all these foods is *Malt*, a product usually prepared from Barley, which is not cultivated in South India with the exception of a few acres on the Nilgiris.

To find a substitute for barley for malting purposes, Mr. B. Viswanath, the Government Agricultural Chemist, Coimbatore, conducted a series of researches and in the end proved that cholam can easily replace barley. He prepared and exhibited several kinds of malted foods prepared from cholam at the Industrial Exhibition held at Madras in 1917. As a token of high appreciation of his efforts, his exhibits won a gold medal. He showed it was possible to imitate the various imported malted products like Horlick's Malted Milk, Mellin's Food and Malt Extract. But these investigations were only on the laboratory scale dealing with very small quantities under conditions admitting of strictest control. It remained to be seen whether laboratory experiments could be translated into large scale operations.

In 1922, the Department of Industries, Madras interested itself in the problem of the preparation of malted foods in India and entrusted to Mr. Viswanath the investigation of the possibilities of large scale operations with cholam. This time the scope of the inquiry was limited to (1) the lowering and control of temperature at Coimbatore and (2) successive production of malts of fairly uniform quality from bag-lots of cholam. The experiments were conducted on a semi-industrial scale using lots of 1 cwt. of cholam which could easily be handled by a small factory. The results of these investigations were published in the Report of the Malting of Large Quantities of Cholam, as Bulletin No. 1 of the Department of Industries and Agriculture, Madras.

It has been shown as a result of these experiments that control of temperature is possible even in the hottest part of the year at Coimbatore and that malts of uniform quality can be successfully manufactured from cholam. 100 lbs. of cholam on an average yield 80–85 lbs. of dry malt of which 60 to 65 per cent is capable of being extracted with hot water. Every portion of the malt is capable of being utilised in some form or another. The finished malt is ground into grists and then passed through a sieve. The fine meal that passes through the sieve is easily digestible and possesses high diastasic activity and can enter into the composition of any kind of malted food product. The coarse fraction retained by the sieve when extracted with hot water gives up about 30 per cent of its material as an extractive. This extract still possesses a considerable amount of *diastase*—an active substance responsible for the digestion of starch. It can, therefore, be utilised along with gelatinised starch for the preparation of Malt Extract. The residue, after extraction with water forms a nutritive food for milch cattle and poultry. Different samples of these products were submitted to the Government Hospital, Royapuram and some were reported upon favourably.

'We have so far considered the investigations establishing the possibilities of malting cholam on the laboratory and the semi-industrial scale. Encouraged with the results so far obtained, the attention of the Chemical Research Laboratories at Coimbatore was next directed to the simplification of the different processes and the reduction of them to very simple methods so that each home can prepare its own malt and obtain fresh foods possessing all the qualities attributed to the malted products of the market. Efforts in this direction have been successful. The simple methods so developed, which will be described presently, were demonstrated at the Health Week Exhibition at Madras in 1929. At the request of the London Mission School at Kamalapuram in Cuddapah, another demonstration was held in November 1929, when a few boys were taught the methods of preparing malt and simple malted foods from cholam. As regards the value of cholam malt in breakfast, and for infants and invalids for continuous use, it can best be described by a quotation from Mr. Viswanath's report published in 1925.

'Since the time cholam malt was discovered in 1917, I have been using it for myself and my children and no untoward results have been noticed. In one instance, in the case of a patient in my own household cholam malt was continuously used as the sole food for over two months with considerable benefit to the patient when other foods were out of question. It was also used and is still in use by adults and children among a large number of my friends at the Agricultural College and Research Institute and elsewhere.'

The process of malting may now be described with a brief and simple explanation of the chemical and bio-chemical changes involved therein.

What is malt? During the germination of cholam after soaking in water, a series of chemical changes take place resulting in the formation of active constituents called *enzymes* which act on the starchy and proteinous matter of the grain. The result is the production of easily digestible sugars, dextrines from starch and peptones and amino-acids from proteins. Thus the malted grain is not only a product which has already been digested but is one rich in the enzymes which assist the digestion of other foods that might be mixed with it. The active agent or the enzyme 'diastase' is present in considerable quantities in malted cholam. In broad outline, malting consists of three operations (1) steeping, (2) spreading and (3) drying. These three operations are very susceptible to slight changes especially in temperature. The object of malting is to so regulate the conditions to bring about bio-chemical changes that the largest yield of extract is obtained on putting the malt in hot water.

Selection of Grain. The cholam selected for malting should be of a good variety and uniformly big in size. It should germinate up to at least 90 per cent and to ensure this the cholam should not be more than a few months old. Burying for a month or two would not interfere with the germination if the grain is new. In no case should the husk be removed as in that case the grain would never germinate. The grain is well graded by freeing it from weevil attacked or broken grain and foreign matter.

Steeping. Convenient lots of cholam, 5 lbs. or about 2 Madras measures are taken in a bucket or any other vessel. Water, preferably drinking water, is poured to a level six inches higher than that of the grain. The lighter seeds and glumes which rise to the surface of the water, are skimmed off. A thorough washing is given by stirring the cholam with a wooden rod. After a short interval, which depends on the external conditions of temperature—usually an hour—the water is poured off and the contents of the vessel poured on to a sieve with meshes just small enough, or on a cloth, the object being to draw off the water. The seed is thus automatically aerated (or exposed to air) and this aeration may be assisted by gentle stirring. The grain is ready for a second steep in another half an hour. It must be remembered that when the temperature is above 90° F, the steeping period has to be reduced say to half an hour and the aeration period to quarter of an hour. At such regular intervals the cholam is alternately steeped and aerated until incipient germination is noticed. This takes from 30 to 40 hours depending on the quality and variety of cholam.

Spreading. At the end of the steeping period the grain suffers very little perceptible changes in composition and it is ready for the next operation of spreading, technically called *Couching*. This is nothing but allowing the wet seed to germinate *very slowly* and *uniformly* in a dark, cool place inside a room. A sieve twice as big as the aerating sieve is used, but with the same meshes. The grain is spread out to stand about an inch thick, the adhering water having been completely drained off by keeping the sieve in a slanting position for some time. During the hotter part of the day, a moist cloth is spread on the sieve without touching the cholam to prevent abnormal rise of temperature and too rapid germination. Moisture is supplied at intervals to keep the germinating process continuous and when the radicles are about ½ to ¾ inch, the supply of moisture is cut off. Usually it takes 4 or 5 days for getting to this stage of germination. It must be pointed out that too high an outside temperature affects the malt and results in the destruction of larger amounts of carbohydrates by too rapid a germination. So it is recommended that malting be done in the cool months.

Drying. At the end of the spreading or *couching* period, the malted grain is sun-dried for a day or two until it is perfectly air-dry, else the starch will get cooked on further drying at a higher temperature and thus complete the diastasic conversion of the same into sugars and dextrines. The improvisation for such drying at 60°-70° C is to use a slow fire of charcoal and to put small quantities of the malt in a frying pan. Stirring must be continuous and as soon as it gives a fine aroma characteristic of cholam malt, the grain is immediately thrown on a piece of gunny for rubbing and removal of radicles. The drying requires some experience and whenever the colour of the fine malt after grinding is not white, it is to be understood that the temperature was higher than 70° C. So care must be taken not to caramelise the malt, as otherwise it gives a coloured product with a slightly bitter taste.

Grinding. The final product is now ready for grinding for which a coffee grinder or a stone mill can be used. At first the malt is ground coarse—into grists—and passed through a sieve, to get fine meal with the highest diastasic activity and nutritive value. The coarse fraction is winnowed to remove a portion of the husk, and ground a second time into a fine powder. Sieving again will give a second grade flour which contains a portion of the husk. The portion retained by the sieve may be fed to cattle or poultry.

Preparation of the food. The first grade fine meal may be mixed with twice its quantity of arrowroot flour and the second grade malt with its own quantity of arrowroot flour, and the intimate mixtures bottled perfectly air-tight. For domestic purposes, it is better to grind a fresh, or a quantity required for a week's use may be prepared at a time. To serve the food, the malt is made into a thin paste with hot water and the paste after standing for 2 to 3 minutes, is poured on to some boiling water with constant stirring. After boiling for another two minutes, and allowing to settle, the clear liquid is strained through a cloth; milk and sugar are then added to taste. If the second grade malt is not desired the coarse fraction may be boiled with water for a few minutes and strained through a cloth and served as before with addition of milk and sugar. The residue may be fed to cattle.

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INSECT PESTS AND THEIR NATURAL ENEMIES IN THE CIRCARS

BY

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In Nature, some of the vegetable-feeding species of insects have such enormous powers of multiplication, that, had it not been for the existence of certain natural checks—biological or climatic—no vegetation whatever will be left on the face of the earth. In the keen struggle for existence, certain insects that live at the expense of others usually exploit the presence of the vegetable feeders in such large numbers and are able to bring about a diminution in their numbers automatically. An attempt is made in this article to give an account of the natural enemies of some of the chief crop pests of the Northern Circars so as to show how they bring about their control.

2. It is a known fact that the *Sarava* (or the first) crop of paddy suffers a good deal from borer, whereas the *Dalava* (the second or Summer crop) suffers very little though it starts with a greater number of moths at the outset. This appears to be partly due to the activity of egg parasites, which make their appearance at the time of harvest of *Sarava* crop and gradually assert themselves on the approach of summer. The chief egg parasite is *Tetrastichus sp.*, which confines itself to egg masses of *Schoenobius*. During some years its parasitisation is remarkable being capable of destroying as many as 80 per cent of eggs. It is, however, found only in small numbers in the main or *Sarava* season, but develops in astonishing numbers in borer eggs from February onwards. No other host excepting *Schoenobius* has yet been noted. The eggs of the parasites are laid inside the eggs of paddy borer, and the tiny grub that emerges from the egg in a day or two empties the egg contents and begins to attack other eggs. During its course of life it destroys from 2 to 3 eggs, and after a larval existence of about 7 to 8 days it pupates inside. The pupal period is about a week. The adult wasp is capable of laying eggs anywhere in the egg cluster and consequently if a sufficient number of eggs is laid in an egg-cluster it is completely emptied. An individual wasp is capable of laying as many as 35 eggs, and lives as an adult for about 10 days. In the case of the other two egg parasites, *Phanurus* and *Trichogramma*, their activities are

limited as they are capable of parasitising only the surface layer of eggs of a *Schoenobius* egg-cluster. *Phanurus* generally parasitises up to 50 per cent of eggs; whereas the degree of parasitisation by *Trichogramma* does not exceed 10 per cent. *Phanurus* completes its life-cycle in about 15 days, whereas *Trichogramma* takes about 9 to 12 days. Both are the common egg parasites of many other Pyralid borers. In the case of *Phanurus* only one grub is noted in each egg, but in the case of *Trichogramma* the number may vary from 1 to 3. The larval parasites of paddy borer (*Topobracon* and *Microbracon*) are not, however, of much economic importance as they are not capable of destroying more than 5 per cent of borer caterpillars.

3. The cane borer (*Argyria sticticraspis*) has the common Pyralid egg parasites controlling its abnormal increase, *Phanurus* and *Trichogramma*, which are of little efficacy in the case of *Schoenobius*, the power of parasitisation being confined to the surface layer of eggs, but are of special importance, in the case of cane borer, the eggs being laid in a thin layer, overlapping one another like the tiles on a roof. The parasites in spite of their limited capabilities can reach any egg. *Phanurus* predominates during summer, but the degree of parasitisation is as low as 12 per cent. *Trichogramma*, however, asserts itself after the break of South-west monsoon and the degree of parasitisation rises as high as 80 per cent. The larval parasite, *Stenobracon*, is not of much use as it is not capable of destroying more than 10 per cent of the borers.

4. In the case of *Sesamia inferens*, the chief borer of *Pyru* Ragi, the controlling factors are the two Braconid larval parasites. The ragi borer which flourishes best in the cold weather, begins to appear in *Pyru* Ragi towards the end of January a fortnight after planting and assumes a serious form with the approach of February. The degree of parasitisation of *Sesamia* caterpillars is as low as 5 per cent in January, but gradually increases during February, reaching a maximum of 80 per cent in March. So there is no wonder if we fail to see any white ears in some of the fields, in spite of a large number of deadhearts in the young crop.

It is the common belief among cultivators, that continuous heavy rains prove detrimental to *Hieroglyphus banian*, the paddy grasshopper and that its depredations are heavier when bright weather prevails. After some heavy showers, the writer noted large number of dead grasshoppers attached to grasses on bunds, which on examination by the Government Mycologist at Coimbatore was found to be due to an Entomophagous fungus (*Empusa grylli.*) Probably the pest is checked to a certain extent by this fungus during humid weather. *Natada nararia*, the leaf eating nettle grub on coconut of the Godavari Central delta assumes a serious form during dry weather. Its presence is not felt much during the rainy season, and hence during the years when the monsoons fail it increases in enormous numbers and badly defoliates coconut gardens. A similar phenomenon has also been recorded in Ceylon where a bacterial disease is reported to affect the caterpillar during rainy weather, the rains greatly assisting the spread of the epidemic.

5. 'Kodu'—the Silver Shoot in paddy—caused by the Paddy gallfly is greatly influenced by its parasites chiefly, *Platygaster oryzae*. It is only when this parasite is affected by adverse climatic conditions, such as, an early break of the monsoon followed by a sudden and prolonged break, that the insect assumes a pest condition.

6. No detailed account of the parasites of *Nephantis*, the black headed caterpillar of coconut, need be given here as a great deal of information is already on record. All along the East Coast, the pest assumes a serious form now and then, the parasites being adversely affected in some way or other. But when later on rains are received and favourable conditions prevail, the pest is naturally controlled by the combined team work of different parasites. A few years back, some of the coconut trees round about Ellore, Samalkot, Anakapalle, Vizianagram and Chicacole Road were so bad that they presented a very pitiable sight indeed. On examination no larval parasites could be noted among the caterpillars. But subsequently, however, the parasites began to appear and assert themselves with the result that the pest was absolutely controlled without any effort on the part of the Agricultural Department, and the trees in these places now present a pleasing appearance. It may also be mentioned in this connection that in the case of certain caterpillars found on paddy, such as, *Psalis* and *Parnara* the parasites are so constantly found that it is generally difficult to rear them into moths and that is why they are never noted in a pest condition.

7. In this connection, it may be stated, that a youug coconut garden near Theenarla in Vizagapatam District noted to be badly affected by scales (*Aspidiotus destructor*) was sprayed with a contact poison, though it could not be supposed that all the stages of scales would be affected. The effect, however, was that

the ranks of the pest were greatly thinned, and the field for predatory Lady birds, and Syrphids being thereby limited, the latter could concentrate on the scales left to greater purpose and check the pest to a considerable extent. The result was that the young garden improved wonderfully and created a good impression on the landlord.

8. The biological study of insect life has greatly widened the sphere of activity of the Entomologist, who has not only to study the insect in detail, but also all forms of life connected with it. The importance of such study has no doubt been realised even by the lay public since the popular demand is for a control of pests by their natural enemies as opposed to artificial methods. Such study is, however, no mean a task, as it requires great patience and keen observation, but it may be confidently stated that it will have its own reward.

THE PRINCIPLES OF BIOLOGICAL CONTROL

BY

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Probably ninety-nine out of every hundred people, when they think of the contributions of science to human welfare, recall the physical, chemical and mechanical inventions which produced the industrial revolution and are now engaged in the mechanisation of the world, and in the evolution of its new master, the centaur of the new civilization—that half-man, half-automobile, envisaged by that brilliant recent writer, Woodruff, in *Platos American Republic.* We are not accustomed to think of *biological* inventions ; by which we mean, with Haldane, 'the establishment of a new relationship between man and other animals or plants, or between different human beings, provided that such relationship is one which comes primarily under the domain of biology, rather than physics, psychology, or ethics.' The application of biology to the solution of human problems has as yet hardly begun. Haldane has shown that the number of great biological inventions can be counted on the fingers of one hand, and most of these were made before the dawn of history.

When mankind was at the hunting stage of culture, living only on animals and perhaps a few plants, secured with the aid of primitive tools, a Malthusian prophet might justly have envisaged, concurrently with improvement in weapons and in hunting technique, a gradual decrease and final extinction of the game, and with it the annihilation of the human race dependent thereon. It is improbable that he would have predicted the innovation—the first great biological invention, namely, the domestication of animals and plants—which was to save the future and ensure the continued evolution of man.

It is interesting to realise that until recent years there had not been, during the whole historic period, any noteworthy addition to the list of man's domestic animals. All had been the servants of man from the dawn of history, they had accompanied him out of the mists of antiquity and had materially assisted his emergence.

The principle of biological control involves a tremendous increase in the numbers of man's animal auxiliaries—it is, in fact, an extension of the first great biological invention—the domestication of animals. It is true that the animals thus utilized are usually not domestic animals in the strict sense of the term, but there exists every gradation between these and such closely-domesticated organisms as dairy cows. Moreover, in what were in all probability among the first attempts at biological control—the destruction of rats and mice by dogs and cats—animals probably already domesticated were the agents. Ferrets, however, used against rats and rabbits, are very much less domesticated than dogs or cats and form a transition to natural enemies which are utilized without true domestication. It is these latter which are the chief agents in the biological control of insect pests.

The term 'biological control' covers at the same time, a multitude of sins and a number of man's newest and most promising weapons in his struggle with the organic environment. We must carefully examine these, for with the increasing popularity of natural control methods it becomes more and more necessary to define clearly what reputable workers understand by 'biological control,' and to distinguish between what should be actually attempted in this sphere, and what must still remain the subject of cautious experimentation. The need is the more urgent from the fact that, as Thompson has recently emphasised, 'economic entomology, though it finds in science its principles and its tools, is itself not so much a science as an art, like medicine. As in medicine, the practice of the art is always to some degree in advance of the written recipes and rules, which hardly do more than catalogue what experience has taught. One consequence of this is that while certain general methods gradually develop, there is a considerable period during which they can be learned only from the practitioners of the trade; another is that their general value remains uncertain until their scientific basis is critically examined. Such is at present the situation in regard to the biological control of insect pests . . . '

How then shall we define 'biological control ? In a sense any method of combating a pest by means other than direct chemical or physical ones, is biological. The breeding of immune varieties of plants is one such, very promising, means. We would, however, limit the term to the utilisation of one kind of organism for the limitation or destruction of another. The theoretical possibilities of such a method are, of course, extremely numerous but we shall confine the following analysis to those cases in which attempts have been actually made or suggested. Even for these the accompanying table is not complete, but it will serve as a basis for discussion.

I. Control of injurious animals.

A—By other animals.

1. Control of nematodes by predacious nematodes (Steiner and Heinly, suggestion only, 1922).

2. Control of molluscs by vertebrates (slugs and snails by birds, hedgehogs, etc.)

3. Control of insects and other anthropods by

    (a) mites.

    (b) other insects.

    (c) birds.

    (d) other vertebrates (e.g., fish and newts against mosquito larvae, toads against nocturnal insects, bats against mosquitoes).

4. Control of vertebrates by other vertebrates (e g., fish by fish, snakes and rats by mongoose, rabbits by weasels, mice and rats by birds of prey).

B—By plants.

1. Control of insects and other anthropods by
    - (a) bacterial diseases.
    - (b) parasitic fungi.
    - (c) algae (e.g., mosquito larvae by *Chara* spp.).
    - (d) phanerogams, e.g., scale-insects on lime trees diminished by allowing Bengal Beans to climb over trees. Montserrat, Ballon. (*Melinis* grass against flies and ticks).
2. Control of injurious vertebrates by bacterial diseases, (e.g., rabbit in Australia, rats).

II. Control of injurious plants (Weeds) by

1. insects (e.g., against prickly pear and *Lantana*).
2. mites (e.g., against prickly pear).
3. fungi (e.g., against prickly pear, blackberry, Californian thistle).
4. bacteria (e.g., against prickly pear).

In addition there are such border-line cases as that of d'Herelle's bacteriophage ; and such indirect control as that of cattle flies by the utilization of dung beetles, which render the manure unsuitable for their breeding.

Most of these cases represent actual attempt ; a few are only suggestions. *As to their relative practicability, it cannot be too strongly emphasised that all are either in the experimental stage or may be dismissed as valueless, save the control of insects and other anthropods by insects.* It is far too frequently forgotten that this and this alone is the only sound general practice in biological control. To this must be credited every one of the sweeping successful applications of the principle. Only when this method has failed after years of trial, should the introduction of natural enemies other than insects (or other anthropods) be contemplated. The introduction and acclimatisation of predacious birds and mammals as a measure against pests (whether insect or vertebrate) has led to such disasters in the past, that it should be universally condemned. I need only mention the introduction of the mongoose into the West Indies, of the stoat and weasel into New Zealand, and of the English Sparrow into North America and other parts of the world. So far as insect-eating birds are concerned, we should carefully distinguish, of course between the importation of foreign species and the encouragement of native ones which have been found useful to agriculture. As McAtee (1926) has recently shown, the local birds may be looked upon ' as an ever-present force which automatically tends to check outbreaks large or small, among the organisms available to them as food. It is a force which should be kept at maximum efficiency by protective measures and which should be taken into consideration and used whenever possible.'

Bird protection then, both passive, by restriction of killing, and active by establishment of sanctuaries and perches, and checking of ground vermin, may be looked upon as a general insurance against insect outbreaks. It can rarely be considered as a measure against individual pests.

Save that in their case, protection is less practicable, the same remarks apply to insectivorous mammals, lizards and amphibians, the two latter being especially important in the tropics.

The control of weeds by means of their insect enemies is still entirely in the experimental stage. The best known attempt—that directed against *Lantana camara* in the Hawaiian Islands—has been successful in that the plant has been largely prevented from seeding by insects introduced from Mexico. By this means its re-infestation of cleared land and its further spread are greatly checked. The prickly pear (*Opuntia* spp.) in Australia—the most spectacular weed in the world—is also, according to latest reports, gradually succumbing to the attacks of insects and mites imported, on a very large scale, from America.

Numerous observers, in many parts of the world, have been greatly impressed with the tremendous mortality among certain insect pests, under certain conditions, through the attack of fungous parasites and bacterial diseases. And just as numerous attempts have been made to reproduce these conditions artificially, and to control outbreaks by propagating the disease. In particular instances, sweeping successes have been claimed, notably by Le Moult and by d'Herelle, but later observers have usually failed to obtain similar results. One of the most thorough and careful workers in this field, Paillot (1916) came to the conclusion that 'la creation d'epidemies artificielles comparables, en intensite et en etendue, aux epidemies naturelles, soit a peu pres impossible dans l'etat actuel de nos connaissances; trop de ces facteurs interviennent, en effet, dans la propagation de ces epidemies, qui echappent plus on moins completement a l'influence de l'homme.' Petch (1921) a mycologist who is perhaps the foremost authority on entomogenous fungi expressed the same conclusion even more strongly when he said:

> 'At the present day, after thirty years' trial, there is no instance of the successful control of any insect by means of fungous parasites. If entomogenous fungi already exist in a given area, practically no artificial method of increasing their efficiency is possible. If they are not present, good may result from their introduction if local conditions are favourable to their growth; but, on the other hand, their absence would appear to indicate unfavourable conditions.'

So far as insect pests are concerned—and these are the worst of our troubles—we are thus left with control by means of their insect enemies. But even here, further analysis is necessary before we arrive at what is practicable and promising and what is not. With insectivorous vertebrates we have just seen that importations have usually proved more or less disastrous mistakes while encouragement of local species is recommended as a measure of general insurance. Precisely the opposite has been the case with insect enemies of insects, for here, as noticed above, all the most sweeping successes have been won with introduced parasites, while the attempted encouragement of native ones has usually proved futile. A consideration of these successes, and notably of those achieved in Hawaii, shows that the most favourable circumstances may be summed up under four heads;

(1) the pests to be controlled are immigrants, accidentally introduced without their natural enemies;

(2) the indigenous fauna is of a limited and peculiar kind, so that the chances of the immigrants finding new enemies in it are very small;

(3) the climate is warm and equable, allowing introduced parasites to multiply without seasonal checks;

(4) there are only a few main crops, so that high organisation and centralisation are possible, and a small improvement is rendered important by the large scale of operations.

Probably no other part of the world is quite so favourably situated as Hawaii in reference to all four of these conditions. But it is safe to say that any country possessing these four qualities in some degree, is favourably situated for biological control. One would expect that once suitable natural enemies were discovered, imported and established, the task would in most such cases be accomplished. Probably the most unfavourable regions in which to attempt control of this nature lie in continental areas, with a rich and varied fauna, and a 'temperate' climate, with a cold winter. In such areas it might be necessary to breed the parasites continuously in the laboratory and distribute them periodically, so as to force them into a condition of permanent dominance, to use the term of H. S. Smith. Such is the method used with the Australian ladybird, *Cryptolaemus montrouzieri*, in California, against the citrus mealy-bug. It is, of course, considerably more expensive than mere introduction and establishment accomplished once and for all, but at least in the citrus industry, it remains less costly than chemical measures of control.

This principle of assisting, as it were, the work of parasites already established, may theoretically be extended to indigenous natural enemies of pests either native or imported. In fact, the large scale utilisation of parasites already present, notably those of the codlin moth in California and of the sugarcane borer (*Diatraea*) in Louisiana, is one of the latest developments of applied entomology. But such extension, whether on a large or on a small scale, has nowhere yet met with any striking success, and biological control as a whole should not be judged by the trial of it alone. The corollary is that the best results in biological control are to be expected in the future, as they have been obtained in the past, from the introduction and establishment of parasites from other regions.

When we come to the tropics it is often a matter of the greatest difficulty to decide whether a given pest is an introduced or an indigenous insect, and provided the entomologist ascertains exactly what parasites are attacking it in the various regions of its range, this becomes largely an academic question. The sugarcane froghopper in Trinidad, evidently an indigenous insect, has very thoroughly adapted itself to cane-field, *i.e.*, essentially exotic conditions, while its local enemies have very largely failed to do so. The position thus simulates that of an insect introduced into a new country, without its natural enemies, and the way is open for the importation and establishment of foreign parasites which are as well adapted to cane-field conditions as the froghopper itself. The same principle applies to a number of other tropical pests.

A most essential part of the work consists in freeing the imported parasite from its own natural enemies (hyperparasites) before it is liberated. Mistakes of this kind are usually irrevocable.

The controversy as to the necessity for a sequence of parasites to attack various stages of the pests insect, with the dangerous tendency to the opposite extreme of super and co-parasitism, or the injurious competition of several parasites for the same individual hosts, seems now to have been resolved in the policy of sending one or two judiciously selected species at the beginning and observing their effect, before introducing others. The choice of species to introduce must, in the present state of our knowledge, be left in each case to the judgment of the specialised investigator who can study the pest and its enemies in the different parts of its range.

The emphasis on foreign parasites implies, of course that the task is not one for the local entomologist to perform single-handed. Biological control offers an extremely promising field for co-operative research, and with the foundation by the Empire Marketing Board of a special laboratory for this work under the Imperial Bureau of Entomology, its rapid further development along these lines, throughout the Empire, seems assured. The mission of the present writer to the extremely promising field of the West Indies is the latest extension of the same organisation. *Fiji Agricultural Journal*, 1929, Vol. II. No. 3.

Extracts

MOTOR MECHANISM IN PLANTS

SIR J. C. BOSE'S DISCOVERIES

At the anniversary of the Bose Institute, Sir Jagadis Bose gave astounding demonstrations which established the great generalisation of the unity of all life. Advance of knowledge of life of plants had been arrested on account of narrow specialisation which made plant physiologists neglect acquiring of first-hand knowledge of parallel phenomena in animal life. Even more serious had been the drawback arising from want of adequate knowledge of physical science in elaboration of new methods for advanced research. The Bose Institute is the only place where scholars have to undergo prolonged and intensive training in essentials of physics, of bio-chemistry and of physiology of both plants and animals. The many-sided activities of the institute resulted from this system of training as evidenced by the publications of some 15 volumes of research work, a good many of which have also been published in French and German. The success of the new researches has also been due to the extraordinarily high magnifying instruments, which are now revealing the wonders of a new world. It is after several years of special training that his scholars obtained mastery of the technique of the novel and difficult methods of investigation. After a stay of nearly a year at the institute, Professor Hans Molisch, the eminent plant-physiologist of Vienna, succeeded in repeating even the most difficult experiments.

Old Doctrine and the New Outlook

Unimportant questions have often been raised to confuse the main issue, necessitating a clear statement of the old doctrine and the new outlook. It was investigations on invisible light, undertaken in his laboratory nearly 40 years ago that led to the formulation of the doctrine of unity of all life. His discovery of response of inorganic matter to stimulus and the characteristic effects of fatigue, of stimulants and of poisons on metals were announced at the International Congress of Science, Paris, in 1900. Intermediate between the behaviour of inorganic matter and that of complex animal life are reactions in the vast realm of inarticulate life of plants. Was there any unifying principle which underlay all life and its diverse manifestations?

The old theory insists on certain fundamental differences. Plants, unlike animals are supposed to possess no conducting tissue analogous to nerve, no widely distributed contractile cells, no pulsating organs and no peristaltic activity in propulsion of fluids. Crucial experiments on plants and animals carried out side by side during the course of the lecture, proved on the other hand that plants possess tissues like nerve and muscle, automatically pulsating organs, and active cells which cause propulsion of the sap, thus establishing the great generalisation of the identity of mechanism of all life. Those discoveries afford a very important confirmation of continuity of the evolutionary process.

Laboratory Miracles

The audience had next the opportunity of witnessing a succession of marvels which revealed the reactions in the invisible realm of life under the action of forces even beyond the range of human perception. The new type of Growth Balance, perhaps one of the most marvellous instruments of high sensibility and precision, was exhibited for the first time. The imperceptible growth of the plant, enormously magnified by the optical Crecograph, appeared as a rush of the indicating line of light upwards. The growth movement was then exactly compensated by starting the balancing mechanism which made the plant subside at an equal rate, and a scale attached to the apparatus immediately measured the exact rate of imperceptible growth. This is of the order of a hundred thousandth of an inch per second, that is to say about half the length of a single wave of sodium light. Exquisite is the sensitiveness of this method of balance; if the observer breathed on the plant, the instrument showed an immediate upsetting of the rate of growth. Still more astounding is the effect of wireless waves which, though imperceptible to man, yet caused movement of response by the plant. The most important result established is that all high tension electrical current modifies growth, the result depending on the tonus of the plant and on the dosage employed. It is clear that no real advancement in scientific agriculture can be possible without discovery of the laws of growth of plants by following the new and exact methods of research that have been devised.

The Dancing Plant

The nervous impulse in animal and plant was next demonstrated by experiments equally startling. By sending an electric current from the left to the right sciatic nerve of a frog, a nervous impulse was started at the point where the electric current left the nerve, causing the right leg to kick out. By reversing the current the left leg was made to give the kick; the frog was thus made to dance, keeping step with the alternate nervous excitations. Precisely similar movements, under nervous excitation, were exhibited by the two leaf-stalks or limbs of the *Mimosa* plant.

Contractile Response of all Plants

The infinitesimal Contraction Recorder, producing a magnification of several million times, shown in action, was absolutely free from physical disturbance, since the indicating line of light remained unaffected even by stamping on the floor. For comparison of excitability of the plant with that of a human being, a subminimal electric shock was administered to a member of the audience and the plant placed in the same circuit. The human being failed to react to the excessibly feeble stimulus which caused a shuddering twitch in the plant. After removal of the man from the circuit, a death-dealing high tension electric current was thrown in for electrocuting the plant. It was a terrible sight to watch the convulsions into which the plant was thrown till after the supreme crisis life passed into the passivity of death.

The Propulsion of Sap

The movement of sap in the stem and leaves has been regarded as merely a passive physical process, water being sucked up in consequence of evaporation from the leaves. The erroneous character of this supposition was demonstrated by the following striking experiment. A wilted and almost dying leaf of *Lupin*, was coated with impermeable varnish, which abolished evaporation. In spite of this, application of a stimulating solution at the cut end of the organ brought about the revival of the dying leaf which reared itself erect with extraordinary vigour. The activity of living cells in the pumping up of sap was further proved by the failure of the stimulating solution to revive a leaf which had previously been poisoned.

Action of Drugs on Pulse-beat of Plant and Animal

Extraordinary interest was roused when the plant was shown to inscribe in luminous tracings its throbbing pulsations similar to those of the animal heart. Under poison, the pulse-beat of the plant fluttered as of a creature desperately struggling for life. In some cases it was possible to save the plant by timely application of a suitable antidote. Accurate investigation of the characteristic effects of different drugs on animal heart has been rendered possible by the invention of the resonant cardiograph. Of special interest was the record obtained by the leading experts of the faculty of medicine in Vienna thrown on the screen. The heart-beat of a frog had just come to a stop, the animal being to all intents and purposes dead. The injection of a few drops of an Indian drug of high potency then revived the heart and the animal was brought back to life. Details of his experimental methods and results will be found in Sir J. C. Bose's recently published work on *Motor mechanism of plants.* A large number of Indian plants are being discovered, whose medicinal properties have never been suspected and whose efficacy in reviving the failing heart appears to be exceptionally high. Further progress necessitates (1) a survey of Indian plants for discovery of their medicinal properties; (2) the establishment of a physic garden; (3) careful isolation of the active principles from the plant extracts; and (4) careful and prolonged investigation for standardisation of the dose on human subjects. The results would undoubtedly lead to the establishment of a new pharmacopoeia for the relief of humanity.

India's Need

Sir J. C. Bose then referred to the important service which can be rendered by the students trained in scientific mothods by the different universities. He believes that one of the causes of unrest in India, as in Europe, is fundamentally due to severe economic distress and on account of its magnitude the problem here is far more acute. The situation may be faced by utilising in increasing measures the inexhaustible resources of the country through practical applications of science. His instruments, which evoked such high appreciation in the West, have all been invented in India and constructed by Indian mechanicians. His countrymen, under special training, are therefore, well-fitted to take a very important part in developing the resources of the country. India has both men and material, but no serious attempts has been made to utilise them. A new programme and a farsighted State policy is urgently needed for meeting the economic crisis and for opening out wider spheres of activity for her children.

The Ascent of Life

In conclusion, Sir Jagadis said: Both in the plant and the animal we have been able to follow the long stairway of the ascent of life. The plant is seen to be very much nearer to us than we ever thought. We find that it is not a mere mass of vegetative growth, but that every one of its cells is full of sensibility. The plant answers to a shock by a twitching movement; it is rendered an organised unity by means of conducting threads along which the tremor of excitation, initiated at any point, courses through the whole. The throbbings of its pulsating life have been found to wax and wane under the specific action of drugs, coming to an end at the death of the organism. In these and in many other ways, the life reactions of man and plant are alike, and thus through the experiences of the plant we hope to alleviate the sufferings of man.—*The Hindu.*

A USEFUL FUNGICIDE AND INSECTICIDE

Like the lime sulphur wash, this spray material has valuable insecticidal and fungicidal properties, and is specially valuable for treating all kinds of mites and red spiders, as well as the various mildews attacking roses, melons cucumbers and many cultivated flowering plants.

Boil 3 lbs. of Caustic soda with 6 lbs. of (powdered) sulphur in two gallons of water till dissolved; the result is a strong solution of sulphide of soda which can be used either diluted with plain water or with soap and water $\frac{1}{4}$ to $\frac{1}{2}$ lb. of soap to the gallon of water. The concentrated solution should be reduced to one-sixtieth with water or soap and water; the two gallons thus producing 120 gallons of spraying material. Used at this strength it is very effective on all red spiders, mites and also young scales when newly hatched and can also be applied to ripening fruits to prevent rot caused by fungus growths or to prevent mildew on roses, pumpkins, marrows, cucumbers, etc.

If desired caustic potash can be used in the place of Caustic soda, the result being the production of sulphide of Potash (liver of sulphur).

Formula for preparation of stock solution

	For 2 gallons	For 1 pint
	lbs.	oz.
Caustic soda or potash ...	3	1
Powdered sulphur ...	6	2
	gal.	pint.
Water ...	2	1

Dilute the stock solution with sixty parts of water.—*Fiji Agricultural Journal.*

Notes

The action of Scorpion poison

Seventy-seven per cent of the vesicular weight is poison. It contains hemolysin, hemorrhagin, leucocytolysin, neurotoxin and agglutinin and has a proteolytic and anticoagulant action. A serum was prepared which neutralized 50 times the lethal dose.—*Chemical Abstracts.* Vol. 23. 1929.

Impressions of Dermatology in North China

From the annual examination of 100,000 out-patients at the Pekin Union Medical College, fungus infections of the skin are stated to be common and are represented by essentially the same Pathogenic fungi and the same clinical characteristics as in other parts of the Temperate Zone. Both tinea tonsurans and tinea favosa of the scalp are astonishingly common due to the use of contaminated instruments by itinerant barbers.—*Review of Applied Mycology.*

Splenic tumours due to fungi

In the case of a young man who suffered from Progressive Splenomegaly from 1920 to 1923, the spleen was found to contain dense, firm tumour masses composed of lymphoid cells, with scanty larger cells having two or more nuclei. Further examination revealed the presence in the haemorrhagic areas, of filiform structures believed to be the mycelial elements of a fungus. Attention is drawn to the importance of this independent confirmation of A. G. Gibson's similar discovery in 1913 and to its bearing on 'Hodkin's disease.'—*Review of Applied Mycology.*

Harvest Reductions through Plant diseases

The following is stated to be the estimated figures for annual reductions in the yield of the principal German crops as a result of Plant diseases :

			Marks
Cereals, 10 per cent, representing a value of			394,000,000
Potatoes, 25 per cent	,,	,,	365,000,000
Sugarbeets, 5 per cent	,,	,,	12,000,000
Vegetables, 10 per cent	,,	,,	35,000,000
Fruit, 10 per cent	,,	,,	40,000,000
Vine, 20 per cent	,,	,,	16,000,000

The average total amount of the reduction consequent on Plant diseases is 10·8 per cent as compared with 7·8 per cent, for insect pests, while the financial loss from both sources together is placed at approximately 2,000,000,000 marks.—*Review of Applied Mycology.*

Shedding of mango flowers and fruits

Investigations of the shedding of mango flowers and fruits in certain districts of Bombay Presidency showed that the flower mildew was caused by *Erysiphe cichoracearum*. The spores flown from an infected area readily adhere to the hairy, unopened flower near the tip of the inflorescence and germinate in five to seven hours. It was shown by detailed observations in 1926–27 that mildew affects the flowers before fertilisation and the fruits in their earliest stages (before reaching 1/8 in. in diameter). Heavy losses may be caused at these times. The data obtained in a series of inoculation experiments showed 'mildew' alone is capable of entirely destroying the crops. An investigation of the effects of spraying against the mildew showed that the application of 5–5–50 Bordeaux increased the number of healthy ripe fruits by 21 per cent in 1925–26 and by about 230 per cent in 1926–27. *Review of Applied Mycology.*

Relation of soil fertility to vitamin A content of leaf lettuce

Grand rapids forcing variety of leaf lettuce was grown in pots containing 5 lbs of (1) sandy loam soil of very low fertility; (2) soil plus the addition of 25 g. of pulverized sheep manure and 1 g. of a mixture of KNO_3, $CaH_2 (PO_4) 2$ and KCL (1 : 2 : 1) (3) soil plus 4 g. of the inorganic mixture but no organic matter. Animal feeding tests for vitamin A were made during a period of eight weeks. Ten rats were used for each treatment. The chemical composition of the plants was determined after the eight-week period. The chemical analysis of the lettuce did not aid in interpreting the results. The total gains in weight were (1) 58.2 g ; (2) 73 g ; (3) 82.4 g. The Vitamin A content increased with plant vigour, robustness and with the greenness of the lettuce. Conclusion :—The vitamin A content is associated with the degree of greenness but not necessarily with vigour apart from differences in chlorophyll. Further experiments on this point are under way.—*Chemical—Abstracts.* Vol. 23, 1929.

Electric Power for Irrigation in South India

Major H. G. Howard, Chief Engineer, Hydro-Electric Development, in his address at the Rotary Club on the 22nd November, has referred to the fact that thousands of acres of unproductive land could be brought under intensive cultivation when the Pykara Hydro-Electric scheme is completed. This augurs well for the future prosperity of the dry-farming ryots in the central districts particularly. This development will be, as Major Howard puts it, an asset to the country, as the Cauvery-Mettur scheme is, the former also requiring nearly as much capital expenditure for maximum development. Furthermore he points out that this investment will be justified by the annual savings effected in the cost of coal and oil consumed at present for power-production purposes, amounting to about 46 lakhs of rupees, a large portion of which will certainly be available for improving the industries of the country. The total horse-power expected to be developed at Pykara will ultimately exceed one lakh and will be more than sufficient for all industrial and agricultural purposes in South India with partial electrification of railways also. When electricity is thus cheaply available, devoid of all attendant troubles connected with oil-engines and petrol motors, power pumping may be resorted to even by ordinary ryots with small holdings. As a result the garden area is likely to increase considerably and the problem will be to find enough water in wells particularly in the hot weather. The Industrial Department will step in at this stage and find out easy means of tapping the underground sources of supply to the fullest extent.

Reviews

Studies in Sugarcane Pollen with Special Reference to Longevity

NANDA LALL DUTT

Agricultural Journal of India, Vol. XXIV. Part 4, pp. 229-244

India has played an important role during the last one decade and half in the development of the Science of Cane breeding. Consistent with the traditions of the Coimbatore Cane-Breeding Station, the author in the third of a series of Studies on Sugarcane Pollen, records the results of his researches on the viability and preservation of pollen. The determination of the nature and extent of Pollen viability being an essential factor in all hybridisation work, the efforts of the author to evolve a technique which would admit of a reliable means for testing viability is praiseworthy. The author has succeeded in germinating pollen on a wide range of Media of which the most complicated merely consists of cane sugar, water and shredded agar. The author deserves congratulations in that he has succeeded in a ground where others have failed or met with only partial success.

A novel piece of investigation attempted by the author is an effort to preserve sugarcane pollen with a view to bridge the gulf between the period of flowering of two likely parents. The partial success obtained in this line promises great possibilities. There remains, however, much to be done before anything like perfection is attained in this and the technique of testing Pollen viability in cane and we would look forward with interest for further contributions in this line.

College Notes and News

Games. Close on the heels of the Pachaiyappa's College who played several institutions and clubs in Coimbatore came the Bangalore Medical College to our town with a heavy programme before them. The weather during their stay in Coimbatore was not all that could be desired, so that several engagements in the town had to be abandoned.

The Agricultural College played an interesting half day cricket match against the visitors. Winning the toss, the Agriculturists put their opponents in. Bangalore opened disastrously, losing their first wicket at 2, the second at 17 and the third at 21. The whole side was dismissed for 59 runs of which Lakshman Rao claimed a useful 21. For the homesters, Padbhanabhan and Thomas shared the bowling honours the former taking 6 wickets for 12 runs and the latter 4 for 23. Venturing out in their turn, the Agriculturists opened none too well. Their first wicket fell at 1, the second at 5 and the third at 7. The partnership between Patnaik and Sankarier, however, brightened up matters for a while, but Venkat Rao who was bowling exceptionally well, claimed two more wickets before the third decade was reached. The homesters prospects of a win or a draw appeared gloomy but Venkatraman and Subramaniam by careful play raised the score to 46 when the former also fell a victim to Venkat Rao. Subramaniam and Lakshman played a defensive game and 50 was telegraphed. Tense excitement prevailed at this stage and the score reached 55 without further loss when time intervened and made a draw of what would otherwise have been an exciting finish. For the Medicoes Venkat Rao bowled unchanged and captured 5 wickets for 15 runs while Rajan and Suriroyan shared the two remaining wickets.

In a hockey match against the Bangaloreans the Agricultural College won by two goals to nil. Both sides displayed high class hockey, and in fairness to the visitors it should be said that the ground after the heavy rains was in a poor condition and the score is not a correct indication of the run of the game.

The visitors gave a good exhibition of their talents at foot-ball also against the College. The teams were well matched and from start to finish it was one struggle for superiority. Eventually the visitors' advance line put in a combined effort which resulted in the only goal of the evening, so that the visitors ran out victorious.

Y.M.C.A. Cricket Tournament. The last game of the tournament was played on the College grounds between the Agricultural College and the Government Arts College. The homesters winning the toss elected to take the field, and thanks to the excellent bowling of Patnaik, dismissed their opponents for a party total of 39 runs of which Chan's 13 was the only double-figure contribution. Patnaik returned an analysis of 7 wickets for 14 runs; Dharmalingam claimed 2 wickets for 11 runs and one batsman was run out. The Collegians put up a total of 128 for 5 wickets, their chief run getters being Padbhanabhan (43), Sankarier (30 not out), Venkatraman (20 not out) Patnaik (14) and Subramaniam (13).

Weather Notes

NOVEMBER 1929

Rainfall Data

Station	Rainfall	Departure from normal
Gopalpore	...	—3·0
Vizagapatam	0·2	—3·6
Cocanada	0·2	—4·1
Masulipatam	0·3	—4·4
Kurnul	0·1	—0·9
Bellary	2·9	+1·2
Anantapur	3·1	+1·7
Cuddapah	5·0	+1·4
Nellore	10·6	—0·4
Madras	15·1	+2·9
Cuddalore	19·1	+4·8
Vellore	7·6	+1·3
Salem	3·9	+0·6
Coimbatore Town	3·7	+0·2
Coimbatore Res. Institute	2·7	...
Trichinopoly	4·6	—0·9
Negapatam	15·2	—0·5
Madura	7·3	+2·4
Pamban	13·0	+2·1
Palamkotah	6·4	—1·0
Trivandrum	7·2	+0·9
Cochin	6·9	+1·0
Calicut	3·0	—1·4
Mangalore	1·6	—0·9
Bangalore	3·8	+1·0
Mercara	0·9	—1·9
Kodaikanal	12·3	+5·3
Coonoor	5·9	—5·9

Notes

Pressure distribution was of the normal type almost throughout the month, and the seasonal trough of low pressure lay in the South of the Bay. It became active on the 3rd and formed into a depression near latitude 9 N and 86 E longitude and crossed the coast near Cuddalore on the 4th night and moving westwards crossed the Coast near Marmagoa on the 6th and moved out westwards and became unimportant. Conditions were more settled from that date till the 23rd when another depression formed in the South of the

Bay about 12 N 87 E and moving northwards lay almost stationary till the end of the month. It gave rough weather in the Bay well out to sea. Weather was unusually fine over the presidency during the second half of the month and rainfall was scattered and light.

Rainfall was heavy and general during the course of the formation and passage overland of the first Bay depression and some heavy falls occurred on the South Madras Coast, Cuddalore, Madras and Negapatam reporting 4 ins. each on the 5th, Cuddalore 7 ins., Madras and Nellore 4 ins. each on the 13th and Negapatam 4 ins. on the 23rd. Total rainfall was in slight excess over the region extending from the Coromandal Coast interior to the Central Districts in large defect in the Circars, where practically there was no rainfall, and nearly normal or in moderate defect elsewhere. A feature of the rainfall was the unequal distribution over the month which will undoubtedly be prejudicial to normal growth and development of crops.

Winds were nearly all the month from some point between North and East, except during the passage of the first Bay Depression when southerly winds prevailed over the South as a part of the circulatory movement accompanying the depression.

Temperatures were normal or nearly so except during the period of fine weather in the second half of the month when day temperatures were higher, and night temperatures were lower than normal.

Humidity was abnormally low in the Circars from the 22nd to the 27th ; on the 25th Vizagapatam reported a humidity of 24 per cent of saturation or 42 per cent below normal.

Weather report of the Research Institute Observatory

Absolute Maximum in shade	89°· 0
Do Minimum ,,	64°· 0
Mean Maximum ,,	85 · 7°
Do Minimum ,,	68 · 5°
Mean wind velocity—daily	2 · 4 Miles per Hour
Do 8 A.M.	1 · 9 ,,
Total Rainfall	2 ·78 ins.
Heaviest fall in 24 hours	0 ·72 ins.
Number of rainy days	6 days
Total hours of bright sunshine	199 · 1 hours
Mean hours of sunshine daily	6 · 6 ,,
Mean humidity of saturation	81 · 1 %

Barometer

The pressure was steady during the month and fell sharply to 28·432 (unreduced to sea level) on 5th during the passage of the first Bay depression inland. Winds had a northerly component on all days and were strong during the first 6 days of the month. Calms were recorded on 12 mornings.

Rainfall

A total rainfall of 2·98 ins. was recorded on 6 rainy days and the heaviest fall was 0·72 ins. during the 24 hours ending 3-11-29. Temperature rose during the second half of the month with clear and other fine weather and the maximum was 89°. Diurnal variation was rather high and was 24° on the 26th when clear skies and dry weather assisted radiation.

P. V. R.

B. S. N.

Departmental Notifications

Appointments, promotions, transfers, leave, etc.

First Circle: Mr. V. Atchyutaramayya, Farm Manager, Anakapalle, leave on average pay for fifteen days from 16th November, with permission to avail Sunday 1st December. Mr. R. Vasudeva Rao, Farm Manager, Anakapalle, leave on average pay from the 25th November. Mr. M. Ramamurti, Assistant Farm Manager, Anakapalle, leave on average pay from the 2nd to 21st December with permission to suffix Christmas holidays.

Second Circle: Mr. P. Sudarsanam Nayudu, Upper Subordinate, Agricultural Section, is confirmed in his appointment.

Third Circle: Mr. K. Ramanatha Ayyar, Agricultural Demonstrator, Hindupur, leave on average pay for one day on 2nd November with permission to avail Sunday 3rd November. Mr. M. Satyanarayana, Agricultural Demonstrator, Nandyal, leave on average pay for one month and fifteen days from 7th November, with permission to suffix Christmas holidays. Mr. B Venkataramana, Assistant Agricultural Demonstrator, Markapur, leave on average pay for fifteen days from 21st November.

Fourth Circle: Mr. P. S. Venkata Subramaniam, Farm Manager, Palur, is transferred to Palakuppam Ground-nut Experiment Station. His transfer to Palmaner is hereby cancelled. Mr. M. A. Balakrishna Iyer, Farm Manager, Palakuppam, leave on average pay for two months from 3rd January 1930 with permission to avail himself of the Christmas holidays

Fifth Circle· Mr. K. Srinivasa Acharya, Agricultural Demonstrator, Tanjore, leave on average pay for ten days from 1st December.

Sixth Circle: Mr Kannappa Pillai, Assistant Agricultural Demonstrator, Melur, leave on average pay for two months from 3rd December. Mr. K. Ramaswami Ayyar, Agricultural Demonstrator on van duty leave on average pay from 3rd to 21st December with permission to avail Christmas holidays.

Seventh Circle: Mr. K. S Ramanna Rai, Agricultural Demonstrator, Mangalore, leave on average pay for twenty days from 25th November.

Eighth Circle· Mr. P. V. Raghavendra Rao, Assistant Agricultural Demonstrator, Hosur, leave on average pay for twenty-six days from 25th November in continuation of one month's leave already granted, with permission to suffix Christmas holidays.

Live-Stock Section: Mr. T. V. Krishnaswami Rao, Farm Manager, leave on average pay on Medical Certificate for one month and four days in continuation of the leave granted. He should produce a certificate of fitness to rejoin duty.

Government Agricultural Chemists' Section. Mr. G. K. Chidambaram, Assistant, leave on average pay for twenty-one days from 1st December with permission to suffix Christmas holidays.

Paddy Specialists' Section: Mr. C. M. John, Assistant, leave on average pay for two days on 9th and 10th November, without Medical Certificate and twenty days from 11th with medical certificate Mr. T. Lakshmipathi Rao, Assistant Farm Manager, Maruter, leave on average pay for three days from 2nd to 4th December in continuation of the leave already granted.

Cotton Specialists' Section: Mr N. C. Tirumalai, Farm Manager, Koilpati, leave on average pay for nine days from the 22nd November, with permission to avail Sunday 1st December. Mr. R. Sankaran, Assistant, leave on average pay for thirteen days from the 9th December with permission to avail Christmas holidays. Mr. Kesava Ayyangar, Assistant, leave on average pay for eighteen days from the 4th December, with permission to avail Christmas holidays.