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

The Madras Agricultural Journal

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

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FINANCING AND FORCED SALE OF PRODUCE [1]

BY

K. C. RAMAKRISHNAN

Reader in Economics, University of Madras

Summary

How far is it true to say that the agriculturists (in Madras) loose heavily by taking advances prior to harvest on condition of selling their crops to or through their creditors?

The net work of rural weekly fairs, facilitating the meeting of producers and consumers, without any financial obligation between themselves, may be said to reduce the chances for middlemen-moneylenders. But the fairs are neither universal, nor important everywhere; and there is little of wholesale trade, particularly in commercial crops, in these fairs—The Central Cotton Committee's recent investigations have revealed that the financial handicaps of growers were far too exaggerated and there is not much of combination of moneylending and trading. But the tracts selected were not all typical and the Committee itself could not accept all the conclusions—holding of produce for better price by the producers is not uncommon in the case of food grains and it is of doubtful utility in the case of commercial crops—Madras has more of agriculturist moneylenders who are not extortionate nor insist on sale of produce of debtors to themselves—The commission shop-keepers in trade centres are increasingly approached by the ryots for advances and though there

[1] A paper read at the Indian Economic Conference, Allahabad, December 1929.

is an undertaking that produce shall be delivered after harvest, there is no stipulation for sale at less than market price. The rates of interest are fair; sale is commonly by auction. Profits are derived by a large turnover, and to some extent by certain market practices detrimental to the interest of growers. But the 'tied' farmers fare no worse than free farmers.—The cartmen-traders still move a large part of the produce from villages and some of them distribute funds, lent by commission-shopkeepers, at higher rates to producers or on condition of the sale of produce by the latter at concession rates to themselves—Increase in the number of commission-shops, better communication between town and country and competition of the larger number of petty dealers tend to mitigate the hardships of all but the backward cultivators—Forward contracts are more common between big firms, exporting or manufacturing, and big bazaar dealers; but neither of these ordinary finance the cultivators directly or indirectly—Other serious handicaps to co-operative or any orderly marketing merit our attention as well as any lack of organised and easy credit.

IT is a common belief with co-operators and other well-wishers of agriculturists that in respect of marketing their produce, the latter are exploited by the merchant-moneylender. The Bania in the North and the Komati in the South are likened to the 'Gombeen-man' of Ireland, who is said to have combined in himself the three functions of money-lending, purchasing produce and vending some of the agricultural and domestic requirements of the cultivators. An attempt is made in this paper to examine the widely held view that the purchaser or his agent by making advances prior to harvest binds or tempts the producer to deliver soon after harvest his produce at a rate profitable to himself but ruinous to the latter. Many of the following inferences are based on facts and opinions gathered in the course of an enquiry into conditions of marketing produce in several districts of the Madras Presidency

Importance of Weekly fairs.—Let us first note the diametrically opposite impression that is likely to be conveyed by the Reports of the Census in 1921, when special information was called for on the subject of rural markets all over India. From statements quoted from the Census Reports of several provinces,[1] one might be tempted to generalise as follows: Most of the trade in agricultural produce in India is carried on in the well-attended rural weekly fairs (known as *shandies* in Madras and *hats* in North India) held within intervals of 5 to 10 miles over most parts of the country. The petty producer himself goes to sell in the fair what he does not need (or cannot afford to store up) for his consumption. He sells to consumers and for cash; or if he sells to some extent to petty dealers, these are an itinerant class of people with

[1] Indian Census Report, 1921, pp. 259—263.

whom he can have no money dealings or any sort of 'forward contracts.' There is therefore little chance for exploitation of the producer by the money-lending trader.

While the existence of the net-work of weekly fairs should not be ignored in any study of agricultural marketing, it is possible to exaggerate their importance. They are, first of all, not so universal. They appear to be more common in the Southern and Eastern Provinces than in the Western and Northern. In Madras, shandies are far more important in the dry inland districts than in the deltaic rice growing districts. They are a recent introduction in many of the Telugu districts. In several places they are neither big nor important and are chiefly meant for vegetables, leaves, condiments and fruits. There is some local and retail trade in staple food-stuffs, but the whole sale trade in the latter and in commercial crops is outside the shandies, though some of them serve also as collecting centres for all kinds of produce. For they are the resort of the very poor ryots with small lots of produce and the large number of landless labourers who receive harvesting wages in kind and are ready to sell, or barter them for what they would fetch. In the case of groundnuts particularly it is possible for assiduous dealers seated in or near shandies to purchase a great proportion of the crop from wage-earners alone, as picking charges for groundnuts vary from 25 to 50 per cent of the crop.

It is not correct to hold that the weekly fairs attract only producers and consumers and that there is little scope for dealers. For even in the case of fresh produce like vegetables and fruits and leaves, in the shandies away from the producing centres, the sellers are seldom growers but are petty traders who collect in one shandy and sell in another and go the round of shandies in the neighbourhood in search of suppliers in one and buyers in another. This much however can be said of the shandy system that even where it is important it does not encourage any kind of a contract between producers and dealers in consideration of any payment of advances by the latter to the former.

The Cotton Committee Investigations.—We have recently a more authoritative refutation of the traditional notion of the dependence of the cotton cultivator on the trader-cum-moneylender, in the reports of 8 investigations organised by the Indian Central Cotton committee.[1] According to these reports, abuses connected with financing prevail to a much smaller extent than imagined. Taking all the 8 tracts together, sowcars lend 65 per cent., landlords 15 per cent., co-operative societies 13 per cent., gin owners 1·6 per cent., and petty merchants and traders only ·2 per cent. of the amounts borrowed by growers. The borrowings though substantial are not excessive. The rates of interest are not high except in Sind. There is a justifiable preference for sale in the village itself, and the growers are right in shunning the market for its

[1] General Report of Eight Investigations into the Finance and Marketing of cultivators' Cotton.

malpractices. Above all 'the cultivators except in Sind are not hampered by their borrowings in the disposal of their produce, either as regards the persons to whom or the time at which they may sell' though they seem to feel a 'moral obligation' to sell to their lenders. The producers are able to, and do, hold cotton for considerable periods in expectation of higher prices. When they sell early, it is not due to financial pressure but to fear of falling prices and of loss by fire.

While Sind is the most unfortunate, Madras (N. & W.) seems to be the most favoured tract. The percentage of loans from sowcars is the least here—only 27·6 per cent., while landlords lend 56·8 per cent., gin-owners 10 per cent., and petty traders 3·8 per cent. Rates of interest are the lowest; 84 per cent. of the loans carry less than 12 per cent. interest; 24 per cent. of the loans are charged less than 9¾ per cent. No wonder the field for co-operative credit is narrow. No interest is charged on advances given on cotton stored in commission shops though in other tracts 9 to 12 per cent. is charged. Again, the village prices are fair, sometimes even better than rates current in the market, due to the anxiety of the village-traders to fulfil their forward contracts within stipulated time. Only 4 per cent. of the borrowers gave even a verbal undertaking to sell to the lenders who happened to be gin-owners.

This picture appears indeed too good to be true! This tract (N. & W.) in Madras is not typical of the Presidency. The average holding is 36 acre of land capable of growing cotton, *jowar* and groundnut in all but drought years, and 74 per cent. of the growers have more than 15 acres each.[1] Even as regards the other tracts, the Committee itself seems to discount the value of the reports in the prefatory statement and to explain away the apparent prosperity of growers by the unbroken series of good seasons they have had. It is averred that the rates of interest are nominal and that they do not reveal the total of the levies made by the money-lender who is often the agent of the bigger buyer who is the real financier. Attention is drawn to the state of co-operative credit as indicative of the low credit-worthiness of cultivators. Further enquiries may modify the optimistic inferences drawn in the reports, though there must be a large element of truth in them.

Holding produce for better price.—In the case of food grains, it is not all the produce that comes up for sale in the market, early or late. A good deal is stored up for consumption by all but the poor, though latterly a craving for finer stuff coming from a distance (e.g., craving for the Circars Rice in the Tamil Districts) tempts the disposal of all the crop. There is a disinclination, so far as the surplus is concerned, to wait for a rise in price as it involves risks of loss, especially if account is taken of the dryage, wastage, and interest for the period of waiting. There is always a rise in price, but not always

[1] Report on the Financing and Marketing of Cotton in Madras (Northerns and Westerns tract).—p 7.

enough to guarantee against such losses. But affluent landlords are prepared to take risks and even buy up the produce of the smaller ryots to whom they might have advanced money and so are in a position to dictate terms to petty purchasers. The Imperial Bank has been for some time past offering facilities to producers as well as traders to take loans on pledge of produce. So far traders have availed themselves of them more than producers who have been partly hindered by lack of proper godowns and partly by considerations of false prestige. This prejudice is breaking down, and godowns are also coming into vogue even outside the taluk headquarters and market centres. We may look to an expansion of this line of business in co-operative and other joint stock bank as well.

There is no question of holding perishable crops; nor is any attempt made to preserve and store the surplus, for future gradual sale. Growers are except in certain seasons at the mercy of purchasers.

In the case of commercial (export or money) copra like *copra* and groundnut and turmeric and jaggery, it is not the practice to hold produce for later sale; for many of the crops undergo rapid deterioration, or lose in bulk and weight; the fluctuations in prices are even greater than in the case of food grains and the demand by shippers in certain tracts ceases after the season. Buyers from outside who assemble for the season disperse and competition goes down to the detriment of growers. Special storage facilities and preservation and care are beyond the capacity of most producers who are unorganised.

Agriculturist money-lenders.—A striking feature of money-lending in the Madras Presidency (noted by Sir F. Nicholson and the late Mr. S. R. Ayyangar and recently by the Cotton Committee investigators) is the practice of the smaller ryots to borrow from their bigger fellows who do not charge unconscionably higher rates of interest unlike the money-lenders in other parts of India belonging to a different class and creed and often to an alien tract. There is no insistence or the sale of produce to the lenders, though the latter might keep a watchful eye on the sale, with a view to recover their dues. Few lenders are so unfair as to compel sale to themselves if a good offer is made by an outsider trader; and often the latter pays the local lender and has the produce sold to himself. The same thing happens in the case of tenants who have agreed to pay cash rents and received advances from landlords for cultivation. There is, no doubt hurried sale, but it is not peculiar to the crops of borrowers.

Cartmen-Traders.—The most ubiquitous of traders in rural areas are the persons who own (or hire) carts and pairs of bullocks and invest a little of their own, and more of borrowed, capital in business. They are of various grades and not all of them advance loans to producers. There are recent recruits to the trade from among ryots themselves. Growers unable or unwilling to go to markets themselves entrust the cartman-trader with the

sale of the produce, and receive the sale proceeds minus commission and cart hire when the trader returns. The traders with a larger working capital, either their own or borrowed from commission shop-keepers in market centres, buy outright the produce in the village and pay down the entire price before they remove the produce. Some are able to lend before the harvest, and a few early in the cultivation season, in which case they charge interest, more in terms of produce than of cash. Conditions are stipulated, though seldom written agreements are drawn up, that produce shall be delivered at a little less than the ruling price for free produce. Interest often takes the shape of a definite additional quantity of produce for every rupee lent. This system is, however, more common in the case of commercial crops than in that of food grains. With regard to the latter, what are commonly known as advances are not for long periods but are given just after the harvest, when the price is settled, though the produce is left in charge of sellers and is taken delivery of after some weeks or a few months. They are more in the nature of earnest money than loans. There is no doubt scope for exploitation, but it is kept in check by the increasing competition among the dealers themselves, who are no longer confined to a hereditary caste of traders. The margins (at any rate openly claimed) are pulled down by the invasion of other classes.

Commission Mandis.—The commission shops or *Tharagu mandis* in market contres play an increasingly important part in the disposal of all kinds of produce, except perishables. A good deal of produce is still brought to these shops by the petty dealers; but they are attracting more and more the producers themselves in the villages in the neighbourhood and in good communication by road. The produce that is brought is quickly disposed of at these mandis to buyers for export or to merchants who stock and gradually distribute to retail sellers. The most common method of sale is by auction at which are present the buyers or their agents. If the highest price bid is not agreeable to the producer or dealer who brings the produce for sale, the produce can be held over for sale on a later day. An 'Advance' to the extent of three-fourths of the probable value of the produce held may be had from the mandiman. Only godown rent will have to be paid, and if the advance be not returned within a month, interest at 12 per cent. will be charged. Some charge interest even for a shorter period. When the sale is effected a commission varying with the produce and some other customary charges in the market will have to be paid.

The commission shop-keeper has to be a financier if he is to be a big dealer in produce. It is common for producers who are old customers to take advances earlier, generally just before the harvest. But more of the mandiman's money is in the hands of petty dealers who distribute it in small amounts to producers in the villages at rates ranging from 12 to 18 per cent. or stipulating for an additional quantity of produce. But the mandiman, when he lends to the producer directly, does not insist on sale

at less than market price but only wants the produce to be sold through him for commission. The rate of interest charged by the mandiman to old producer-customers as well as to dealers is 9 to 12 per cent, which is very reasonable in view of the rate he has himself to pay to his creditors, the Multani, Chetti or Brahman bankers or Hundi merchants, whose lending rates are slightly higher than the Imperial Bank's. But their readiness and elasticity in dealings account for their popularity while the rigidity of the Imperial and Joint Stock Banks repels them. The risks in lending to ryots and petty dealers on mere pro-notes and on personal security are not inconsiderable. They have also to extend short credit—for a week or so—to buyers. Producers who have had dealings with mandimen directly have little complaints against them. It is only when they do not fulfil their part of the contract—and for example divert their crops elsewhere—that trouble arises. Overdues are charged at 18 to 24 per cent. and with some justification too, as the shopkeeper has to earn all his profits by a quick and large turnover in a short season. There is no legal obligation on the part of the receiver of advances to sell his produce only to his creditor, but the 'moral obligation' is a natural and universal feeling.

Forward contracts with Firms.—Forward contract is the rule between big firms, exporting or manufacturing and big bazaar merchants who agree to buy for them and deliver a definite quantity and quality of produce at a given price and place and before a fixed date. The buyers are generally men of capital but they also borrow from big bankers. Sometimes they send their own men into the interior to purchase produce but more commonly depend on the commission shops, which extend credit to them for a week. The firms, exporting or manufacturing, with whom they have contracted do not ordinarily help them with any advances, while, on the other hand, they are required to make deposits. Cash advances by firms are as a rule discredited and are considered demoralising by reputed firms.[1] There is no need to finance when competition between buying agents is so great that there is a scramble for business with the big firm. But almost the entire value of the produce is sent soon after the railway or steamer receipt reaches the Head Office. The mandiman has to wait for a week or more to be paid. In exceptional cases money is advanced even by manufacturing firms of repute with a view to be sure of getting raw material for the mills. For example, Messrs. Parry & Co., used to finance cultivators of sugar-cane to feed the mills at Nellikuppam.

Exploitation of backward classes.—Even now in the Krishna and Godavari districts they advance through the *Dubash* amounts to 'agreemented dealers' who contract to deliver jaggery by a certain time and who in turn disburse the amounts to various tappers of palmyra trees on terms which are

[1] Indian Cotton Committee (1918) Evidence Sir Cl. Simpson (5467) & Royal Commission on Agriculture. Evidence Vol. X Steiner.

extortionate. There are in all tracts some depressed classes of producers who by their ignorance as well as their imprudence easily lend themselves to exploitation. The most notable instances in Madras are, besides the tappers mentioned above and in Tinnevelly, the Hill tribes of the Agency Tracts exploited by the Komatis; the Badagas of Nilgiris exploited by the Lubbai merchants; the pepper growers of Malabar exploited by Moplah traders. It is noteworthy that in all such cases the lenders are not of the same creed or caste as the borrowers.

Credit extended by Producers.—At the other extreme are cases of producers who not merely do not borrow from prospective buyers of their produce but also extend credit to them. Sale on credit of plantains in the Trichinopoly district to local agents of firms in Madras is quite normal. Money is received a week or more after, and sometimes long after the fruits are sold. Plantains being perishable, producers are in some slack seasons put to so much trouble and anxiety as regards disposal of their produce that even price is not always fixed before the sale to the local agent but depends upon what the latter and the Madras firms are pleased to pay.

Another curious practice in the City of Madras and even in the mofussal towns is for owners of buffaloes, whose milk is not so much in demand for domestic consumption as cow's milk but has to depend on the demand of the coffee hotels and tea clubs, to finance the keepers of such hotels and indeed help start such a concern on condition that the latter should purchase all the milk brought for sale. This help is given by the milkman, though he may himself be in deep debt to money-lenders for the purchase of his animals and their maintenance.

But the suffering is not all on one side. There are consumers in every place who are prepared to advance sums to milkmen for a steady supply of pure ghee and other milk products for domestic consumption, demanding no interest on the advance. The most common experience in such cases is that the producers, whose supply of such goods is usually below the commitments they make to one or more creditors, fall in arrears and are a source of vexation to lenders, with whose woes we may well sympathise.

Advances not sought but thrust.—It is not always the producers that seek advances. It is often the temptation of money dangled before them than their need that accounts for hasty sale. The binding nature of forward contracts which big dealers enter into with exporting or manufacturing firms impels them to assure themselves of a definite supply fairly in advance of due date. Millers of all kinds are anxious to purchase raw materials to keep their plants going for as long a time as possible in the year, and their agents scour the country with cash in the hands. Too many rice mills in Tanjore and Nellore districts and too many cotton gins in Guntur and Ceded Districts have brought about competition for produce and the temptation to sell it in advance at a fair price is irresistable.

It is not denied that there is exploitation where the opportunities are great. There are in every village petty-holders of land who can never make both ends meet and whom none but a missionary agency can perhaps rescue. Such ryots do come into the clutches of money-lenders—whether they are merchants or not. But though they constitute in number a large proportion of the ryot population, their surplus produce available for sale is not considerable especially in respect of food grains which occupy 5/7ths of the total area cultivated. It is not the reform of the marketing-credit system alone that is likely to redeem them.

'Tied' farmers fare no worse than free farmers.—As regards the average ryots, it cannot be asserted that credit is now got on ruinous terms and that from the trades-people. Wherever they have had access to the commission shops in market centres, they have had no lack of credit. The profits of commission shop-keepers are earned not so much by lending money as by attracting a large number of clients with a view to a large turnover. Though the brokerage is small the total profits swell, by the authorised and unauthorised indirect earnings by way of samples, deductions, over weights, cesses, etc. But in all these respects the 'tied' farmers seem to fare no worse than the free farmers; for the latter also submit themselves to all such customary outgoings. There is generally not much to choose between one commission shop-keeper and another, though the unscrupulous who rob the weak and the helpless are few. Even if the victims to the existing credit systems were to be relieved by the grant of co-operative credit, there would be other problems to solve before co-operative marketing can be successful and bring complete relief to producers. It is noteworthy that in the few well worked Loan and Sale societies in Madras, there is not so much demand for loan as for help in sale.

Other Handicaps to orderly marketing and co-operative sale.—To lay all the emphasis on the exploitation of the money-lending merchant, which is not proved, is to distract our attention from the other serious handicaps to co-operative sale, or any kind of 'orderly marketing' among which may be mentioned (apart from the difficulties of management) the following: the lack of transport facilities which inconveniences all but those who have specialised in surmounting the difficulties and therefore captured the trade, the chaos of weights and measures which is the curse of the country-side but which is the *forte*, of the shrewed trader, the fear of a failing market and the lack of any agency to forecast in intelligible terms to the cultivators the trend of probable prices in world markets, the paucity of proper storage facilities in the villages and of warehouses in market centres on the basis of which bank credit will be easily forthcoming, and the absence of any desire on the part of the grower to achieve high quality and uniformity in production or to have the produce well graded before sale.

Above all the want of a fervent faith in joint enterprise on the part of many farmers and the members' readiness to deliver produce into alternative channels of trade account for meagre success. Without a guaranteed supply by the farmers of their surplus produce by means of a supply contract or otherwise, no co-operative sale can be built up; there cannot be enough margin to cover overhead expenses; nor sufficient basis for credit. There can be no regulation or 'smoothing out' of supply according to demand, which is the aim of all 'orderly marketing.' There can be neither the power for collective bargaining nor the power to resist competition by those established in the trade. Without the assurance of members' loyalty to society even in times of adversity, at least in the early stages, we shall be only playing with the idea of co-operative trade.

THE ECONOMIC ASPECT OF INSECT ASSOCIATIONS WITH SPECIAL REFERENCE TO SOUTH INDIAN COCCIDAE (SCALE INSECTS AND MEALY BUGS)

BY

T. V. RAMAKRISHNA AYYAR

The existence of such phenomena as parasitism, symbiosis, commensalism, cannibalism and other curious associations in the animal world is a fact well known to all biologists; but as far as the writer is aware such relations are nowhere found in such numbers and in such extraordinary and remarkable varieties as in the realm of insects.

'Those fleas that do us bite
Have other fleas that bite them,
And those in turn have others
Ad infinitum.'

This well known doggerel describes in a pithy way the web of life among insects. The significance of such mutual associations, the benefit or disadvantage of such affinities to the individuals concerned in their struggle for existence and their effect, if any, on other organisms in nature, and especially on man, are therefore problems of great interest and well worth the attention of not only the entomologist or zoologist, but also that of every biologist and even economist. Such a study forms an important aspect of that branch of biological science known as *Ecology*. Insects in their superior numerical strength, in their diverse varieties, in their easy dispersal and wide distribution, and in their remarkable relations to other forms of life, afford numerous interesting examples for the study of this branch of biological study in its multifarious aspects. Very little work appears to have been done in this line, at any rate, on insects in India. The writer has been trying to do something in this direction by a systematic study of the Coccidæ of South India, their relations with other forms of life and the economic importance, if any, of such associations; and this paper is designed to place on record the results of a preliminary study so far made.

General organisation and life history of Coccidæ.—Before coming to the main theme of the subject, *viz.*, the associates of Coccidæ, their inter-relations and the importance of those affinities, it may not be out of place to indicate very briefly the salient features in the general organisation and life history of the Coccidæ which might have a bearing on the subject of the paper. The insects included in the family Coccidæ belong to order of bugs (*Rhynchota*) and are closely allied to plant lice in various ways. The great majority of these are minute forms, the largest among them not exceeding 15 to 20 m.m. in length. The general morphological characters and the features in the life-history are more or less similar throughout the group. In all cases the insects secrete a covering for the body which may be of hard chitin, soft wax, hard

resin or mealy matter, and with a few exceptions the greater part of their lives is spent in a stationary condition on the food plant, and for all outward appearance they resemble lifeless encrustations on the plant surface. A generation of coccids starts with the swarming of hundreds of fairly active larvæ or young ones out of the batch of eggs from under the mother scale; these which are almost microscopic in size and which possess all insect characters such as legs, feelers, eyes, etc., after restlessly wandering over the food plant for sometime, which may range from a few hours to three or four days, anchor themselves on the juicy parts of the plant by means of the needle-like feeding tube. Soon after fixation the larvæ cast their first moult and in that process lose their conspicuous legs and feelers; the characteristic scaly or mealy secretion now begins and the insect feeds and grows in this position. From this stage every female becomes fixed for life, but the male larva after a few days emerges out of its scale as a slow moving adult insect with all insect features and one pair of wings in most cases. These crawl over the female scales which are mature by this time and after fertilizing them die away. The fertilized females feed and grow very vigorously from this time onwards and in a few weeks the gravid female scales filled with eggs and covered with profuse secretion become conspicuous objects on the food plant; before the second generation of larvæ emerge the soft body of the female shrivels up and it dies under its scale. The morphology and life history briefly noted above are similar in almost all species of the group. In some cases no males have been discovered and reproduction has been found to take place by the process of 'agamogenesis' (the female producing young ones without the help of the male) as is often found in plant lice and a few other insects.

Coccid associates.—The small size of the Coccidæ, the structural degeneration they pass through in life, their practically stationary existence, their easy dispersal and wide distribution, the peculiarities in their life histories and their enormous powers of multiplication, all these evidently exert a considerable degree of influence on their ecological characters, and one important result is the tendency on the part of other forms of life to take advantage of one or more of these peculiarities in different ways and thus become very often unwelcome associates. In the case of the Coccidæ such associates are of different categories, though almost all of them belong to the class of insects. The more important of these forms may be divided into two main groups according to their habits, viz. *Predators* and *Parasites*.

Among the well known predators on the scales and mealy bugs are the beetles known popularly as the '*Ladybirds*', small and medium sized spherical creatures, the larvæ of which greedily devour eggs and larvæ of scale insects of different kinds. These beetles are very partial to soft scales and mealy bugs; the general appearance of some of these beetle larvæ is very similar to some mealy bugs and often the predator is mistaken for the victim. Of the

other predatory insects associating with scales and mealy bugs we have the *Chrysopas* or 'lace wings' belonging to the group *Neuroptera*; the larvæ of these pretty insects have formidable jaws with which they attack young scales and feed on them. Of occasional importance are some flies of the family *Syrphidæ* (Hoverflies), the wormlike maggots of which attack and feed on the eggs and larvæ of Coccidæ. Compared to the ladybirds, the relation of these lace wings and flymaggots to coccidæ may be regarded as of minor importance. Among other predators on coccidæ noted till now in South India are two or three species of *Lepidoptera*—one being a butterfly larva and the others the caterpillars of moths.[1] Among butterflies a species of Blues[2] is the only one known to the writer which has been found to seriously interfere with the economy of Coccids. The caterpillar, unlike others of the group which are phytophagous, lives in the midst of mealy bug colonies feeding on them and thus destroying them in numbers. The thickset fleshy larva covered with a white mealy coating slowly moving in the midst of a colony of mealy bugs forms an excellent example of insect camouflage. Its chrysalis found on the plant surface presents an appearance not unlike the face of a monkey in general contour, and is known as the '*monkey face pupa*'. This butterfly has been noted on two or three kinds of mealy bugs in Coimbatore. The moth caterpillars do not, like the butterfly, confine their attentions to mealy bugs alone, but are found in the company of other coccids also. Three or four species have been noted in India; of these the commonest one[3] in South India associates with some of the very common and destructive species of Coccidæ and acts as an important natural enemy of these. The caterpillar may be found in the midst of the scale colonies covered with a case or house made up of the empty scales of its victims cemented together; with this protection it moves about the scales colony devouring the victims one after the other until it pupates, fixing itself under the covering on the plant surface. Another moth[4] was found as a predator on a new species of giant coccid *Aspidoproctus xyliæ* which the writer discovered on rain trees in Coimbatore in 1924. The caterpillar of this insect weaves a silken band around the scales thereby preventing all the embryos emerging out and then feeds on these creatures inside the scale. Sometimes 2 or 3 caterpillars are found inside each scale. Some notes on the bionomics of these Coccid-feeding lepidoptera are recorded in a paper[5] read by the author at the Bombay Session of the Indian Science Congress in 1926.

The Coccid associates of the other important category are the numerous 'Parasites'. Most of these are internal, passing their early stages inside the bodies of scale insects and their activities are therefore not so evident and easily understood as in the case of the many predators. The parasitic forms affecting Coccidæ are mostly Hymenopterous wasps of the family

[1] Belonging to the genera *Eublemma* and *Euzophera*.
[2] *Spalgius epius*.
[3] *Eublemma scitula*.
[4] *Euzophera cocciphaga H.*
[5] B. J. xxiii. 1929. pp. 668-675.

Chalcidæ, and many of them are very minute insects. It is often not easy to state whether a colony of Coccidæ is inhabited by parasites or not by a casual observation; for, in many cases until after the emergence of the adult parasite, hardly any external sign is visible. The usual indication of parasite infestation among scales is the presence of minute holes of emergence on the scales of the victims, and in some cases abnormal body swellings or colouration are also signs of the presence of an internal associate. In the case of parasitism it is also often found that more than one kind associate with a scale, and in such cases the interrelations between the different parasites on the one hand, and their connection with the Coccid on the other hand become problems which can be solved only after very careful observation on the bionomics of all the insects concerned. Examples are known where one parasite is not a direct associate of the coccid, but only a secondary relative—that is, it parasitises the original parasite of the coccid or it may be a parasite on a predator on the coccid host. Without a clear understanding of these interrelations, the economic aspect of such associations in an insect complex is liable to be misunderstood and cases are known where such mistaken ideas have been formed. Among a few such cases noted by the author in his studies of South Indian coccidæ one is worth mentioning, *viz.*, the author's discovery of a wasp parasitic on the predatory moth caterpillar. This wasp which was many years ago (1895) bred out from lac insects in Ceylon was considered to be a primary parasite of the lac coccid until the recent discovery of the fact that the wasp had nothing to do with the coccid but lived as a parasite on the predatory moth caterpillar. Some observations on the bionomics of this interesting insect[1] are given in the author's memoir[2] on the *Nim* scale.[3] Thus, in the study of Coccid associates those that are parasites demand a more careful and thorough investigation before we attempt to interpret their relationships, particularly their economic value. Among other parasites of minor importance are some small flies of different kinds, chiefly found on soft scales and mealy bugs. Besides parasites and predators coccidæ occasionally share the attentions of a few other insects, though not to such an extent as those of the former groups. Commonest among these are different kinds of ants; these visit coccid colonies for the honeydew which many soft scales and mealy bugs secrete in profusion. When the secretion is very abundant, as in the case of some destructive species and the honeydew often wets the foliage of the infested plants, swarms of bees and wasps of different kinds visit the Coccid colonies. Though such relations are only casual they also play their part in the economy of the scale insects concerned as is explained below. In the following table the associates so far known of South Indian Coccidæ are given, briefly indicating the status of each.

[1] *Aphrastobracon flavipennis*. Ash.
[2] Memoirs of the Department of Agriculture. Pusa. Ent. Series viii. 1925, pp. 127-155.
[3] *Pulvinaria maxima* Gr.

Insects associated with Coccidae in South India

Coccid	Predator	Parasite	Others
1. *Aspidiotus lanarindus* G.	*Chilocorus circumdatus*	*Comperiella* n. sp.	
2. *Mytilasis piperis* G.		A Eulophid chalcid	
3. *Chionaspis aspidistræ* S.			
4. *Chionaspis granuris* G.		*Adelencyrtus chionaspidis*	
		Aphelinus mytilaspidis	
5. *Pulvinaria psidii* G.	*Eublemma scitula*	*Encyrtus flavus*	
		Coccophagus sp. ?	
		Microterys kotinskyi, Full.	
6. *Pulvinaria maxima* G.	*do*	*Aphycus* n. sp.	
		Perissopterous n. sp.	
		Scymnus coccivora R.	*Aphrastobracon flavipennis* (wasp.)
7. *Ceroplastes ceriferus* A.	*do*	*Scutellista cyanea*	
8. *Inglisia cheloniodes* G.		An aphelenine chalcid	
9. *Ceroplastodes cajani* G.	*do*	*Chiloneurus* sp.	
		Metaphycus n. sp. and	
		Aniselus ceylonensis, How.	
10. *Lecanium nigrum* N.	*do*	*Anicetus ceylonensis*, How	
		Scutellista cyanea,	
		A new Genus and species of Encyrtus	
		Microterys kotinskyi, Full.	
		Encyrtus barbatus, Tumb.	
		Comys rufescens, *Coccophagus* sp.	
11. *Lecanium haemisphaerica* T.	*do*	*Coccophagus and Aphycus* sp.	*Cremastogaster* (ant.)
12. *Lecanium viride* G.	*Chilocorus nigritus* and *Chilocorus sexmaculata*		
13. *Lecanium discrepans* G.		*do*	
14. *Ananalococcus indicus* G.	*Eublemma scitula* R.	*Elasmus indicus*	*Aphrastobracon flavipennis* (wasp.) *Camponotus*, (ant.)
15. *Pseudococcus cibri* R.	*Spalgius epius*	*Tetracnemus* n. sp.	
16. *Phenacoccus insolitus* G.	*Scymnus coccivora* R.	A Eulophid chalcid	
17. *Phenacoccus iceryoides* G.	*Spalgius epius*	3 or 4 small chalcids	
18. *Tachardia lacca* K.	*Eublemma scitula*	*Gampsloneurus indicus* R.	*Aphrastobracon flavipennis* (wasp.)
19. *Aspidoproctus xylic* G.	*Encospherа coccidiphaga*		
20. *Iceryа Ægyptiaca* D.	*Scymnus coccivora*	2 small chalcids	

[*Note.* This study is still incomplete and the new forms are being described elsewhere.]

It is hardly necessary to add that the above list represents but a very small fraction of Coccid associates yet to be studied in South India; the author has only just touched the fringe of the subject and there is no doubt that as a result of further investigations a good deal more may be added to our present knowledge on the subject.

Significance and economic aspect of these relations.—We may now consider the significance, the effect on the individual forms concerned and the economic importance, if any, of these relations between Coccids and other organisms. While on the one hand these insects have the capacity to multiply rapidly and enormously and often cause serious and extensive damage to cultivated plants, on the other hand their practically fixed life, their small size and the absence of any appreciably defensive organs render it easy for other forms of life to associate with them and enjoy the benefits of such a relation. In some cases the coccid itself gains the advantage by getting dispersed and distributed by these agencies; this is very much facilitated in the case of the soft scales and mealy bugs which secrete the characteristic honeydew, often in abundance to attract numerous casual visitors like ants, bees, wasps, flies etc. During the brief sojourn that these make among the scale colonies to lick up the sweet fluid, many young coccid larva and eggs get attached to their bodies and are carried away to other trees and places. This is very commonly noted by the author in Coimbatore in the case of the *Nim* scale.[1] Ants play a very prominent part in this part particularly in its relations with mealy bugs. The common black ant[2] and the notorious arboreal red ant[3] are striking examples of cocciphilous ants in South India; the former often builds its nests at the foot of coccid-infested trees and this is commonly seen in connection with the *Babul* scale[4] on the Coimbatore farm.

While these casual visitors in most cases play a more or less friendly role, the influence of the predators and parasites on the economy of the coccids is far greater and much more important. In most cases they are Coccipha-gous—direct enemies of the scale. Whole colonies of young and soft bodied scales are wiped away in certain seasons by both predatory and parasitic enemies. The ladybird beetles are particularly important in this respect; they are effective against the young of the armoured scales and against the soft and freely moving forms also. Some of these ladybirds have been known to completely control many scales in the different parts of the world. In South India there exist a few beetles which play some part in this direction. As an effective predator on the *Nim* scale the writer discovered and noted the bionomics of a small brownish beetle which he has recently described.[5] Each grub of this beetle devours hundreds of the eggs and minute larvæ of the host and acts as an efficient natural enemy. The story of the parasites is similar in many cases. In certain seasons scale insect infestation is suddenly

[1] *Pulvinaria maxim* Gr. [2] *Camponotus.*
[3] *Occophylla.* [4] *Anamalococcus indicus* Gr.
[5] *Scymnus coccivora* R. (Journal of the Bombay Nat. Hist. Soc. xxx. 1925. p. 491.)

checked as if by magic and a close investigation often reveals it to be the remarkable work of minute parasites; this is occasionally found to be so in the case of the common black scale[1] almost a perennial pest on the Portia (*Thespesia populnea*) trees on the Coimbatore farm. All these are evidently provisions made by nature to keep such extraordinarily prolific insects under some control and help to keep up the natural balance of life in the world. The sudden outbreaks of scale pests, for the matter of that, of all pests during certain seasons and a lull in their activities during other seasons have to a great extent to be attributed to the effective or tardy influence of friends and foes, through other important factors like food and climatic conditions equally exert their influence in maintaining the necessary balance of life in nature. A proper study, therefore, of these interrelations and the different factors connected with man's welfare, will not only be valuable from a purely scientific and ecological point of view for the biologist, but it would also open up a vista of great economic value to the farmer and the economic entomologist. The economic importance consists in the correct understanding of various such relations and the proper utilisation of the knowledge gained by such investigations to the best advantage. Advantage has been and is being taken of the results of such studies in many countries at present. In many tropical and sub tropical regions it has been found by experience that the ordinary and time-honoured methods of insect pest control, such as spraying, dusting, fumigation etc., do not prove very effective in checking some of the worst pests like scale insects, fruit flies etc., and entomologists and agricultural authorities in different parts of the world have nowadays begun to feel the need for the trial of the 'Biological methods of pest control' *viz.*, the encouragement of the existing natural enemies of pests and if necessary the introduction of beneficial forms from other places to combat a local pest. It may be interesting to note that the pioneer attempt in this line was directed to check a notorious Coccid pest—the cottony cushion or Fluted scale.[2] This pest was causing terrible havoc in the Citrus orchards of California in the early eighties and was found to withstand all artificial methods of control. In 1889 a United States Department officer Mr. Koeble succeeded in finding in Australia, the native home of the pest, an effective enemy—the '*Vedalia*' ladybird and introduced it into California. The experiment proved a remarkable success and since then a similar line of pest control began to be studied in almost every country where this pest gained entry. This notorious insect got itself distributed into many parts of the world like Spain, Italy, South Africa and even Ceylon and began to assert itself, but did not somehow or other enter India and was considered one of the many undesirable foreign insect pests as may be seen from the author's paper[3] 'On some foreign insect pests which we do not want in India.' But unfortunately it has recently gained admission into the country

[1] *Lecanium nigrum*, N. [2] *Icerya purchasi*, M.
[3] *Agricultural Journal of India.* xiv. 1919. p. 500–511.

and was first noted on the Nilgiris in the spring of 1928, on some Australian wattles. It is not known exactly how and when it came in. The insect began to cause some appreciable damage and the Madras Government has recently introduced the '*Vedalia*' beetle [1] from California and the result of the experiment is keenly watched. It will be interesting to note side by side with this account of the introduction of the predatory beetle to check a scale, the recent introduction into India of a new Coccid in the interests of man. With the object of destroying the 'prickly pear' which is a bad pest in different parts of South India—a species of *Cochineal* insect [2] has been recently introduced into parts of the Tinnevelly District. During a recent trip to Tinnevelly the writer found the newly introduced scale insect spreading rapidly and destroying the prickly pear weed appreciably. These two are just two of the many examples to show the economic importance of a study of the bionomics of the Coccidæ in the various aspects, food habits, associates etc. It must, however, be emphasised, again that in all such cases where it is intended to utilise the knowledge so gained of coccid associates for the good of man it is very essential that the following points should be accurately and thoroughly investigated before any attempts are made to take advantage of such relations.

i. The complete life history of the coccid in all its aspects.

ii. A thorough study of the associates of coccids in the same manner; in this study a proper investigation of the interrelations between the various associates themselves is of equal importance—such as the connection between parasites, co-parasites, hyperparasites etc. This aspect is of the utmost importance in any attempt to introduce an extraneous organism; for, an unknown predator or parasite of the beneficial immigrant itself may gain entry without our knowledge and in some cases the new arrival itself may prove an undesirable one and unexpectedly become a pest in its adopted home. In such cases the remedy, unfortunately, will be worse than the disease.

This shows that all such investigations should be done carefully and thoroughly and the results applied for economic use only after sufficient and satisfactory trials.

The author has tried to deal with this subject only in a preliminary way and that only in relation to one group of organisms viz. Coccidæ. He will feel sufficiently repaid if the notes contained in this paper serve in any way to stimulate others working on insects to bestow a little more of their attention to the bionomics and ecological relations of insects—an aspect of Entomology—on which depend a great deal the future possibilities and success of the economic entomologist. As explained above the study is not only of absorbing interest to the pure scientist, but is pregnant with economic possibilities.

[1] *Vedalia cardinalis*, M.
[2] *Dactylopius tomentosus*, L.

STUDIES IN THE COST OF PRODUCTION OF CROPS

III

Name of Crop: Paddy. Area: 2½ Acres.
Village: Seshanchavadi.
Locality: Salem Taluk (Salem District).

General notes. The ryot in question is a farmer with some capital and has engaged permanent labourers under him on monthly wages. He farmed his lands himself with his own cattle. Besides ploughing operations he engaged his cattle for irrigation, as the lands were garden lands, and the irrigation had to be done wholly from the well. For a period of about three weeks the mhotes were not worked on account of rains. During the remaining period, the mhotes were constantly at work. In carting green manure, weeding and harvesting operations, the farmer had to employ outside labour. The area cultivated was 2½ acres under the well, and the local paddy variety *Sadai Samba*, was transplanted. The permanent labourers were paid only small amounts ranging from Rs 3-8-0 to Rs 7. In the case of cattle labour, the charges of feeding cattle were high, as they were fed with groundnut-cake or cotton-seed besides bran. The cattle were better than those maintained by smaller ryots in the village. The three pairs of cattle cost in all about Rs 400.

Economic planting was adopted.

Seed was sown in seed-bed on the 5th August 1928. The seedlings were transplanted when they were 40 days old. Harvesting was done on the 22nd of January 1929.

Details of Cultivation and charges

Particulars of Work	Men @ 8 as.	Women @ 4 as.	Pairs @ 8 as.	Amount	
				Rs A P	
Preparatory Cultivation					
Ploughing the land for 1½ months	45		45	22 8 0	
Total ...	45		45	22 8 0	
Seeds and Sowing					
Ploughing seed bed, irrigating	12	...	12	6 0 0	Own cattle used
Manuring seed beds with leaves	...	...	3	1 8 0	
24 bundles @ 2 annas per bundle	...	...	...	3 0 0	
Cost of seed—30 *vallams*—at 5¾ lbs. per *vallam*	...	...	...	10 0 0	
Pulling seedlings and transplanting	6 @ 6 as.	36	...	11 4 0	
Total ...	18	36	15	31 12 0	
Manures and Manuring					
Cost of 280 bundles at 2 annas per bundle on contract ...	...	...	...	35 0 0	
Trampling leaves	15 @ 4 as.	21	...	9 0 0	
Total ...	15	21	...	44 0 0	
After cultivation					
Weeding	18 @ 2⅔	54 @ 3 as.	...	13 2 0	
Total ...	18	54	...	13 2 0	
Irrigation					
Irrigating by mhote—for about 3 months leaving about 3 weeks of rainy days—at 2 pairs per day on an average ...	150	...	150	112 8 0	At 10 as. per pair including men
Charges for 3 mhote buckets, tail ropes, and mhote ropes ...	...	...	...	30 0 0	
Wages of chucklers, carpenter, etc.	...	...	...	3 0 0	
Total ...	150	...	150	145 8 0	
Harvesting (contract work)					
Harvesting, bundling, threshing. 1¼ *khandayam* of paddy given as wages at Rs 12 per *khandayam* of 225 lbs. ...	...	...	...	15 0 0	
Stacking straw—after cattle threshing	6	8	6	4 8 0	
Total ...	6	8	6	19 8 0	
Assessment	...	...	...	7 13 0	
Interest on the investment of cattle Rs 400 @ 12% for 6 months.	...	. .	...	24 0 0	
Interest on the capital expended	...	...	...	6 0 0	
Mhote ropes, manure leaves, etc., say on Rs 100 @ 12% for 6 months	...	...	...	20 0 0	
Depreciation	...	...	...	1 5 0	
Total ...	...	...	...	59 2 0	
Grand Total ...	...	...	...	335 8 0	

Cost of Produce and Profit

	Per Plot	Per Acre
Yield of paddy		
Grain	8,550 lbs.	3,420 lbs.
Straw	7,500 „	3,000 „
Value of produce	Rs A P	Rs A P
Grain at Rs 12 per *khandayam* of 225 lbs.	456 0 0	182 8 0
Straw—7,500 lbs. at 100 lbs. per Rupee ...	75 0 0	30 0 0
Total ...	531 0 0	212 8 0
Total value per acre ...		212 8 0
Less expenses per acre ...		134 5 0
Baiance, profit ...		78 3 0

VIRUS DISEASES OF PLANTS [1, 2]

BY

Dr. LESLIE C. COLEMAN, M.A., PH.D.

Director of Agriculture in Mysore

Plant Pathology or the study of plant diseases is, in a sense, one of the most modern of the applied sciences. So modern is it that it is still largely in the leading strings of the mycologist and, in fact in India, the term mycology is considered as synonymous with plant pathology. This is to be regretted because many pathological conditions in plants are produced by agents other than fungi, so the terms mycology and mycologist do not rightly indicate the nature of the work and the training required by an investigator of plant diseases. The person who is a mycologist and nothing more is, in fact, very ill-equipped for a study of the problems connected with diseases affecting plants.

In no field of plant pathology is this more strikingly illustrated than in the field of virus diseases, for whatever may be the character of the primary cause or causes of these diseases they cannot be attributed to the action of fungi in any usual acceptation of that word.

The use of the term virus as applied to the diseases of both animals and plants is really a confession of our ignorance, for it can be defined but vaguely. A virus, as we understand it to-day, is an element or principle of unknown origin and character which is the agent for communicating infection or infectious diseases. As common examples, more or less familiar to all, may be cited the virus of smallpox, the virus of rabies, the virus of rinderpest and the virus of foot and mouth disease. In the case of none of these diseases has it been possible as yet to isolate any organism which can be multiplied in pure culture and can thereafter produce the disease when inoculated into a healthy animal.

As in the case of diseases in general so in the case of virus diseases, those attacking animals and more especially human beings have received much more extensive and concentrated attention than those attacking plants. Nevertheless in recent years the economic importance of the virus diseases of plants as well as their absorbing scientific interest has led to a steadily increased attention being paid to them. As an example at our very doors may be cited the 'Spike' disease of sandal which seriously threatens our most important source of forest revenue and which is at present under investigation by a considerable number of scientific workers in South India.

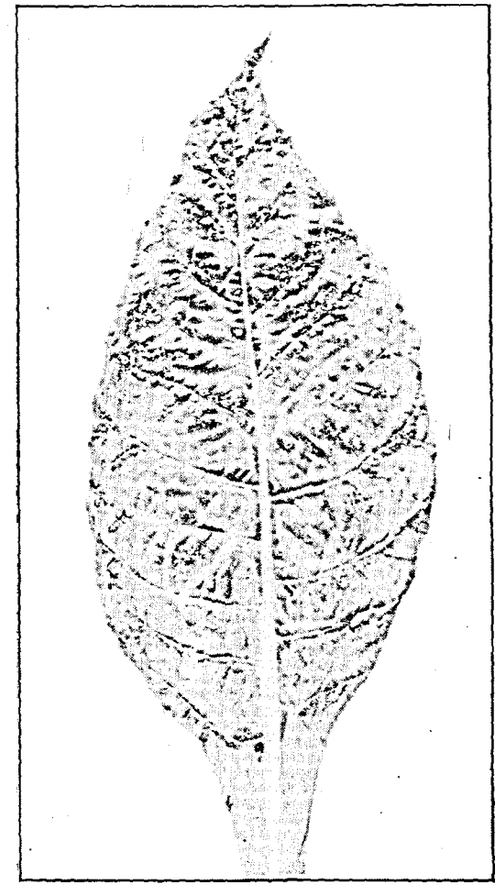
As the subject of my address to-night indicates, I shall not attempt more than a very general survey of the virus diseases of plants largely because my work is of such a character as to prevent my taking an active part in the investigation of any of these diseases. My reasons for dealing with the

[1] Address to the South Indian Science Association.
[2] The photographs reproduced in this paper are by the courtesy of *The Mysore Agricultural and Experimental Union.*

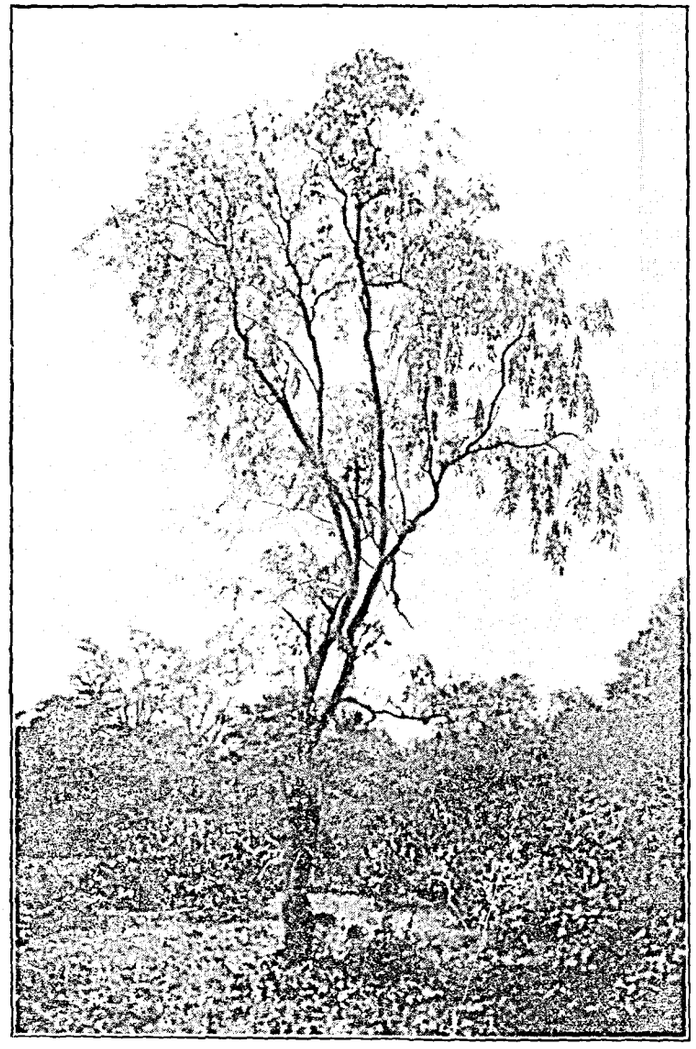
subject are three-fold. In the first place there is no doubt that the virus diseases of plants are continually levying an increasing toll in the agricultural and forest products of the world. In the second place there seems to be some connection between the virus diseases of plants and the more strikingly important diseases of human beings and domesticated animals; it seems, therefore, probable that continued investigation of the former may throw some light on the latter. The third reason is a personal one. While, as I have said, I have not myself in recent years contributed to our knowledge of these diseases—nor can I hope to do so in the near future—I have had opportunities of observing a goodly number of them in other parts of the world, such as have not been afforded to most workers in India. I should like further to preface my remarks by the statement that as I am a biologist, I shall confine myself to a consideration of the biological aspect of the question leaving a consideration of the bio-chemical and other aspects to those much better qualified than I in those fields.

The first virus disease of plants to attract scientific attention was the mosaic disease of tobacco and this may be used as a suitable starting point for our hurried survey of the field. This disease is present in all parts of the world where tobacco is grown including India though in this country it has not yet been studied. As the name indicates it is characterized by a mottled appearance of the leaves in which rather irregular areas of lighter green alternate with areas which show the darker green colour typical of healthy leaves. The lighter areas are at the same time somewhat thinner. Where the disease breaks out in a field it is almost always the younger leaves which show the symptoms. The disease is highly infectious in nature. In fact it can be transmitted by simply rubbing a diseased leaf between the fingers and thereafter rubbing the leaves of a healthy plant with the same fingers. The handling of tobacco in the field in the processes of topping and removing secondary shoots is considered in Sumatra to have been one of the regular means of spreading the disease. A microscopic study has revealed no fungus or bacterium which could be looked upon as the causal organism. The expressed juices are highly infectious even in very great dilutions (1 : 10,000). Even when this juice is filtered through a filter candle which prevents the passage of ordinary bacteria, it still remains infective. One of the most striking features of the infective principle is its resistance to drying out for long periods. I have personally transmitted the disease by grinding up dried diseased leaves, which have been kept in the herbarium for a year in distilled water and injecting the extract by means of a hypodermic syringe into healthy plants. Others have found such dried leaves infective after preservation in an herbarium for over twenty years.

The filterable nature of the virus is characteristic not only of this disease but of a large number of virus diseases of both plants and animals. However, that it is intimately associated with particles which are very large as compared with, for instance, a molecule of water is shown by the fact that filteration through the finer filters such as those made of celloidin leads to a filtrate which is no longer infective. An attempt has been made to measure the size of these particles by comparing their filterability with that of colloidal particles of which the size has been more or less accurately estimated. In this way Duggar and Karrer have come to the conclusion that the particles carrying the virus of tobacco mosaic are approximately of the same size as the colloidal particles of 1 per cent hæmoglobin or 30 millimicrons. Such particles



Tobacco mosaic showing mottled appearance of leaf having more light green areas than dark green ones. In addition, the leaf shows a peculiar crinkled appearance.



Sandal tree affected by spike disease. This type, showing a pendulous orientation of the affected branches, is met with occasionally.

are far below the limits of visibility with the most powerful microscopic magnifications. To give one an idea of the size of these particles relative to that of bacteria it may be stated that half a micron is about the lower limit for the diameter of known organisms such as micrococci. In other words these particles seem to have a volume not more than 1/4000 of that of our smallest bacteria. As a matter of fact, however, the method of judging size by ultrafiltration, is so beset by pitfalls, such as those associated with absorption and electric charge, that any estimates of size made by this method must be accepted with a great deal of reserve.

Another striking feature of the virus of tobacco mosaic in which it resembles many other plant and animal viruses is its marked resistance to disinfectants. Thus it can withstand concentrations of alcohol, thymol, corrosive sublimate and other disinfectants which are far in excess of that required to kill bacteria except when they are in the spore stage. These two characteristics of viruses, *viz.*, small size and great resistance to disinfectants, have been used as arguments against the supposition that we are here dealing with living organisms. As to size, no one knows what the lower limits of size for living organisms are; as to resistance to disinfectants, Olitsky has recently shown in his studies of Foot and Mouth disease that this resistance is not a real one but is due to the association of the virus with protein materials which serve as a protection, through their coagulability or their electric charge or both. Thus the virus was found highly resistant to such coagulating disinfectants as corrosive sublimate where as to such non-coagulating disinfectants as antiformin and sodium hydrate it was just as susceptible as living microorganisms such as staphylococci. It seems probable that the observed greater resistance of virus extracts in general to certain common disinfectants is not due to any greater resistance in the virus itself but to the protective action of the proteins from which it has in no case, up to the present, been separated.

For a long time it was considered that there was one and only one disease of tobacco included under the designation mosaic. Work of the past four or five years, however, has indicated that this is not the case, but that there are a large number of such diseases. One author claims, for instance, that tobacco is susceptible to no less than six distinct strains of mosaic virus. A Dutch scientist has quite recently discovered and described a new virus disease of tobacco in Sumatra distinct from the common mosaic. Similarly workers on mosaic of potato have reported as many as eight strains of mosaic virus on that plant. These strains are distinguished by the different symptoms they produce, their different reactions under varying temperature conditions and by the fact that in some cases the inoculation of a plant with two different strains has led to symptoms very different from those produced by either when used separately.

A very similar state of affairs has quite recently been found in the case of Foot and Mouth disease of cattle where these strains have been found. Here, the differentiation is on perhaps a surer basis, for Vallee and others have shown that an animal after being attacked by one type of Foot and Mouth disease and having acquired thereby the temporary immunity of about 4 weeks that results from attack, is immediately susceptible if inoculated with one of the other two virus strains. It is quite possible that this condition occurs in the case of other virus diseases as well. This is a possibility which we shall have to keep in view in our investigations of Sandal Spike.

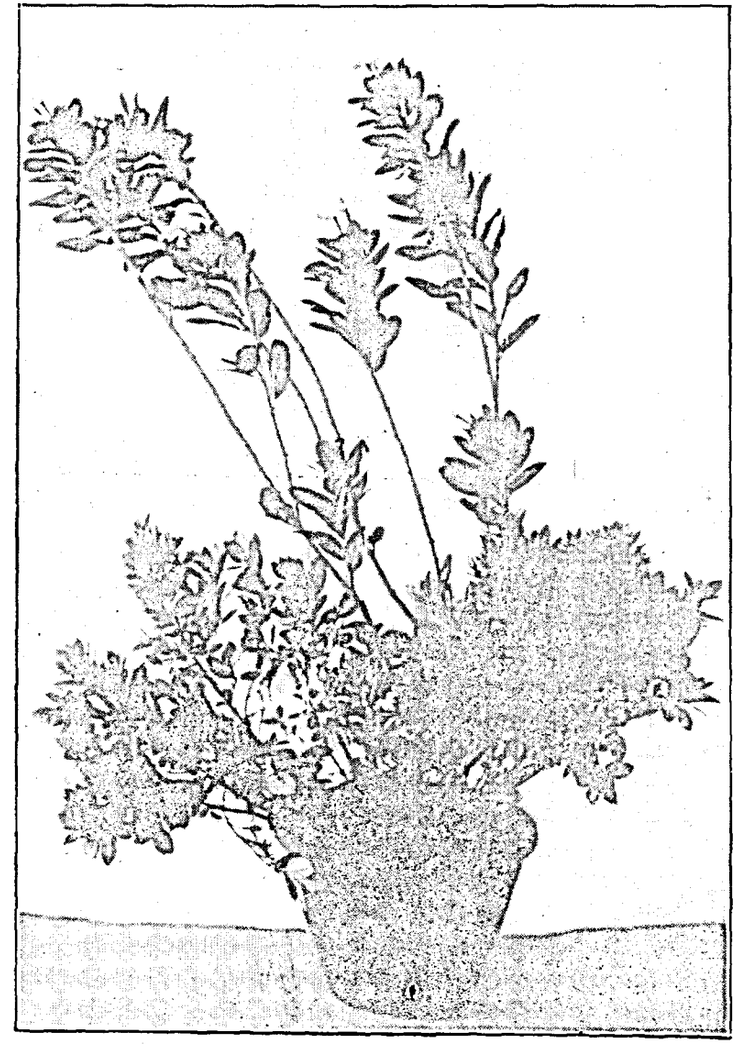
It must be clear that the method of disease transmission already described is one that does not usually occur in nature, for while in the case of mosaic diseases of economic plants transmission through the handling or rubbing by human hands or through the use of cultivating implements or pruning tools might be possible, this could hardly be a factor in the case of the mosaic diseases of wild plants. Investigators, therefore, very early sought for some other factor in disease transmission. The most natural place to look for such a factor was in the insect world and as a matter of fact, it was here that it has been found and among those insects which obtain their nourishment by sucking up the juices of plants such as mosquitoes suck the blood of human beings. In a very large number of the mosaic diseases transmission through sucking insects such as plant lice and leaf hoppers has been established and the insect vector has also been demonstrated in a number of other virus diseases as well. I shall refer to this later on.

Transmission of virus diseases through seed from diseased plants has been established in only a very few cases. It does not occur, for instance, in tobacco mosaic, nor does it apparently occur in the case of Sandal Spike. Transmission of disease through the soil has not yet been established in a single case, so I think we may take it that this sort of transmission must be rare indeed.

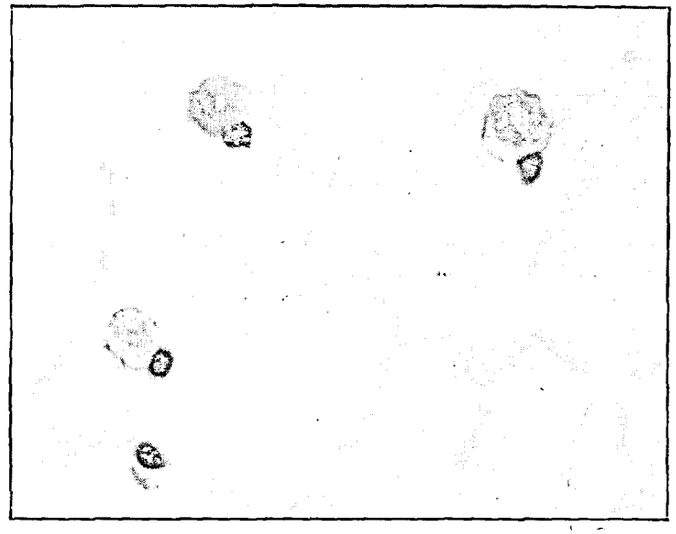
Lastly there are quite a number of virus diseases in which transmission has been brought about only through grafting a scion or bud from a diseased plant on to a healthy stock and as you are aware, Sandal Spike and a number of similar diseases found in South India belong to this group. We know, however, that these diseases spread in nature where no such grafting takes place. Therefore there must be some other means of transmission. It seems highly probable that insects are responsible in the case of these diseases also.

In respect of insect transmission, virus diseases of plants resemble many human and animal diseases such, for example, as plague and malaria. The question naturally arises whether the insect vectors are simply the carriers of these virus diseases or whether the virus must pass through a stage in the insect itself before it is able to infect a healthy plant, similar to the conditions we find in malaria.

One of the most interesting pieces of work on virus diseases of plants (that by Kunkel on Asters) throws a most interesting light on this very question. Kunkel found that the disease known as Aster Yellows which attacks the China Aster and a number of other plants is transmitted by a leaf hopper *Cicadula sexnotata*. He found further, however, that infection did not take place if an interval of less than ten days elapsed between the time when the insect fed on the diseased plant and the time when it fed on the healthy plant. In other words, an incubation period of ten days has to elapse before the Cicadula becomes infective. A similar but shorter incubation period has been established in the case of three other virus diseases: the curly top of sugar beet, the streak disease of Indian corn and the leaf roll disease of potatoes. One is almost tempted in these cases to draw an analogy with malaria and one can hardly escape the conclusion, in the case of Aster Yellows at least, that the virus does develop in the insect. The important experiments of Kunkel seem to me to furnish the most convincing evidence yet advanced that we are here dealing with a living organism. It is almost inconceivable to



Periwinkle (*Vinca rosea*, L.) showing the lower branches affected by spike disease, the top ones being apparently healthy.



Photomicrograph showing vacuolated intracellular bodies attached to the nuclei present in the cells of a spiked sandal leaf. Intracellular bodies are large, the nuclei smaller and dark coloured.

Photomicrograph showing the intracellular bodies in the cells of a spiked Vinca leaf. In the middle of the photograph one is shown attached to the dark coloured nucleus.

me that an unbalanced sap circulation or a plant enzyme out of control or a lethal gene escaped from the plant cell could propagate itself in the body of an insect. I need hardly point out that Kunkel's work greatly complicates the problem of insect transmission, for we shall have not only to seek out from among the large numbers of insects which are found on, for example, the sandal tree the one insect which is capable of transmitting the disease, a difficult job in itself; we shall also have to take into account the possibility that even that one insect may not be capable of transmitting the virus till the latter has passed through an incubation period of unknown duration in the insect's body.

While I must point out to you that the views of workers on virus diseases are very divided on the subject of the nature of the virus, there seems to me no escape from the conclusion that in a large number of these diseases at least the virus is a living organism. As I have already stated, in no case has any organism yet been observed which on inoculation could produce any one of these diseases. However, evidence is steadily accumulating in connection with virus plant diseases that certain definite structures are present in the cells of diseased plants which are not to be found in healthy ones. While there is as yet no valid evidence that these bodies are themselves the organisms of the virus (they seem much too large for that), there are workers who believe that they are either stages in an organism which has also an ultramicroscopic stage or that they hide within them the ultramicroscopic organism which causes the disease. To my mind the most important recent contribution to our knowledge of Sandal Spike has been the discovery by Mr. M. J. Narasimhan of the presence of intracellular bodies of this character in diseased sandal leaves as well as in the leaves of vinca suffering from a similar disease. Mr. Narasimhan has been good enough to allow me the use of some of his micro-photographs here.

I trust that the very hurried and imperfect survey which I have been able to present to you will convince you that we are here dealing with a subject of immense practical and scientific importance and that the investigation of our very important virus diseases of plants demands the very best in brains and investigating genius that this country can produce.

It would perhaps be going too far to speculate upon the possibility of coming, through a study of these diseases, to a knowledge of the most elemental forms of life existing on earth. Whatever the cause of these diseases may be, if it is a living organism it is one that cannot live by itself. It is, in other words, an obligate parasite whereas the most primitive forms of life must be organisms which can live free. There is also the possibility of our having to do here with organisms whose structure has been degraded and simplified through their parasitic mode of life. Who is to say, however, that there are not free living organisms to-day which are similar in their minuteness and their simplicity of structure to those which we believe to be the causes of virus diseases? If such exist, they stand very close to the line separating the animate from the inanimate world.

Before proceeding to the consideration of the lantern slides you may wish my views as to the lines of future work which are most likely to lead to practical results in the control of these diseases. Apparently they are in many, if not most, cases insect-borne and a control of their insect vectors must always be kept in view as a means of controlling the diseases themselves.

This, as you know, is the most effective means of controlling many of our insect-borne human and animal diseases. However, in the case of plants where the economic factor is much more prominent than in the case of human diseases, at least, I believe that our chief hope for the future lies in the discovery of, or the breeding of, resistant varieties. Much progress has already been made in this direction in connection with quite a number of the virus diseases of plants and while the breeding of a sandal strain resistant to spike will probably be very difficult, still it seems to me to be our chief hope for the future.—*The Journal of the Mysore Agricultural and Experimental Union.*

THE CINEMATOGRAPH IN AGRICULTURAL EDUCATION

A Leicestershire Experiment

BY

F. V. MILLINGTON

The Empire Marketing Board supplied lists of films applicable to agriculture and allied subjects, and arranged to provide most of the films free of charge. Amongst them the following were selected as most suitable for the experiment:

Commercial Potato Growing (British)
Co-operative Marketing of Eggs (Canadian).
Aspects of Modern British Poultry Farming (British).
Soil Physics (Canadian).
The Life of a Plant.

No difficulty was experienced in obtaining other films of interest and educational value, although those which dealt with home practice were not so readily available as films produced overseas.

Procedure.—The van commenced its itinerary in October 1928, and visited villages in which a suitable room could be obtained. The more modern elementary schools, with their movable screens, usually provided sufficient space for seating accommodation and the fireproof cabinet which enclosed the projecting apparatus. Schools or village halls in which electric lighting had been installed were used where possible.

In spite of the fact that a 'cold light' was used in the projector, the lamp being of the filament variety, the County Police Authorities required to be notified several days in advance of the display, and a permit was issued after the local police officer had reported as to the suitability of the premises. The permit required that proper gangways should be provided, exit doors readily accessible and labelled, and sand, water and blankets available for use in case of fire.

The van was drawn up outside the building and placed in a convenient position as near as possible to the room in which the films were displayed. A length of insulated cable was carried from the switchboard in the van to the projector inside the school, through the upper part of a window. The projector worked most satisfactorily, throwing a sharp flicker-free picture about 6 feet square, at about 40 to 50 feet distant. The faint 'ticking' of the mechanism was not sufficiently loud to inconvenience the lecturers. Lantern slides were also utilized, these being of use on the rare occasions when the cinematograph apparatus could not be employed.

Farmers, small-holders, poultry-keepers, and others interested in land or live stock were notified by letter or small handbill of the dates and times of the lectures to be delivered. Posters were also exhibited in the district. It was usually found convenient to remain at a centre for three or four nights, thus enabling the Agricultural Organizer, the Poultry Instructor, the Horticultural Instructor, or the Dairy Instructress to deliver lectures in their respective subjects.

Films Shown—At the first centre visited, Market Bosworth, an agriculturist district, the number of persons who attended on the three nights on which the lectures were given was over 400, the room being filled each night. The films shown at this centre were generally typical of those shown throughout the tour. They included the following:

Evolution of a Grain of Wheat.

Soil Physics.

Co-operative Marketing of Eggs.

The Life of a Plant.

The practice adopted throughout the tour was for the lecturer to outline the subject of the lecture and then to follow with a running commentary on the film as it was shown. After the film had ended, the lecturer proceeded with his remarks, and a period was devoted to questions.

The close interest with which the audience followed the films, and the questions asked at the close of the lecture, showed that this form of presentation of technical subjects was fully appreciated.

As the tour progressed other films were obtained, among the subjects dealt with being Bee-keeping, Sugar Beet, Clean Milk Production and Distribution, and the Rat Menace. Films of general interest were also displayed, these usually dealing with life in the Colonies, and including such subjects as forestry, cattle, sheep, and pig farming; and experimental farms in Ontario.

A particularly good film, 'The European Corn Borer', depicting the ravages of an insect pest in a maize crop, although of interest mainly as illustrating one of the difficulties experienced by American and Canadian farmers, was useful in comparing its similarity to pests found in our own country.

Films dealing with milk were in regular use. A film prepared for a firm of London milk retailers, showing the methods adopted in conveying of milk from the milking pail to the breakfast table, was greatly appreciated. This film had been admirably prepared, the captions were skilfully written and humorously illustrated by sketches. A long film loaned by the National Milk Publicity Council was also shown, and was of value in describing the care

required in the production of 'Certified Milk'. Lantern slides supplied by the National Milk Publicity Council were also shown.

Two films prepared by the British Instructional Films, Ltd., 'Commercial Potato Growing' and 'Aspects of Modern British Poultry Farming', provided valuable material for the horticultural and poultry lecturers. These two films were especially useful as dealing with home practice.

The 'Commercial Potato Growing' film provided an elementary survey of salient points in successful potato growing, and illustrated the common methods employed by the average farmer. It demonstrated the following processes:

Riddling the crop for 'seed'; sprouting the 'seed'; examining the sprouts; opening the furrows; applying the various manures; planting 'seed' and cultivating the crop: lifting and preparing the crop for market. The treatment of blight and the regulations laid down regarding wart disease were also explained.

The poultry film pictured the details of hatching, rearing, housing, and feeding, and the basis for the economic nutrition of poultry for egg and flesh production.

The Canadian film on the Marketing of Eggs was displayed on several occasions. This film described how our Canadian friends have successfully surmounted the difficulties experienced in marketing their produce when long distances from centres of population; showed the proper methods of collecting, grading, and marketing; and emphasized the benefits of these to both producer and consumer.

The manufacture of Vegetable Margarine was dealt with by a film entitled 'From Tropics to Tea Table'. This described the various processes from the growth of the coco-nut to the packing and boxing of the finished article. This film called attention to the growth in the consumption of this substitute for butter and emphasized the nutritious materials, clean handling, and efficient organization used in its manufacture.

'The Rat Menace,' a film prepared for the Ministry of Agriculture, was shown during the tour and was also loaned for display at public cinemas. This film cannot fail to convince an audience of the heavy loss occasioned by the rat and the most effective methods to use in its destruction.

The film '*The Life of a Plant*' which was of the 'slow motion' type, portrayed the complete life history of the plant. The plant described was the common Nasturtium, the lecturer being able to demonstrate its similarity to the life cycle of agricultural and horticultural plants with greater accuracy than by verbal description alone. The germination and growth was shown at a speed of 20,000 times greater than the actual rate of development.

A film which caused marked interest was that which described the manufacture of Beet Sugar. The cultural operations in the growth of the beet were on a large scale, the whole film having been prepared in Canada. It was none the less interesting and instructive, especially to farmers who have grown this crop in recent years.

The film 'Soil Physics' is an Ontario Government Film. It describes a laboratory experiment in which the permeation of water through clay is contrasted with its permeation through sand. It explains why the addition of humus improves the water-carrying powers of both the clay and the sand, and it shows how, through surface cultivation, the supply of moisture is assured where it is required, that is, at the roots of the plants.

General—The experience gained from the experiment tends to show that there is a promising future for the cinematograph in the illustration of lectures on technical subjects. Other nations, and our own colonies, long ago realized the importance of this form of education, and it is, therefore, not surprising that the majority of the films available are made abroad.

The films of colonial agricultural life were excellent in quality, but were not in all cases suitable for comparison with the operations carried out with similar crops or stock on our own farms. There is a shortage of suitable home-produced films relating to agriculture, horticulture and poultry-keeping, for use on a projector of standard size, i.e., similar to the ordinary picture-house apparatus. There are, of course, projectors which use a smallar film, and these may be found more convenient for display to small audiences. The range of British films for these smaller projectors is probably more extensive, as they can be produced at less expense than the more ambitious foreign film prepared for use in public cinemas.

A most satisfactory feature of the tour was the appreciation shown by the people in the villages in purely agricultural districts. The attendance at the lectures given in villages of this character was always excellent. This is possibly to be explained by the villagers having few opportunities to see cinematograph films and that they were, therefore, attracted by the novelty of the occasion. The type of audience to which the films were shown was composed, at many centres, of persons who were not used to book-learning, and it was pleasing to note their keen attention to, and interest in, this new educational method. The tour extended from October, 1928 to February, 1929. The number of villages visited was eighteen, and films were shown on 58 nights. The time taken up each evening by the lecture and films was about 2½ hours. There was an aggregate attendance for the full period of the tour of 4,629 persons, or an average of nearly 80 at each lecture.

Many letters of appreciation were received, amongst them being a letter from the Leicestershire and Rutland Federation of Women's Institutes. The possibility of arranging similar tours each winter is being considered. If the work is again carried on, it is probable that a smaller type of projector will be adopted, permitting the use of smaller accumulators which may be charged up more conveniently and at less expense. The picture shown by the smaller type of apparatus is quite large enough for a school-room or village hall of normal size. The experiment was considered to be successful, and to have provided reliable evidence that the moving picture can supply a healthy mental imagery, which cannot fail to make a lasting impression. Further, the effect seems likely to be more permanent than that obtained by the ordinary methods, by which lectures are delivered without visual aid.

Similar work in the U.S.A. and France—It may not be out of place here to note that the United States Department of Agriculture support an Office of Motion Pictures. This office has produced over 200 films and distributed them widely throughout America. It favours distribution through

'circuits,' each having an agent who deals direct with the central office. In such circuits county agents, Department of Agriculture—field men, home demonstration agents, club leaders, and other extension workers are organized and films are sent from one to the other. The Department co-operates with State or—Federal Institutions in arranging these circuits, and in preparing the programmes of films which are to be sent through each area. Arrangements have also been made whereby individuals or organizations may buy prints of the Department's films at manufacturing cost. State Agricultural Colleges, extension organizations, public school systems, farmers' organizations, and boards of trade have in many cases formed their own libraries.

In France a large sum was set aside in 1923 for the use of the Ministry of Agriculture for the creation of a permanent Agricultural Cinema Commission to investigate new ways of using the cinema for the guidance of farmers. A central bureau was formed, under the direction of this Commission, for the production and distribution of agricultural films. This bureau has, since its foundation, formed a library of 237 different films illustrating modern practices in all branches of French farm work. The films are designed for practical instruction and, unlike many of the American films, are not popular descriptions of farming for lay audiences. The library of the central bureau contains several copies of the more useful films, and, altogether, some 2,500 reels. Thirty to forty of these are sent out daily to various parts of France, and as many as 15,000 loans have been arranged in the year. This represents 60,000 presentations of instructive agricultural films before farmers in a single year. The development of the use of the cinema in agricultural France is further evidenced by the fact that 60 of the agricultural schools and colleges and 500 local centres have been fitted with cinema projectors at the expense of the bureau.—*The Journal of the Ministry of Agriculture.*

PRACTICAL HINTS ON GRAPE CULTURE

BY

B. S. NIRODY

The cultivation of grapes in South India is not as extensive as it deserves to be, largely because it involves a little technique in pruning which, though simple, is beyond the comprehension of the ordinary *mali*, unless he is specially instructed in the art.

The varieties which are well-known for their quality in the northern latitudes are naturally unsuited for cultivation on the plains in this part of the country, but there are sufficiently hardy kinds which, if properly grown, give fairly good results under sub-tropical conditions at medium elevations, and to a lesser extent, are also successful at low elevations.

The varieties known as 'Aurangabad' and 'Krishnagiri' are the best suited for the low elevations including the plains down to sea level, but it is mainly at elevations above 1,000 feet and at stations a few miles away from the coast that they are the least exacting in their cultural requirements. With a little greater attention to accuracy in pruning, the varieties grown in the climate of the west can also be grown at elevations above 3,000 feet, and some of the best known American varieties such as the Concord and the Delaware, which are easily imported from Australia, are well worth growing at stations with a climate like that of Bangalore.

The secret of success with grapes is largely in the art of pruning, and the vines demand continual care in this respect. Neglect in any one season not only results in the failure of the crop during that season but leads to difficulties in pruning during the subsequent one or two seasons. Hence the necessity of knowing how to handle a grape vine from the time it is planted.

The grape vine is easily propagated by cuttings taken from the mature wood of the current season's growth at a time when the vine is resting or has become almost leafless during the winter. Each cutting should have two to three eyes or leaf buds on it. It should be cut at its lower end immediately below a node, and at the upper, immediately above a node. These cuttings are best put down in a pan filled with either pure river sand or a mixture of sand and leaf mould, and buried in this material in a slightly slanting position and preferably close to the sides of the pan, to the depth of about two-thirds of the length of the cutting and placed in a shady place. As soon as they have rooted (in about four weeks), they should be potted up singly in 4″—5″ pots in the ordinary compost for pot plants and well established in these pots before they are planted in the ground.

The holes for planting the vine should be fully 4′ × 4′ × 4′ and the soil from the pits thus prepared should be mixed with a liberal quantity of well rotted farm manure as is done for planting fruit trees. The newly planted vine should be given a firm stake to a height of 6 feet, and its further growth should be supported by means of a trellis or pergola of a horizontal or *pandal* type, which should be made of lath or bamboo. In the northern latitudes, the practice usually is to train the growing vine as close to the ground as possible, in order that the radiating heat from the soil may help to bring the crop to maturity in as short a period as possible. In a hot climate like ours, the vines should be trained about 6 feet or higher from the ground in order that the radiating heat may not prove excessive to the young growth and the fruit.

At the end of the first season's growth of a vine after planting a rooted cutting, the vine should be cut back to two eyes. If both these grow, the weaker shoot should be rubbed off after the stronger one is well established. The growth made at this stage should form the main trunk of the future vine, and pruning in subsequent seasons should consist of cutting back part of the new wood so as to throw all the vigour of the plant into the few buds that are saved. This is effected by one of two courses: Of all the many shoots that grew during the season immediately prior to the pruning, only two *strong*, healthy ones are retained and these too cut back to about eight eyes on each and all the other shoots are removed right to their base.

An alternative course is to save all the strong shoots of the current season's growth prior to pruning, and to cut these back to one or two eyes on each shoot. The vines should be liberally manured at this stage with fish guano or with superphosphate and watered liberally. The fruit clusters appear close to the base of the new shoots from the pruned vine, and usually on the under side of the trellis. At this stage, i.e., when the young fruit is rapidly growing

it is sometimes attacked with mildew and should be promptly sprayed with Bordeaux mixture.

The manuring should be done each time the vine is started for a new crop. About 1 lb. of potash, 2 of bone meal and 10 of oil cake should suffice for an average sized vine at each application.

When the main trunk gets old and the vine shows lack of vigour, it can be renovated by saving any strong new shoot from the base and retaining only half the usual wood on the old trunk for fruiting. In the subsequent year the new shoot can take the place of the old trunk and be treated as a newly planted vine.—*Madras Mail.*

PLANT AND SOIL RESEARCH

BY

SIR JOHN RUSSEL, F.R.S.

Opening the discussion on soil fertility and its control, Sir John Russell, F.R.S., defined a fertile soil as one which satisfies all the conditions of plant growth, adequately supplying plant nutrients, water, warmth, air for the roots, space for the roots, free from undesirable substances or harmful reaction. The supply of plant nutrients affects crop production in two ways. Other conditions being favourable the amount of plant growth is increased with increasing supply of nutrients up to a certain point. The relationship is not simple; it can be expressed by two factors, one being the minimal amount on the crop of the particular nutrient, and the other the supply of the nutrient already present in the unmanured soil. Some degree of proportionality between the various nutrients is necessary, but there is no evidence that the ratios are narrow. These relationships are much affected by the water supply. In general, nutrients are most effective when there is a good water supply, and the water is most effective when there is a good nutrient supply. A good water supply thus economises the nutrients, and conversely a good nutrient supply economises water. For fruit the relationships are somewhat different, fruiting and growth being in some ways antagonistic. These relationships are important in irrigation practice.

The second way in which nutrients affect the plant is to change its composition, habit of growth, and response to external conditions, including the attacks of insect and fungus pests. So long as the proportion between the different nutrients is such as to give a normal plant, variations in the total amounts have but little effect on composition or habit of growth; the individual plants may be larger or smaller, but the material of the plant is not much affected. As soon, however, as the proportion of any one element falls too low, certain characteristic effects are produced on the plant, which may profoundly alter its reaction to external conditions, and its chemical composition, and therefore its agricultural value.

In certain conditions any of the elements may thus be in deficiency. Considerable investigation has been made to discover the effects of these

deficiencies, and also their symptoms, so that the agricultural expert might be in a position to recognise them. Large excess of certain of the elements relative to the others also produces characteristic effects, which are being studied.

In humid regions deficiency of nitrogen relative to the other elements is common, the result of the ready solubility of the soil nitrates. This reduces the rate of growth and the total amount of growth, but otherwise has little effect on the composition or character of the plant. Nitrogen deficiency is closely linked with the organic matter content and the micro-biological activity of the soil. In the lecturer's experience it does not occur in dry regions.

Phosphate deficiency may arise anywhere, but especially on soils derived from rocks containing little or no animal remains. It reduces the root activity of plants and the tillering of cereals and brings about certain chemical changes profoundly affecting the quality of the produce. Phosphate starved grass is innutritious to animals inducing phosphate deficiency diseases which have been much studied by Theiler, du Toit, and Green in South Africa.

Iron deficiency is, perhaps, more common than is usually recognised. B. C. Aston first found it in certain New Zealand soils, and traced it to a persistent anaemia of cattle, from which they suffered greatly, and finally died. This was in a wet region on somewhat acid soil, sufficiently light to allow of ready leaching out of the iron from the surface layer. A similar disease is said to occur elsewhere in similar conditions, and may have the same cause. Unfortunately, no easily recognisable symptoms in the vegetation have been observed, but analysis of the ash at once reveals the deficiency of iron. A like deficiency may occur in dry regions; possibly some of the fertilising effect of sulphur in these conditions may arise from an effect on the iron compounds in the soil.

To manganese deficiency has been attributed a disease of oats, and to magnesium deficiency a chlorosis of tobacco.

Potassium deficiency is usually found only in relation to nitrogen excess. When the ratio of nitrogen to potassium becomes large, the plant is considerably altered; its leaves become very dark green, liable to die in discoloured patches, liable also to attack by certain fungi; the percentage of starch or sugar in the storage organs falls off, and the percentage of nitrogen compounds correspondingly increases. The grain of barley suffers in malting quality, the tubers of potatoes suffer in cooking quality, and the roots of sugar beet not only contain less sugar, but yield a more impure juice.

Calcium deficiency is in a different category, being closely linked up with the exchangeable bases in the soil, and with the whole body of its physical and chemical properties. It is most liable to occur in wet regions, where it results in an acid soil. It may occur in dry regions, however, especially where sodium chloride is present, and the sodium has displaced some of the calcium.

When this replacement has proceeded beyond a certain stage, the properties of the soil are drastically altered, making it unsuitable for many agricultural crops. This change is of great importance in irrigation areas, and it is an important factor in the evil effects of overwatering.

Mr. C. G. T. Morrison discussed some factors controlling soil fertility, dealing with:

variations in soil composition; the soil as a succession of changing horizons; change in horizon character with season; the content in exchangeable bases, and in degree of saturation of definite horizons varies through the year; the effect of loss of water upon the pH content of soil suspensions, and upon the exchangeable bases content of the soil; the possible effect of dehydration upon soil fertility.

In a paper on 'Physical factors and their control', Dr. B. A. Keen, Dr. W. G. Ogg, and Prof. N. M. Comber pointed out that the soil moisture is undoubtedly the most important physical factor in plant growth. Measures of control seek, as far as possible, to maintain it at its optimum value, which lies between the deleterious extremes of excess (waterlogging) and deficiency (drought). Methods of soil treatment to encourage rapid drainage of excess water are quite well understood, but there is still very considerable divergence of opinion as to how far it is possible, by appropriate methods of cultivation, to conserve soil moisture in regions of deficient rainfall. It is frequently stated that the preservation of a mulch of dried soil is an effective means of conserving from evaporation the water in the soil below the mulch. On the other hand, extensive work on the influence of moisture on crop production in the Great Plains area of America has led to the conclusion that the loss from a mulched surface is practically the same as from an unmulched one; the effect of cultivation is to prevent weed growth, and hence transpiration losses, and the mulch is, in fact, only incidental. The theory on which the supposed action of a mulch is based likens the soil to a mass of fine capillary tubes up which water can ascend from the free water table to the surface. The mulch is supposed to break these channels, and thus to prevent water in liquid form from rising higher than the bottom of the mulch. Work at Rothamsted and elsewhere has shown this idea to be incorrect, and has also demonstrated that the distance to which water can ascend above the free-water table is much less than that predicted by the laws of capillary rise.—*Tropical Agriculture.*

Extracts

PRESENT DAY METHODS OF APPRAISEMENT OF DRAFT ANIMALS

The most important improvement effected by modern animal husbandry consists in basing the selection of breeding animals upon the concept of output or yield. The determination of their capacities as a measure of their value implies the estimation of individual efficiency. This determination is relatively simple for the greater number of these capacities, and as regards the estimation of yield in milk, meat, wool etc., methods have already been adopted, the value of which is generally recognised, at least in principle, and which only need to be perfected in detail and made uniform in their practical application.

But this concept of output which dominates modern zootechnics ought also to govern the estimation of draft animals. The collective and individual capabilities of these animals, are, indeed, estimated by the aid of *trials of output* but, on the other hand, *correlations between the output and the external characteristics of the animals* are also sought for.

The appraisement of draft animals is therefore carried out in two ways to-day. (1) Theoretically, according to their external characteristics. (2) Experimentally, by the aid of trials of output.

I. Theoretical Appraisement

The most recent theoretical method of evaluation, known as the *static-mechanical* aims at determining the correlations between the anatomical structure of an animal and its capacity for work, so as to be able to estimate the latter from the former. The animal is regarded as a machine, in which the different parts are studied analytically.

It has been conjectured for some time, and it is now proved, that the different parts of an animal's body are constructed with a view to the part they have to play and constructed so well that an engineer, working in accordance with the principles of modern machanics, could not improve upon them. It is possible, to-day, to calculate mathematically the conformation of the different bones, muscles, etc., which will best answer their purpose, and the ideal values obtained in this way from the body approach these values more the better will the animal be adapted to its task.

But this method cannot be applied in an absolute manner because an animal's body forms a mechanical whole in which the different parts can relieve each other and complete each other's functions and this mechanical compensation does not allow of the consideration of each part separately. This is the most important and the most difficult point of the theoretical method of evaluation and thorough investigation is thus required before this method can be put into practice.

Besides mechanics, statics also play an important part in an animal's body Technically, statics serve, in the first place, to calculate the stability of a construction and the dimensions of which it admits and, above all, to determine the equilibrium between the internal and external forces acting upon the construction. On the contrary in an animal's body, statics are not limited to the calculation of the states of equilibrium but serve chiefly as a means of studying the latent internal forces, e.g., the force which a muscular fibre can produce or resist; the weight which a bone can support, etc.

These few observations on the static-mechanical method of appraisement show that it is still in the elementary stages, but that it already has a great scientific and practical importance on account of the new perspectives which it opens for the appraisement of draft animals. By this method it will be possible to eliminate the purely individual and subjective element from evaluation and to place it upon an exact mathematical basis.

II. Trials of output

The object of these trials is to determine as exactly as possible the value of an animal for a certain purpose and to express this value quantitatively. Their object is also to discover if and how an animal transmits these capacities to its offspring, in such a way as to be able to judge the value of the animal for breeding from the point of view of output.

The testing of the work output is difficult because this output assumes different forms which complicate the evaluation, and is the result of an irregular concurrence of different factors, depending, in their turn, upon a series of conditions which have no direct bearing upon the work capacity of the animal undergoing the test. In the end this output in work is dependent upon the traction power, the speed and the endurance of the animal.

The appraisement of the work output cannot, therefore, be limited to the simple evaluation of the work produced; the different factors contributing to this production and the different conditions in which it is obtained. must also be taken into account.

The organisation of output tests of draft animals has only just been begun. In spite of the interest of these tests, it has not yet been possible to establish uniform methods by which the animals can be correctly classed according to their work capacity. At the same time a greater assurance of the existence of uniform principles is beginning to emerge.

To-day tests of draft animals are concerned chiefly with endurance and draft force.

(1) *Test of endurance.*—This is relatively simple. A pair of animals pull a cart with a load proportional to their weight. A minimum speed is prescribed which will prevent the animals being overdriven but will give the opportunity for showing their paces. The endurance of the animals can be measured by the distance they are able to cover.

(2) *Test of draft force.*—It is necessary to distinguish the force exerted: (*a*) at the start—(*b*) immediately afterwards—(*c*) during the course.

The force shown at the beginning is measured with dynamometers, but this kind of test does not show the true draft force of the animal and is not very often employed.

The force exerted during the course is usually measured by means of COLLINS' waggon or with Prof. VISSER'S apparatus.

In order to move COLLINS' waggon, the team must exert considerable force owing to the weights which act as a drag upon the wheels and only liberate them when the animals have exerted a certain draft force. In determining these weights it is, of course, possible to modify the resistance of the waggon to the draft force. The waggon is only drawn for short distance (generally 8·4 m) during which the speed is measured. The inconvenience of this method lies in the fact that the draft force of the animals cannot always be calculated with certainty from the measurements shown by this apparatus.

Prof. Visser's apparatus (of Wageningen, Holland) is a species of capstan in which the resistance to the draft force is produced by a hydraulic brake. After each circuit made by the animal the force of the brake is augmented until the animal can no longer pull. The time taken in making the circuit is also noted and the output calculated from the figures obtained.

The tests of output completely eliminate from the appraisement any subjective element and the results obtained correspond mathematically to the actual work capacity. It must not, however, be forgotten that to this result many factors contribute which have no relation to the work capacity of the animal in the proper sense. Thus it has been established that the form of the harness, the personality of the driver, the surroundings and above all the training of the animal are of the greatest importance. Here abstract science once more enters the field; these causes of error can be eliminated only by an exact evaluation; on the other hand the results of tests of output provide valuable bases for the science. In this way the two methods of appraisement complete each other and together attain their common purpose: a selection of draft animals which will conduce to the augmentation of their output.—*International Review of Agriculture, August 8, 1929.*

THE GAZETTED OFFICERS' CONFERENCE

Mr. G. R. Hilson, Director of Agriculture, Madras convened at Coimbatore a conference of all the Gazetted Officers of the Department from the 27th to 30th January 1930 (both days inclusive). So far as we are aware this is the first instance that such a conference was held in which all the Gazetted Officers of the department were invited to participate. With the exception of Mr. R. W. Littlewood who was absent on military duty, every Gazetted officer of the department was present. Mr. Bhogappa Sastri, Special Duty Deputy Collector on Palm duty was also present by invitation.

Mr. Hilson in opening the conference, stated that his object in convening this meeting was (1) to impress upon every member of the department that he is a part of an organised whole and that members should not imagine that they belong exclusively to either teaching, or research or propaganda sections of the department; (2) to review the propaganda work done in the past and to discuss the directions in which improvements may be effected. He invited free expression of opinion from all the officers present as only then it would be possible to make a critical study of any problem or proposition and see it in its proper perspective. The agenda as given below was very comprehensive in regard to propaganda work.

AGENDA

1. *Agricultural Demonstrators.*
   (*a*) Jurisdiction. (*b*) Depot Exhibition rooms; Central depots under District Agricultural Officers with store clerks. (*c*) Permanent Depot Keepers,—kind of men and pay. (*d*) Training. (*e*) Reduction of office work.
2. *Maistries and Messengers.*
   (*a*) Their training. (*b*) Number required for each demonstrator.
3. *Fundamental items of propaganda.*
4. *Specific items of propaganda.*
   (*a*) Manurial programme crop by crop. (*b*) Methods of cultivation. (*c*) Strains—Procedure—Deputy Directors and Crop Specialists.
5. *Seed—increase of seed supply.*
   (*a*) Decision of Agricultural Advisory Committee. (*b*) Green manure seed. (*c*) Seed testing methods.
6. *Implements—Suitable types—Method for cheapening prices.*
7. *Demonstration areas and plots.*
8. *Pests—Diseases—Live Stock.*
9. *Exhibition Vans, Exhibitions, Lantern Lectures, Excursions, Conferences.*
10. *Publications—Revision of leaflets and bulletins.*
11. *Inclusion of cost of baling water in cultivation sheets.*
12. *Type design for District Agricultural Officers' offices.*
13. *Standard type of weighing machine or balance for depots.*
14. *Special die for sealing outfits and their supply.*
15. *Relief of audit work to circle officers.*

A detailed report of the findings of the Conference will be published as soon as the official report is made available.

The conference was an unqualified success from every point of view. It has enabled Research Officers and Propaganda Officers to understand and appreciate each other's difficulties in their respective spheres of work, to take stock of our present knowledge of the agricultural requirements of the country and to discuss future lines of work in all branches of the departmental activities. Above all, the conference has enabled the officers of the department to make new friendships, renew and strengthen old ones, and this is certainly of immense benefit to the department.

We congratulate Mr. Hilson on the success of the Conference which was largely due to his outstanding knowledge of the men and the working of the department and of the requirements of South Indian Agriculture.

NOTES AND COMMENTS

University Elections

We offer our congratulations to Dr. T. V. Ramakrishna Ayyar, and Rao Bahadur M. R. Ramaswami Sivan on their election to the Senate from the constituency of Registered Graduates and Mr. T. V. Rajagopala Acharya on his election to the same body from the Academic Council. We feel assured that with the wide experience they have in agricultural education in this Presidency the guardianship of agricultural interests in the university has fallen on worthy shoulders. Messrs. Ramakrishna Ayyar and Ramaswami Sivan are seeking election to the Syndicate from the Senate and our good wishes follow them.

The Origin of the Biblical Manna

A great divergence of opinion has existed among the scientists as to the true nature and origin of the manna, believed to have fallen from heaven to provide food for the Israelites in the Sinai desert during the Exodus from Egypt. It has sometimes been considered to be a desert lichen, while others have considered it to be a physiological secretion from plants of the genus Tamarix, or as its sap flowing from wounds caused by insects. In order to solve the problem, Drs. Bodenheimer and Theodor of the Hebrew University in Jerusalem led an expedition to the Sinai Peninsula in 1927 and visited some classical localities where manna had been recorded. They established beyond doubt that 'manna' was nothing but 'honeydew'—a well-known sweet secretion of Plant-lice (Aphigae) and scale-insects (Coccidæ). Two scale-insects—*Trabutina mannipara*, Ehrenb., occurring in the lowlands, and—*Najacoccus serpentinus*, var. *minor*, Green, found in the mountains, live on the plant—*Tamarix nilotica*, var. *mannifera*, Ehrenb., and give rise to the sweet secretion. In the dry desert climate of Sinai, the syrup-like fluid secretion crystallizes into whitish grains which cover the branches or fall to the ground underneath them and constitute the true manna of the Bible.

A chemical analysis of the manna demonstrated the presence of cane-sugar, glucose, fructose, and saccharose; pectines were also found, but there was no trace of proteins.—*Nature*, December 28, 1929.

N.B.—In Arabic speaking countries, such as Iraq, the word *Man* is well-known and applies to 'honeydew' secreted by plant-lice; and sometimes the term is also applied to the insects themselves. Thus certain plant-bugs causing similar secretion of honeydew on the date-palm are known popularly as *Man-al-Nakhl*, i.e., Plant-lice of the Date-palm (*Nakhl*). [Ed. M.A.J.]

Value of Phosphorus to Farm Animals

In a paper presented to the recent Pan-African Agricultural and Veterinary Conferences, Professor P. J. du Toit discusses the value of phosphorus in the cattle industry. He shows that large areas of parts of South Africa are markedly deficient in phosphorus and describes the work of Theiler and his

co-workers. The supply of phosphorus in the form of bone-meal in addition to preventing the disease lamsickte, accelerated the rate of growth, increased the milk yield of cows, reduced mortality, increased the number of calvings, the calves throve and kept condition. Bone-meal-fed mothers weighed almost as much as those that were not so fed, but at weaning those receiving bone-meal increased in weight to the extent of 16 per cent. The fertility of cows that had bone-meal was markedly more than the control cows. The effect of supplementing the ration with the lime and bone-meal or the growth of calves is under study at Coimbatore. The work so far confirms the observations made above and shows that calves fed on bone-meal grow better than those receiving no bone-meal and that the reaction to bone-meal feeding does not appear till after 4 months have elapsed.

Interval between two calvings of cows

J. Matson in an article in a recent issue of the Journal of Agricultural Science discussing the results of investigation on the effect on lactation of the interval between two calvings observes that in India it has been found that the most satisfactory interval is about a year for cows giving about 3180 lbs. of milk per annum. In the case of cows giving 5400 lbs. of milk per annum an interval of 420 days is necessary; less than 355 days is injurious. The interval should be considerably longer for the first lactations than for the subsequent ones.

Identification of cattle

G. H. Dacy in *Agricultura Zootecnia*, Vol. VIII of 1929 describes a new process for identifying cattle by means of nasal prints similar to the procedure employed by the police with human finger prints. The new process enables the identification of animals in large herds or in cases of dispute. The process of branding which is painful to the animal and injurious to the hide may be dispensed with.

Tractor trials

The Royal Agricultural Society of England and the Institute of Agricultural Engineering of the University of Oxford are organising trials of Agricultural Tractors of the World during the summer of this year. These consist of two parts: (1) Scientific and practical trials which are not open to the public but will last from 1st June to 1st September, (2) Demonstrations which are open to the public. These will be held from 16th to 19th September. The competition is open to machines of all countries without any restriction regarding weight or number of horse power and includes four classes: (*a*) Tractors for all uses. (*b*) Cable traction of agricultural machines. (*c*) Automobile machines for tilling the soil. (*d*) Special automobile machines capable of serving for field work other than those included in the previous classes.

Striga lutea or the Witch Weed

A notorious parasite upon cholam, Striga (called *Agni pundu* in Tamil) occurs all over the country and is one of the worst enemies of the ryot. In

seasons of excessive as well as low rainfall it makes its appearance in such large numbers that the host crop suffers considerably. During this season, on the Central Farm in Field No. 37, the cholam crop was very badly attacked by this parasite. It will be therefore very interesting to note what Mr. S. D. Timson writes regarding methods of control of this pest in the Rhodesia Agricultural Journal for November 1929. Striga is reported to do havoc on Maize crop in Rhodesia. Based on the researches of Saunders at the Potchefstroom School of Agriculture and on field observations in Rhodesia, the following methods are advocated in the article.

Control methods may be direct and indirect. Under *direct* methods are included the construction of storm water drains and contour ridging to prevent the seeds of the parasite from being washed into unaffected fields, burning of grass and rubbish on the field to destroy the seeds, destruction of the parasite by effective and timely hand-weeding and intercultivation before they begin to set seed, and trap cropping. 'Trap cropping implies the planting of a favourable host plant on land infested with witch weed in order to cause the germination of the parasite and then ploughing under the trap crop before any witch weed plant can flower and set seed.' It is reported that this trap cropping seems to be the most promising method of eradication and a reduction of 98 per cent of the infestation has been brought about in two years in many instances. Sudan Grass is recommended as a trap crop for Rhodesian conditions. It may not be very difficult to find such a suitable host plant among the grasses in South India. Trap cropping in three successive stages is recommended if the field is very badly affected. It is also suggested that a green manure crop like Sunn-Hemp may with advantage be mixed with the trap crop.

Under *indirect* methods, judicious rotation of crops, deep ploughing, application of suitable fertiliser to give vigour to the host crop, early sowing or planting, wide spacing of the crop, intercultivation with suitable cultivator having duck-foot points and spike harrowing over the young host crop to remove germinating parasites, are all effective methods easy of adoption.

Grass in solid form

In an article in the news edition of Industrial and Engineering chemistry the Norwegian chemist, Thomas Gram, describes a process in which he has worked out a drying process by means of which it is possible to produce a completely dry grass, which, in all respects, has the same qualities and the same nutritive value as fresh grass. It is an apparatus, originally developed for the drying and briquetting of peat, which has been adapted for use on grass. The grass is here obtained in the form of briquets. When being fed to cattle, the briquets are mixed with a little water, and this fodder is enjoyed by the animals as much as fresh grass. It has been proved by feeding experiments, that young, short-grown grass has a considerably higher nutritive value than older, long-grown grass. Thus one advantage of the invention is that the grass can be harvested and conserved in the most favourable stage of growth. Naturally, the number of crops per year can be increased correspondingly. The process has been worked out in England in collaboration with the Department of Agriculture of the University of Cambridge. Large quantities of grass briquets have been distributed among British farmers for testing, and their reports of the results of the practical feeding tests are very favourable. These experiments are to be continued in England. Patent licences have already been sold to several European countries.

A Further Merging of American Sugar Journals

From January 4, 1930, the familiar weekly Sugar Journal—*The Planter and Sugar Manufacturer*, and the monthly technical review '*Sugar*' with which it had amalgamated in October last, will have undergone a further merging and have appeared under the title **'Facts about Sugar** including **Sugar** and **the Planter and Sugar Manufacturer'**. The *Louisiana Planter* was started in 1888, *Sugar* in 1899, and *Facts about Sugar* in 1916 and the consolidation of these three important sugar journals within one cover and under one direction will serve, in the words of the Editor of the new publication, as an important landmark in the progress of journalism in the sugar industry. With no sacrifice of the features that have given each of these three journals its distinctive place, but with the hope of combining and preserving the best of their ideals, the Editor hopes to go forward to the task of building a journal of broader service to the industry. It is also stated that once a month the new weekly will appear in enlarged form to preserve the character and contents of *Sugar*.

GLEANINGS

Linseed Oil as an Adhesive for Bordeaux Mixture

Ever since the time that spraying against coffee and areca diseases was introduced by the Department in Mysore, experiments, alike in the laboratory and the field, were being conducted with the object of finding out a cheap and efficient adhesive for use with the spray mixture. The use of an adhesive is necessary owing to the advantage that it not only helps in the uniform spread of the mixture over the sprayed surface, but it prevents the mixture from being washed off by the heavy rains. If it were not for the use of an adhesive with the mixture, spraying work in the malnad before the monsoon, over large areas of coffee and areca would be much less efficient in its results. By using a good adhesive there is not only economy in the quantity of materials used in spraying but also necessarily of a good deal of time and labour.

Very successful results have been achieved hitherto by using lime caseinate as an adhesive.[1] This adhesive has been taken up by most of the areca garden owners and coffee planters and has practically displaced the resin-soda adhesive originally advocated by the Department.

Preliminary trials in the use of linseed oil as an adhesive in the spray mixtures were made during the monsoon season at Talaguppa. The oil was added at the rate of four fluid ounces to each pound of solid matter contained in the mixture. To 2[illegible] bordeaux containing 5 lbs. copper sulphate, 5 lbs. lime, 25 gallons of water, forty ounces of oil were added. The mixture was well

[1] Narasimhan, M. J.: 'Casein as an adhesive in Spraying against Areca Koleroga.' —*Journal of the Mysore Agricultural and Experimental Union*. Vol. V, No. 1.

stirred and sprayed on glass plates and, after drying, placed outside in the heavy rains. At the same time mixtures, to which only twenty ounces and ten ounces of oil were added, were sprayed on glass plates and subjected to the heavy rain.

After some time during which twenty-six inches of rainfall were recorded, the mixture was found to be adhering alright to the plates.

The following proportions were tried:

Bordeaux	*Oil added*	*Mixture on glass plate*
5.5.25	40 ounces	Intact.
5.5.25	20 ounces	Do
5.5.25	10 ounces	Do
5.5.25	20 ounces	Do
5.5.25	10 ounces	Do

Casein bordeaux and bordeaux without any adhesive were also used for comparison. When the oil was added to the mixture it was found that the excess oil floated to the surface. The quantity of linseed oil to be used has no bearing to the quantity of water used in the mixture, but it has a relation to the quantity of solids used. Preliminary trials of spraying on arecanuts and coffee leaves were found to be very promising. When compared to casein bordeaux, it was found that the linseed oil bordeaux was not so easily dislodged. Further experiments are under way to see how this mixture will work under field conditions.—*Journal of the Mysore Agricultural and Experimental Union.*

Note—Since the above was written, reports have been received that spraying with Linseed oil-bordeaux on areca trees in the malnad, and on coffee, has given promising results.

The following note by the Imperial Bureau of Animal Genetics, Edinburgh, occurs in the *Journal of the Ministry of Agriculture* for December 1929, on Voronoff's Rejuvenation treatment of farm animals:

'Stock-breeders who were interested in the Voronoff operation, will remember that the delegation which went out from this country to investigate Dr. Voronoff's own experiments in Algeria, reported that there was insufficient evidence to justify his claims. Since then two French veterinarians, Messrs. H. Velu and L. Balozet (Laboratoire de Recherches, Service de l'Elevage, Casablanca, Morocco), who also inspected Dr. Voronoff's work, have been repeating his experiments on sheep.

'Eleven pairs of young rams (first cross between Crau merino ewes and a Rambouillet merino ram) were chosen, the members of each pair being for the most part half-brothers, and were numbered by tattooing on the inside of the ear. Lot A were to be grafted by the Voronoff method, and Lot B to serve as "controls". The mean age of the two lots did not differ by more than three days, nor their weight by more than 108 grammes 1/300 of mean weight). Lot A received the testicular graft according to the Voronoff technique, and all survived the operation. They were kept in stalls for two or three days before and fifteen days after the operation, and were then placed with the flock, as were the "controls". Thus both A and B received precisely the same treatment, except that Lot A were grafted. Thereafter each animal in each lot was weighed once a month. During the first seven months Lot A showed a slightly greater increase in weight than Lot B, though in both there

was considerable individual variation. After those first seven months A drew and remained ahead of B in weight, but the mean difference was negligible. Similarly, there was no significant difference between the two lots in weight or quality of wool. The investigators therefore conclude—justly, in our opinion—that the successful results apparently achieved by Voronoff were really due to the fortuitous choice of superior animals, and that testicular grafting has no effect on weight or growth. For the purpose of studying whether the effects of the graft are inherited, the rams, both of A and B were each isolated with a ewe. At the time we received their report it was too early to expect any results from this part of the experiment; but, remembering the failure of all the many efforts to induce the inheritance of acquirement, it is scarcely, to be expected that the graft will be any more successful.'

Man as Balancer in the Balance of Nature

Ignorance of the laws of the Balance of Nature, is usually very costly, and not least when anything is done to disturb the Balance of Nature. However, Man, with increasing knowledge, is learning to adjust a balance which he has helped to disturb. Thus, to take a well-known instance, he has been able to cope with the Australian Fluted Scale-insect, (*Icerya purchasi*), which threatened at one time to put an end to the citrus trees in California. In 1888, Riley and his collaborators imported from Australia a ladybird beetle, (*Novius cardinalis*) which is the native enemy of the Scale, and in less than eighteen months the conquest of the pest was assured. The Fluted Scale-insect has been practically exterminated in California, and the United States has sent the effective Ladybird to other Scale-infected countries, such as South Africa and Egypt, with happy results. *In hoc signo laboremus.*—J. Arthur Thompson in the *Journal of the Ministry of Agriculture.*

The same ladybird is now being introduced into the Nilgiris to check an invasion of the same Scale-insect—*Icerya purchasi.* [Ed. M. A. J.]

Systematic blastomycosis of man

Toepel describes a fatal case of blastomycosis in a 37 year old man who died six months after pricking the left index finger with a thorn. The condition progressed by the direct route along the bones to the upper arm, thence by metastasis to the right lung, subsequently to the left lung, and eventually to the left kidney. Blastomycetes were found in the pus of the finger, in an abcess on the arm, and in the sputum.—*Review of Applied Mycology.*

Bud Mutation in Cotton

A form of *Gossypium arborcum*, Linn., known as Burma Laciniated, with extremely deeply laciniated leaves has been grown for several generations at the Cotton Research Station. The original plant appeared in a mixed lot of Asiatic cottons grown from seed brought by Dr. S. C. Harland from Mahlang, Burma. A graft from a plant of the second generation grown in Trinidad was planted in the greenhouse. Selfed seed from this graft was planted, and bred true in all obvious characters. In June 1929, the grafted plant gave rise

to a branch which has broad leaves. The leaf index (length of leaf ÷ length to sinus) of typical leaves is about 10 to 13. The leaf index of leaves on the mutant branch is about 2·0 to 2·2. This mutation has crossed at one step the boundary between G. arboreum and G. nanking which Leake has shown is due to a difference in a single gene. Since the arboreum (laciniated) type of leaf is dominant to the nanking type in Trinidad, and since Burma laciniated has been shown to breed true, it follows that the same mutation occurred in both homologous chromosomes. It would be of great interest to discover whether the two mutations occurred simultaneously or whether one followed the other. The first two leaves on the mutant branch are laciniated. The branch was cut off above the third leaf, and grafted on to a perennial stock. A shoot appeared at each of the three nodes, and an extra shoot appeared from a bud on the parent branch at the base of the mutant branch. This latter bore laciniated leaves. The shoots from all three nodes on the mutant branch had broad leaves. Clearly both mutations occurred below the first node on the mutant branch, and were either simultaneous, or followed one another during the formation of a single node which is only 2 m.m. long.—*Tropical Agriculture, Vol. VI. No. 10.*

Legislative and Administrative Measures in Brazil

An Ordinance, dated 26th May 1928, of the Brazilian Ministry of Agriculture, Industry and Commerce, prohibits the importation of coffee and coffee plants and seeds and plants of other species of *Rubiaceæ* from any country: and potato tubers from any country, unless accompanied by a certificate of origin and health vouching that the locality of origin is free from the diseases caused by *Synchytrium endobioticum* and *Spongospora subterranea*; until further notice the importation of potato tubers from Portugal and Spain is prohibited. Sugar-cane plants and cuttings may not be imported from any country without a certificate of freedom from Fiji-disease, while all species and varieties of citrus from Asia, Oceania, South Africa and the United States must be accompanied by a statement that the place of origin is free from *Pseudomonas Citri.—Review of Applied Mycology.*

Legislation against Sugar-cane 'mosaic' in Peru

The sugar-cane plantations in the Rimac and Carabayllo Valleys of Peru have been declared, by a Presidential Decree of 10th August 1928, to be infested by mosaic disease. The movement of cuttings from these areas to other parts of the Republic is therefore prohibited.—*Review of Applied Mycology.*

Killing weeds with Arsenical sprays

The following formula is given for arsenical weed-killer: Mix four lbs. of grey arsenic with 1 lb. of crushed solid caustic soda and slowly add enough water to make 4 gallons of solution; the mixture will spontaneously warm up almost to the boiling point. Instead of solid caustic use may be made of 4 pounds of washing soda which is dissolved in 3 gallons of water and heated in an iron pot to boiling; the 4 lbs. of arsenic are added and the solution kept boiling until all is dissolved, after which sufficient water is added to make four gallons. For use in spraying dilute one pint of this solution with four gallons of water. About 75 to 100 gallons of this dilute solution are required per acre. Succulent weeds are most easily destroyed in the early stages of their growth, the quantity and the number of sprayings depending on the nature of the weeds; in general, grasses are the most difficult to kill.

In preparing and using arsenic solutions great care should be taken not to inhale the vapours and fumes, and to avoid contact of the solution with the clothing. Before eating meals the hands should be carefully washed, and the operators should bathe frequently. The use of these weed-killers is rather dangerous and is justifiable only under exceptional circumstances.—*Facts about Sugar.*

Thrips as Carriers of Fig-decaying Organisms

The general consensus of opinion with regard to the endosepsis of figs, caused by *Fusarium moniliforme* (var.) *fici* is that no insects enter green, hard figs unless caprification is practised. In May 1928, the writer collected several thousand uncaprified, hard, green figs of the Calimyrna, Adriatic, Kadota, and Mission varieties from various parts of California. On microscopical examination over 20 per cent of the figs were found to be infested by *Thrips tabaci* and *Frankliniella* sp. (probably F. californica) the interiors of 200 figs showing evidence of insect invasion and of 10 apparently healthy ones, were cultured on nutrient media to determine their fungus flora. Each of the infested fruits yielded one or more of the following organisms: various species of bacteria, Rhizopus, Aspergillus, Penecillium, Fusarium, Verticillium Spicaria, Hormodendrum, and a number of yeasts, while the ten sound ones remained sterile.

These data show that green, hard figs entered by thrips become inoculated with organisms capable of producing decay and fermentation in the ripening fruit. The comparatively high percentage of green hard figs infested with thrips would appear to indicate that infection from this source alone suffices to cause heavy loss. Possibly also, the early inception of decay and fermentation in the infested fruit, giving rise to odours attracting *Carpophilus hemipterus* and *Drosophilia, ampilophilia* is partly responsible for the appearance of these insects in the orchards at the time when the figs are approaching maturity.

Parchment Paper as a Source of Mold Infection in Butter Areas of distinct mould growth may be produced on the surface of mould-free butter by infection with spores (e.g., of Penecillium and Aspergillus spp. and Oidium (Oospora lactis) brought into contact with the butter by contaminated parchment paper used for wrapping. Similar areas may also develop on the paper itself. Varying periods (up to several weeks) may elapse.

The Potato a Food and a Remedy

The potato is not only an excellent food, perhaps the best of all foods, but it is a remedy (according to Dr. J. H. Kellogg, in the *American Potato Journal*). It dissolves uric acid as well as chalk, and is therefore able to cure different forms of gout and rheumatism. . . . If you send your patient to an alkali spring, or if you give him plenty of potatoes, the result will be the same. But the potatoes are the cheaper.—*Agricultural Gazette of New South Wales.*

'Everything can always be done better than it is being done'—

Henry Ford.

QUERIES AND ANSWERS

I. *Ques.* Last season, sprouted paddy seedlings in my nursery were dislodged and otherwise washed away by heavy rain. Please let me know what can be done to prevent such a loss, when heavy rains are expected during the early stages of the seedlings in the nursery.

Ans. When heavy rains are expected, the nursery plots should be flooded and about one to two inches of water, according to the size of the seedlings, should be allowed to stagnate in the plots. After the rain is over the water may be allowed to run off. This impounded water covers the tender seedlings and prevents the force of the rain from coming into direct contact with them. Thus the seedlings are saved.

II. *Ques.* I wish to try a fine variety of paddy for my domestic consumption, on my lands at Sholavaram, irrigated by a tank. Which do you recommend ?

Ans. You may try G. E. B. 24 if your land is in good condition, otherwise you have to manure it heavily or else the yeild will be poor.

III. *Ques.* Is it preferable to penn my cattle on my paddy lands during the summer months, or to keep them in the stalls and cart the manure obtained to the fields before puddling is commenced ?

Ans. If you can carefully conserve all the dung and the urine of the cattle by adopting the loose-box system or a modification of the byre system in which you litter the floor to enable the urine to be absorbed and remove the same to the manure pit periodically, it is preferable to do so and cart the manure to the field shortly before puddling. But penning is preferable to the usual method of heaping up the dung alone and carting it. In penning, the urine is mostly absorbed by the soil and the dung, if spread out early in the morning, dries out quickly and loses nothing except its moisture.

'A man is but what he knoweth' —*Bacon.*

'Figures, *qua* figures, are of little value ; intelligent interpretation is called for to discern their instinct value'.—*Major C. Wheeler.*

'Industry is not unlike a table with four legs : labour, capital, invention, and management—each leg contributing towards the stability of the table top, —"Industry". If any one leg be missing so will the top suffer in proportion.'—*Major C. Wheeler.*

College News and Notes

The Gazetted Officers' Conference

A Conference of the Gazetted Officers of the Department was convened at the Agricultural College between the 27th and 30th January. With the exception of Mr. R. W. Littlewood who was unavoidably away on military duty, all the Gazetted Officers were present. It is understood that the Conference was summoned to discuss the present position of Demonstration work carried out by the Department and to devise ways and means of extending its scope.

Socials

The Gazetted Officer's Conference was the occasion for a number of social meets on the Colony. On Monday the 27th January, the Indian Officers' Association (Agricultural Branch) was 'At Home' to their brother officers from the districts. On Tuesday, the Gazetted Officers at Coimbatore were 'At Home' to their mofussil colleagues. On Wednesday the Council of the Madras Agricultural Students' Union entertained all the Gazetted Officers of the Department. Thursday saw a return party at which the mofussil officers entertained their local comrades.

The M. A. S. Union

The 'At Home' on Wednesday was followed by a Conference in the Freeman Hall where a free and frank discussion took place regarding the affairs of the Union. Rao Bahadur B. Viswanath, on behalf of the Union Council explained the present position of the Union and its journal and stated what steps were taken by the Working Committee and the Editorial Board to improve the journal. He made a fervent appeal to one and all present to do their very best to place the Union and its journal on a footing worthy of its best traditions and the prestige of the Department to which they all belong. Several officers who participated in the discussions expressed satisfaction at the recent improvements in the get-up of the journal and the punctuality in its publication. They suggested that there was still room for improvement and that District Officers acting as Honorary Correspondents should collaborate and actively co-operate with the headquarter staff in their effort to make the journal worthy of its name. There was general agreement about the suggestions made, and the Council Members on their part gave the assurance that they would spare no pains to produce a journal which would find general acceptance and expressed the hope that in view of the individual and collective assurance given by their mofussil colleagues regarding the supply of matter, enlistment of subscribers and popularisation of the journal, their task would be made easy.

On the 2nd February, the President and the Working Committee of the Union met the Director of Agriculture and discussed with him the present position of the Union and the Journal. Mr. Hilson expressed the opinion that the Union is a body which exists for good, but it should be made much more active and alive. The quality of some of the papers presented at the annual Conference and the discussions which followed them leave much room for improvement and that we should not rely entirely on the Conference for matter to be published in the journal and with this end in view the Union should be kept alive throughout the year. He expressed a desire to see the *Madras Agricultural Journal* as a live-business which educates the public and holds a lead on public opinion in this Presidency and for this purpose the Union can drew on all official sources of help. The Committee expressed gratitude for the official sympathy and support and on their part gave an assurance that every endeavour would be made to make the Union and its journal worthy of their avowed aims.

Officers' Club

The annual meeting for the election of office-bearers took place on the 27th January. The out-going Committee presented a report recording all-round progress and this was received with applause. Ballots for the election of President, Vice-President, Secretary and Assistant Secretary resulted in the election of Rao Sahib Y. Ramachandra Rao, and Messrs. G. N. Rangaswami Ayyangar, K. M. Thomas and R. Narasimhan respectively. The choice for the other members of the Committee fell on Messrs. C. Vijayaraghavan, V. T. Subbiah Mudaliar and M. A. Sankarier.

Visitors

Dr. K. L. Butterfield, President of the State College of Agriculture and Applied Sciences, Michigan, U.S.A., who is a specialist in rural problems and is now on a world tour to study rural conditions, paid a visit to the Agricultural College and Research Institute. During his short stay at Coimbatore, Dr. Butterfield delivered a public address on 'The Significance of the Rural People'.

Mr. Richie, Secretary of the Indian Central Cotton Committee visited Coimbatore early in February to discuss with the local specialists the question of manuring cotton and to formulate a manurial scheme.

Dr. J. Sen, Offg. Imperial Agricultural Chemist was on a short visit to Coimbatore to discuss problems of Agricultural Chemistry and to make a representative collection of Madras Soils.

Mr. A. P. Cliff, Deputy Director of Agriculture, Behar and Orissa was in Coimbatore for a week to acquaint himself with the work of the Madras Agricultural Department.

A contingent of 24 students belonging to the Natural History section of the Union Christian College, Alwaye, under their lecturer Mr. Narayanan Ayyar, visited the College and Research Institute, on a week-end excursion.

Association of the Upper Subordinate Officers

Under the auspices of the Association a meeting of all the officers connected with the Research Institute and the College was held on Saturday the 15th February in the Freeman Building, to discuss the Government Memorandum received by the Association regarding the substitution, partial or entire, of a contributory provident fund to which Government would contribute, or other alternative schemes for pensionary benefit. Mr. V. Muthuswami Ayyar who presided over the meeting, pointed out that the matter was of vital interest to all Government servants, and emphasised the fact that members should go into the details of the scheme with ability and insight and help in sending a most comprehensive and effective reply to the Government. The Secretary of the Association then explained the nature of the scheme and requested that all officers should think over the matter and give their considered opinion and the benefit of their experience, at an early date, so that the reply to the Government may be sent before the due date. A Sub-Committee of seven was then formed, three members from the Association and four others from members of other services. The Committee has been empowered to draft the reply to the Memorandum and submit it to another meeting before 10th March.

Students' Week-end trips

The Second Year students with the Vice-Principal camped at Palayakottai on the 24th and 25th January, to study the herd and pastures of the well known breeder, the Pattagar of Palayakottai. As usual they spent a very enjoyable time and most usefully too, studying the methods of breeding and rearing of the Kangayam Cattle under the most interesting natural conditions of the Kangayam tract. The students were shown the methods of feeding, selection of bulls and 'mulling'—local method of castration. They evinced keen interest in studying the methods of cultivation and upkeep of the wide stretches of pastures, grouping of the herd according to age, size, colour, etc., and also in learning how the Pattagar solved the problem of adequate fodder supply to his herd of over one-thousand animals.

The Final Year students proceeded to Bangalore on a two days' trip, on the 13th February with the Lecturer in Chemistry. They visited the Hebbal Farm, Indian Institute of Science, the Imperial Institute of Animal Husbandry and Dairying and the Lal-bagh Horticultural Gardens.

Games

Taking advantage of the visit of the Gazetted Officers, the Students' Club arranged a half-day cricket match on the 28th January in which the students of the College were pitted against the officers of the Department. The Officers' team was strengthened by the addition of Messrs. C. Ramaswami and M. Kanti Raj, though much disappointment was felt at the unavoidable absence of Messrs. Murari and Edmonds. The officers who had first tenancy of a perfect pitch scored 113 for 6 wickets when they cried halt and put the students in. Ramaswami treated the spectators to some delightful fireworks scoring as he did 44 runs of which 38 came in boundaries including a straight-field sixer. Others who contributed substantially to the score were Dutt and Venkatraman who made 24 (not out) and 23 (not out) respectively. The

students venturing out in their turn lost two wickets before the second decade, but the next pair made a determined stand, the side scoring 85 runs for the loss of only 4 wickets when stumps were drawn. Patnaik, their skipper, played aggressive cricket and made 29 runs while Sankarier who was more cautious made 28—both very creditable performances against some good bowling.

The tournaments for the 'Victory' and 'Parnell' cups elicited keen competition for the champion-ship honours. 'B. Sc. I qualified for the former by defeating B. Sc. III in foot-ball. The deciding match in foot-ball had to be played three times before B. Sc. I snatched a victory by the narrowest of margins. The Parnell Cup was annexed by B. Sc. III who had an exciting win over their serious rivals—B. Sc. I.—in the final game.

Ladies' Club Day

The first annual Club Day of the Agricultural College Ladies' Club was celebrated on Saturday the 15th of February 1930 in the presence of a large gathering of the ladies of the College. A few visitors from the town also participated in the function. The proceedings began at 4-30 p.m. with sports, which included such items as thread and needle race, musical chairs, breaking chatties and races for children. After tea which was served on a lavish scale there was a meeting at 6 p.m. presided over by Mrs. Rama Reddi, the Vice-President of the Club. After the presidential speech and the reading of the annual report by the Secretary, Mrs. Hilson kindly gave away the prizes to the winners in the various games and sports. This was followed by an entertainment at which several members displayed their talents in vocal and instrumental music. The items which included a farce 'The Sleeping Beauty' acted by some juvenile artistes of the Estate, merited repeated applause from the gathering. The pleasant function terminated at 8 p.m.

'The one says (in wisdom's words): They that eat of me shall yet be hungry. And the other says: They that drink of me shall yet be thirsty. And both alike continually enlarge our curiosity, and multiply our inlets to happiness'.—*Prof. D'Arcy Wentworth Thompson, C.B., F.R.S.*

'Play the game, and take no mean advantage of a Rival.'

College Library

The following is a list of books received in the Library of the Agricultural College, Coimbatore, during the year 1929.

Serial No.	Author's Name	Name of Book
1.	Achard, J.	... *Fragments Entomologiques, 1925.*
2.	Adams, R.	... *Organic Synthesis, Vol. VIII. 1928.*
3.	Adrian, E. D.	... *The Basis of Sensation, 1928.*
4.	Allee, W. C.	... *Synoptic Key to the Phyla, Classes and Orders of animals, 1923.*
5.	Allexander, J.	... *Colloid Chemistry-Theoretical and Applied, 1926.*
6.	Allen, A. H.	... *Commercial Organic Analysis, fifth edition, Vol. VI. by Saddler S. S. and others, 1928.*
7.	Do.	... *do. Vol. VII. 1929.*
8.	Anderson, F. G. H.	... *Facts and Fallacies about the Bombay Land Revenue System, 1929.*
9.	Armsy, H. P.	... *Nutrition of Farm Animals.*
10.	Bahl, K. N.	... *Indian Zoological Memoirs. No. 1, Pheretima, 1926.*
11.	Balfour Brown, F.	... *Insects, 1927.*
12.	Balls, W. L.	... *Studies of Quality in Cotton, 1928.*
13.	Barratt, O. W.	... *The Tropical Crops, 1928.*
14.	Bartholomew, J.	... *The Oxford Advanced Atlas, 1928.*
15.	Bayles, H. A. and Danbeny, R.	... *Synopsis of the Families and Genera of Nematoda, 1926.*
16.	Bennet, E. W.	... *Problems of Village Life.*
17.	Bhatia, B. L.	... *An Elementary Text book of Zoology, 1928.*
18.	Bond, J. R.	... *Farm Implements and Machinery, 1925.*
19.	Borel, E.	... *Space and Time, 1926.*
20.	Brayne, F. L.	... *Socrates in an Indian Village.*
21.	Do.	... *The Remaking of Village India. Second Edition, 1929.*
22.	Brooks, F. T.	... *Plant Diseases, 1926.*
23.	Brown, J. E.	... *British Journal Photographic Almanac, 1928.*
24.	Bugnion, E. Translated by Ogden, C. K.	... *The Origin of Instinct—a study of the war between Ants and Termites, 1927.*
25.	Carpenter, G. H.	... *The Biology of Insects, 1928.*
26.	Carpenter, K. E.	... *Life in Inland Waters, 1928.*
27.	Chapman, R. N.	... *Animal Ecology with special reference to Insects. Third Edition, 1926.*

Serial No.	Author's Name	Name of Book
28.	Clark, W. M.	... *The Determination of Hydrogen Ions, 1928.*
29.	Coatman, J.	... *India in 1927–28.*
30.	Cockerham, K. L.	... *A Manual for Spraying, 1923.*
31.	Coker, W. C.	... *The Saprolegniaceae, 1923.*
32.	Conn, H. J.	... *Manual of Methods for Pure culture study of Bacteria, 1926.*
33.	Cox, J. F. and Starr, G. E.	... *Seed Production and Marketing, 1927.*
34.	Craig, R. R.	... *Common Diseases of Farm Animals, 1927.*
35.	Cresson, E. T.	... *Types of Hymenoptera other than those of Cresson. American Entomological Society Memoir, No. 5–28.*
36.	Crooks, M.	... *Touch Typewriting for Teachers, 28.*
37.	Cryer, T. and Jardon, H. J.	*Text-book of Applied Mechanics. Tenth Edition.*
38.	Daniels, F.	... *Mathematical Preparation for Physical Chemistry, 1928.*
39.	Dane, E.	... *Wages and Labour Costs, 1927.*
40.	Darling, M. L.	... *Punjab Peasant in Prosperity and Debt. Second Edition, 1928.*
41.	Davidson, J. B.	... *Agricultural Engineering, 1926.*
42.	Davidson, H. C.	... *The Culture of Potato plants in Rooms, Greenhouses and Frames, 1926.*
43.	Donisthorpe, H. St. J. K.	... *The Guests of British Ants, their Habits and Life history, 1927.*
44.	Ealand, C. A.	... *The marvels of animal ingenuity, 1926.*
45.	East, E. M. and Watson, W. H.	... *A Report on the Sugarcane Mosaic situation in February, 1924 at Solidad, Cuba, 1925.*
46.	Elderton, W. P.	... *Frequency Curves and Correlation. Second Edition, 1927.*
47.	Elton, C.	... *Animal Ecology, 1927.*
48.	Fenby, T.	... *Handy Dictionary of English Synonyms.*
49.	Gates, R. R.	.. *The mutation factor in Evolution with particular reference to Oenothera, 1915.*
50.	Gauman, E. A.	... *Comparative Morphology of Fungi.*
51.	Ghare, B. K.	... *Manual of Dairy farming, 1928.*
52.	Goodrich, E. S.	... *Living Organisms, 1924.*
53.	Gowen, J. W.	... *Milk Secretion, 1924.*
54.	Do.	... *Manual of Dairy Cattle Breeding.*
55.	Gray, R.	... *Poultry Diseases and how to prevent or cure them, 1925.*
56.	Gregory, J. W.	... *The Elements of Economic Geology, 1927.*
57.	Grey, E. C.	... *Practical Chemistry by Micromethods, 1925.*
58.	Gwyne-Vaghan, H. C. and Barnes, B.	... *Structure and Development of the Fungi, 1927.*
59.	Haddon, A. C.	... *History of Anthropology, 1910.*
60.	Hadley, F. B.	... *Principles of Veterinary Science, 1924.*
61.	Haldom, J. B. S. and Huxley, J.	... *Animal Biology, 1927.*

Serial No.	Author's name	*Name of Book*
62.	Hall, A. D.	... *Fertilisers and Manures.*
63.	Handschein, E.	... *Praktische Einfutrung in diemosphologie der Insekten, 1928.*
64.	Hart, I. B.	... *The Great Physicist, 1927.*
65.	Hass, P. and Hill, T. G.	... *An Introduciton to the Chemistry of Plant Products, 1928. Vol. I.*
66.	Haupt, A. W.	... *Fundamentals of Biology, 1928.*
67.	Hawk, P. B. and Bergam, O.	... *Practical Physiological Chemistry, 9th edition, 1927.*
68.	Hemingway, F. R.	... *Madras Co-operative Manual, 1929.*
69.	Henderson, H. D.	... *Supply and Demand.*
70.	Henry, W. A. and Morrison, F. B.	... *Feeds and Feeding, 1928.*
71.	Heras, Rev. H.	... *The Aravidu Dynasty of Vijianagar, 1927.*
72.	Hogben, L. T.	... *Comparative Physiology, 1926.*
73.	Howard, A.	... *Crop Production in India, 1924.*
74.	Jackson, B. D.	... *A Glossary of Botanic Terms, 1928.*
75.	Johnstone, J.	... *The Mechanism of Life in Relation to Modern Physical Theory, 1921.*
76.	Kellner, O.	... *The scientific feeding of animals, 1926.*
77.	Kent and Jones, D. W.	... *Modern Cereal Chemistry, Revised edition, 1927.*
78.	Kesava Iyengar	... *Studies in Indian Rural Economics, 1927.*
79.	Kingzett, C. T.	... *Chemical Encyclopedia, fourth edition, 1928.*
80.	Kruyt, H. R. Trans. by Klooster, H. S.	... *Text book of Colloids, 1927.*
81.	Kyle, H. M.	... *The Biology of Fishes, 1926.*
82.	Leppan, H. D.	... *Agricultural Development of Arid and Semi-arid Regions, 1928.*
83.	Linton, R. G.	... *Animal Nutrition and Veterinary Dietetics, 1927.*
84.	Linton, R. G.	... *Veterinary Hygiene, 1921.*
85.	Lister, A.	... *A Monograph of the Mycetozoa, 1925.*
86.	Lord, L. J.	... *Practical Butter and Cheese making, 1925.*
87.	Lull, R. S.	... *Organic Evolution. 1927.*
88.	Lunge, G. and Keane, C. A.	... *Technical Methods of Chemical Analysis, Vol. II, 1928.*
89.	Mac-Bride, E. B.	... *Evolution, 1928.*
90.	Majumdar, G. P.	... *Vanaspathi-Plant and plant life as in Indian Treatises, 1927.*
91.	Martin, H.	... *The Scientific Principles of Plant Protection. 1928.*
92.	Mason, A. F.	... *Spraying, Dusting, and Fumigating of Plants, 1928.*
93.	MacDonald, W. F.	... *A Study of Weather Influences on Sugarcane Production in Lousiana, 1926.*
94.	Malcom, J.	... *Agricultural Surveying Including Mensuration, Road construction and Drainage, 1926.*

Serial No.	Author's name	Name of Book
95.	Mason, F.	... *Creation by Revolution, 1928.*
96.	Mathews, A. P.	... *Physiological Chemistry, fourth edition, 1927.*
97.	Mellor, J. W.	... *Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. VIII, 1928.*
98.	Mellor, J. W.	... *Do Volume IX, 1929.*
99.	Metcalf, C. L. and Flint, W. P.	... *Destruction and Useful Insects, 1928.*
100.	Meyrick, E.	... *Revised Hand book of British Lepidoptera 1927.*
101.	Miall, L. C.	... *History of Biology, 1910.*
102.	Mitchell, C. F. and Mitchell, G. A.	... *Building Construction, 1925.*
103.	Morton, J. W.	... *Practical Spraying, 1926.*
104.	Morton, R. A.	... *Radiation in Chemistry, 1928.*
105.	Mukharji, R.	... *Rural Economy in India, 1926.*
106.	Nadkarani, K. M.	... *The Indian Materia Medica, 1927.*
107.	Neblette, C. B.	... *Photography its Principles and Practice, 1928.*
108.	Needham, J. G. and Frost, S. W. and Tothhill, B. H.	... *Leaf Mining Insects, 1928.*
109.	Newman, H. H.	... *Outlines of General Zoology.*
110.	Newman, H. H.	... *Evolution of Genetics and Eugenics. Fourth Edition, 1929.*
111.	Nowell, W.	... *Diseases of Crop plants in the Lesser Antilles.*
112.	Nutting, W.	... *Photographic Art Secrets.*
113.	Parker, T. J. and Haswell	... *Text-book of Zoology. Vols. I. and II.*
114.	Partridge, W.	... *Dictionary of Bacteriological Equivalents.*
115.	Pearce, E. K.	... *Typical Flies, 1928.*
116.	Penlington, W. A. G.	... *Science of Dairying. Second Edition, 1927.*
117.	Picters, A. J.	... *Green manuring. Principles and Practice, 1927.*
118.	Prideaux, E. B. R.	... *Problems in Physical Chemistry. Second Edition revised, 1920.*
119.	Punnet, R. C.	... *Mendelism. Seventh Edition, 1927.*
120.	Raina, T. A.	... *The Co-operative Movement in India, 1928 Edition.*
121.	Ralband, E.	... *Home Animals Find Their Way About, 1928.*
122.	Raman, E.	... *The Evolution and Classification of soils, 1928.*
123.	Rangachari, K.	... *Elementary Botany for India, 1916.*
124.	Do	... *Hand-book of some South Indian Grasses, 1921.*
125.	Do	... *A Hand-book of Botany for India, 1925.*
126.	Reed, S.	... *The Indian Year-book, 1929.*
127.	Remington, J. S.	... *Seed Testing, 1928.*
128.	Rew, Sir H.	... *A Primer of Agricultural Economics, 1927.*
129.	Rogers, L. A.	... *Fundamentals of Dairy Science, 1928.*

Serial No.	Author's name	Name of Book
130.	Russel, E. J.	... *Plant Nutrition and Crop Production, 1926.*
131.	Rutnagar, S. M.	... *Bombay Industries. The Cotton Mills.*
132.	Sahasrabuddhe, D. L.	... *Agricultural Geology of India. Second Edition, 1929.*
133.	Schertz, F. M. and Merz, A. R.	... *Investigations on Chlorophyll. Methods and Results, 1928.*
134.	Schmidst, L. B. and Ross, E. D.	... *Readings in the Economic History of American Agriculture, 1925.*
135.	Scott, D. H.	... *Introduction to Structural Botany, Part II. Flowerless Plants. Ninth Edition, 1924.*
136.	Silvesthi, F.	... *Report of an Expedition to Africa in Search of Natural Enemies of Fruit flies, 1914.*
137.	Sinnot, E. W. and Dunn, L. C.	... *Principles of Genetics, 1925.*
138.	Smith, J. B.	... *Explanation of Terms used in Entomology, 1906.*
139.	Spoher, H. A.	... *Photosynthesis, 1926.*
140.	Sterling, T. S.	... *The Year-book of the Universities of the Empire, 1929.*
141.	Stewart, A. W.	... *Recent Advances in Organic Chemistry, Vols. I and II. Fifth Edition, 1927.*
142.	Stewart, R. M. and Jetman, A. K.	... *Teaching Agricultural Vocations, 1927.*
143.	Stone, A. A.	... *Farm Machinery, 1928.*
144.	Strasburgher, E.	... *Text-book of Botany, 1921.*
145.	Sutermester, E.	... *Casein and its Industrial—Applications, 1927.*
146.	Swingle, D. B.	... *A Text-book of Systematic Botany, 1928.*
147.	Tanssig, F. W.	... *Principles of Economics, Vols. I and II. Third Edition, 1927.*
148.	Tillayampalam, E. M.	... *Indian Zoological Memories No. 2. Scoliodon, 1928.*
149.	Thatcher, R. W.	... *Chemistry of Plant Life, 1921.*
150.	Thomas, E.	... *Economics of Small Holdings, 1927.*
151.	Thomson, J. A.	... *The Biology of Birds, 1923.*
152.	Tildale, C. W. and Woodnut, W. E.	... *Practical Cheese making, 1928.*
153.	Trelease Sam., F. and Eurma Seraputa Yule	... *Preparation of Scientific and Technical papers, 1927.*
154.	Vetch, R. and Simmonds, J. H.	... *Pests and Diseases of Queensland Fruits and Vegetables, 1929.*
155.	Waddington	... *Planting Directory of Southern India.*
156.	Waggaman, W. H. and Easterwood, H. W.	... *Phosphoric acid, Phosphates and Phosphatic Fertilisers, 1927.*
157.	Wadsworth	... *Standard Methods of Milk Analysis. Fifth Edition, 1928.*

Serial No.	Author's name	Name of Book
158.	Waksman, S. A. and Davidson, A. E.	... *Enzymes Properties, Distribution, Methods and Appliances, 1926.*
159.	Websters	... *New International Dictionary. 2 Vols.*
160.	Weiser, H. B.	... *Colloid Symposium Monograph. Vol. V. Colloid Chemistry, 1928.*
161.	Wheeler, W. M.	... *The Social Insects, 1928.*
162.	Whistler, H.	... *Popular Hand book of Indian Birds, 1928.*
163.	Whitemore, F. C.	... *Organic Synthesis. Vol. VII. 1927.*
164.	Wilkins, H. T.	... *Marvels of Modern Mechanics. Second Edition, 1928.*
165.	Wood, R. C.	... *Note-book of Agricultural Facts and Figures. Fourth Edition, 1928.*
166.	Wood, T. B.	... *Animal Nutrition. Second Edition, 1927.*
167.	Woodruff, L. L.	... *Foundations of Biology. Third Edition, 1927.*
168.	Woolridge, G. W.	... *Encyclopaedia of Veterinary—Medicine, Surgery, Absterics. 2 Vols., 1923.*
169.	Wytsman, P.	... *Genera Insectorum. Coleoptera Fam.* **Carabidae**—*Fasicule, 192.*
170.	Do	... *Genera Insectorum Diptera* **Pratorhyphidae**—*Fasicule, 190.*
171.	Do	... *Genera Insectorum Lepidoptera Fam.* **Anthelidae**—*Fasicule, 191.*
172.	Yapp, R. H.	... *Plant in Relation to Water by Maximov, 1929.*

Weather Review

FEBRUARY 1930

Rainfall Data

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

Pressure was below normal over the reporting area till the 6th during which time unsettled weather prevailed and some heavy falls of rain occurred. The low pressure area then retreated southwards and was followed by a ridge of high pressure which persisted till the end of the month over the south of the area reporting to Madras.

Weather conditions were disturbed before the invasion of the ridge of high pressure and rainfall occurred along the whole coast, the rainfall area regressing southwards. Some noteworthy falls were: Gopalpore 3·5 ins. on the 4th, Cuddalore 4·0 ins. on the 6th and 4·7 ins. on the 9th, and Palamkotah 3·9 ins. on the 12th. Rainfall disappeared with the establishment of the high

pressure ridge till the 21st, and thunderstorms gave sporadic showers on and near the hills on the 22nd. Weather was fine and dry thereafter. Total rainfall was markedly in excess of normal locally on the North Madras, and Madras Coasts and nearly normal or in slight defect elsewhere. No rain fell in the Ceded Districts and parts of Malabar.

Temperatures were everywhere above normal during the first days of the month, the excess being more marked in the case of night temperatures, but with the incidence of rainfall temperatures dropped sharply and remained below normal under the influence anti-cyclonic conditions induced by the ridge of high pressure referred to above. Gopalpore reported a maximum of 69° on the 5th a temperature 13° below normal, and Kurnool 52° on the 15th and 16th which was 15° below the normal. The lowest temperature for the year recorded at the Research Institute Observatory i.e. 55·5° was recorded on the 28th.

Humidity was also very much in defect during the latter half of the month Kodaikanal recording only 7% of saturation on the 25th.

Winds had generally all the time a Northernly component, and were blowing off the anti-cyclone.

Report for the Research Institute Observatory

Absolute Maximum in Shade	94° · 0
Do Minimum in Shade	55° · 5
Mean Maximum in Shade	91° · 2
Do Minimum in Shade	65° · 3
Total Rainfall in Month	0 ·02 inches
Heaviest fall in 24 hours	0 ·02 ,,
Total Number of Rainy Days	0
Mean daily wind velocity	3 · 7 miles per hour
Do 8 A.M. velocity	2 · 8 ,,
Total Hours of bright Sunshine	260 · 6 hours
Mean daily hours of bright sunshine	9 · 3 ,,

Pressure was low in the first week of the month, rose to the maximum on the 16th and then fell gradually towards the end of the month.

Temperatures were high for the first half of the month, but with the fine clear dry weather night temperatures fell and the lowest temperature of 55·5° was reached on the 28th. Diurnal variation was very high reaching 37·5° on the 28th.

Winds were from one point in the North-east Quadrant and were fairly vigorous during the middle of the day.

Rainfall was scanty, only one shower of 0·02 inch being recorded.

Humidity was very low in the latter half of the month the percentage of saturation being only 41% in the morning of the 27th. The air was very much drier during the early afternoons. Skies were clear and the mean hours of sunshine were 9·3 per day.

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

Departmental Notifications

First Circle. Mr. B. P. Papaiah, Assistant Farm Manager, Anakapalli, leave on average pay from 10-3-1930 to 31-3-1930, both days inclusive; Mr. N. Ramadoss, Agricultural Demonstrator, Cnodavaram, leave on average pay for one month from 25-2-1930.

Second Circle: Mr. S. Kuppuswami Iyengar, Farm Manager, Guntur, leave on average pay for the one month and twelve days from 5-3-1930 with permission to suffix Easter holidays from 7th to 22nd April 1930.

Third Circle: Mr. S. Varadarajulu Naidu, Assistant Articultural Demonstrator, Gooty, promotion to the Upper Division, V Grade, from 1-3-1930.

Fourth Circle: Mr. K. V. Natesa Ayyar, Probationary Agricultural Demonstrator, St. Thomas' Mount, transfer to Palur Agricultural Research Station; Mr. M. Gopalan Unnithan, Probationary Farm Manager, Palur Agricultural Research Station, to be in charge of District work at St. Thomas' Mount. Mr. V. Kumaraswami, Assistant Agricultural Demonstrator, Palmaneir, promotion to the Upper Division, V Grade, from 1-3-1930; Mr. S. Rama Rao, Assistant Agricultural Demonstrator, Chandragiri, promotion to the Upper Division, V Grade, from 1-3-1930.

Sixth Circle: Mr. P. Kannappa Pillai, Assistant Agricultural Demonstrator, extension of leave on average pay for three months.

Seventh Circle: Mr. K. P. Sankunni Menon, Agricultural Demonstrator, Calicut, leave on average pay for three weeks from 18-2-1930.

Cotton Specialist's Section: Mr. M. Chinnaswami Naidu, Farm Manager, Cotton Breeding Station, Coimbatore, transferred to Research Station, Anakapalle on expiry of leave.

Government Entomologist's Section: Mr. S. Ramachandran, Entomology Assistant, leave on average pay for three months from or after 24-2-1930.

Curator, Government Botanic Gardens: Mr. K. Govindan Nambiar, Assistant Farm Manager, Ootacamund, leave for one year from 5-2-1930.

Paddy Specialist's Section: Mr. T. Lakshmipathi Rao, Assistant Farm Manager, Maruteru, promotion to the Upper Division, V Grade, from 1-3-1930.

Live Stock Section: Mr. T. V. Krishnaswami Rao, Farm Manager, Chintaladevi, extension of leave on average pay for two months and thirteen days from 12-2-1930 and leave without allowances for seventeen days in continuation thereof; Mr. M. P. Kunhikutty, Live-Stock Demonstrator, Coimbatore, extension of leave on average pay by fifteen days up to and inclusive of 17-3-1930; Mr. T. Seshachalam Naidu, Farm Manager, Live-stock Research Station, Hosur Cattle Farm, leave on average pay for one month from 15-3-1930. Mr. K. Ramanuja Acharya, Farm Manager, Chintaladevi, leave on average pay for four months from or after 15-4-1930; Mr. H. Narahari Rao, Assistant Farm Manager, Hosur Cattle Farm, promoted to the Upper Division, V Grade, from 1-3-1930, transfer to Agricultural College Dairy for training; Mr. A. Gopalakrishnayya on completion of training, transfer as Farm Manager, Chintaladevi; Mr. P. A. Narayanan Nambiyar, Assistant Farm Manager, Chintaladevi, transfer to Hosur on 15-4-1930; Mr. M. C. Menon, Farm Manager, Hosur Cattle Farm, transfer to the Buffalo Breeding Station, Guntur on 15-4-1930; Mr. M. Alagiriswami, Assistant Farm Manager, transfer to the Buffalo Breeding Station, Guntur, on or after 15-4-1930; Mr. V. Karunakaran Nair, Farm Manager, Buffalo Breeding Station, Guntur, transfer to Hosur.

Latest Notifications

Principal's Section: Mr. T. S. Azizuddin Sahib, Upper Subordinate, V Grade, leave on average pay for one month and 25 days with effect from 5-4-30 preparatory to retirement; Mr. G. R. Venkatachalapathi Raja, Lower Subordinate, IV Grade, in charge of the Botanical Garden in addition to his own duties as Assistant Farm Manager, Estate planting.

Government Entomologist's Section: Mr. V. Margabandhu, Assistant, leave on average pay for one month and 12 days from 25-2-30.

Paddy Section : Mr. K. Venkatarama Ayyar, Officiating Superintendent, Agricultural Research Station, Adutturai, leave on average pay for three months and 15 days from 7-4-30.

Live-Stock Section : Mr. A. Venkatarangam, Farm Manager, Live-Stock Station, Hosur, extension of leave on average pay for one month from 6-3-30.

First Circle : Mr. I Kurma Rao, Assistant Farm Manager, Anakapalle, leave on average pay for one month from 5-3-30; Mr. R. Vasudeva Rao, Farm Manager, Anakapalle, leave on average pay from 15-3-30 to 30-4-30.

Fourth Circle : Mr. M. Gopalan Unnithan, Upper Subordinate, Agricultural Section, V Grade, confirmation in his appointment.

Eighth Circle : Mr. V. S. Narayanaswami Ayyar, Agricultural Demonstrator, Salem, leave on half average pay from 7-3-30 in continuation of leave already granted.

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