Madras Agricultural Journal

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

Vol. XX] MARCH 1932 [No. 3

CONTENTS

THE ROLE OF THE PROTOPLASTIC PIGMENTS OF PLANTS [1]

BY T. R. SESHADRI, M.A., Ph.D., F.C.S.

Soil Physicist, Agrl. Research Institute, Coimbatore.

The importance of colour in nature cannot be overstated. As an element of beauty it brings joy to life. Its very abundance is indicative of its necessity. Nature's paint box is a large one indeed; indigo, madder, xanthone, flavone, flavonol, anthocyanin, hæmoglobin, chlorophyll and carotin are only a few typical group examples. Apart from æsthetic considerations we can boldly say that the world would have come to a standstill and all life processes stopped but for the presence of pigmented bodies. Chlorophyll and hæmoglobin are well-known examples in support of the above statement. Further, it has been observed that coloured substances act as reliable indicators of physiological conditions and difference in genus.

Pigments of plants fall under two main divisions, (i) those that are directly connected with the protoplasm and hence called protoplastic pigments and (ii) those that are found dissolved in the cell sap and hence called sap-soluble pigments. Chlorophyll, carotine and xanthophyll are members of the first group whereas anthocyanins, flavones and flavonols illustrate the second group. There are fundamental chemical and physiological differences between the two.

Chlorophyll, which is the characteristic green pigment of leaves is a chemical substance of primary importance in the organic world since directly or indirectly the lives of all plants and animals depend upon it. Animals depend for their existence on certain complex amino-acids which they are unable to make for themselves and for which they have to depend on plants and plants in turn will have no existence except by virtue of the valuable properties of chlorophyll. The property of chlorophyll which is so important is the power it possesses of absorbing radiant energy from the sun and

[1] Summary of a Lecture delivered before the Association of Economic Biologists, Coimbatore, on the 22nd July 1931.

bringing about the chemical reactions that result in the synthesis of carbohydrates. The chemistry of this vital phenomenon is not yet quite clear.

Chemically and physiologically, chlorophyll in plants is the prototype of hæmoglobin, the red-coloured material of the blood of higher animals. That there is a striking similarity between the two has been called to the attention of chemists since the beginning of this century. R. Willstatter and H. Fischer, both of them Nobel laureates in Chemistry have established beyond doubt the close connection between the two pigments by breaking down their huge molecules and studying the fragments. The simpler decomposition products were either identical in the two cases or very closely related. Following upon years of thorough study of the derivatives of pyrrol and various porphyrins, Hans Fischer was finally able to build up hæmin in the laboratory and subsequently he made hæmoglobin itself synthetically. The day is not far off when the chemical synthesis of chlorophyll will be an accomplished fact.

In view of the above chemical similarities, it is not unreasonable to expect physiological resemblances. According to Palladin and Willstatter both hæmoglobin and chlorophyll are instrumental in the transfer of oxygen. This well-recognised function of hæmoglobin is a matter of common knowledge. A somewhat similar function has been assigned to chlorophyll in the photosynthetic process. About a decade back, evidence was produced by Manilov that the chemical tests which distinguish male and female blood are equally applicable to male and female chlorophyll in diœcious plants. Recently, an interesting piece of work has been reported in *Science* which bears on this question. It was proposed to test if the substances which influence the formation and stability of hæmoglobin in the blood would have a similar effect upon the chlorophyll of plants. Liver extract was chosen for the purpose since it has been reputed for some years to be a specific for the much-dreaded pernicious anæmia. Its exact function is not yet clear. Whether it prevents the destruction of the red cells containing hæmoglobin or promotes the growth of fresh ones, is not quite well understood. Probably it does both. Quite similar results have been obtained by the use of the liver extract on seedlings of the corn plant. When transferred to a dark room in an artificial culture solution for about 10 days, it was noticed that at the end of this period those that had the liver extract supplied were distinctly greener than the controls without it. Albino seedlings which were fed on liver extract in a similar fashion showed a greening in excess of controls.

The green matter of leaves consists of two different entities called chlorophyll A and chlorophyll B which are very closely related in chemical composition. In solution, the former is bluish green whereas the latter is purer green. The existence of two different individuals in chlorophyll was not understood till many of their decomposition products, called phyllins and phytins, were studied in detail. As a component amounting to a third of their weight the chlorophylls contain phytol, a long-chain aliphatic alcohol. This combines with the carboxylic compound chlorophyllin to produce chlorophyll. Phytol is particularly of interest owing to its phytochemical relationship to the yellow protoplastic pigments called carotenoids.

The yellow colour that persists in dead leaves is due to the presence of carotenoids. The name of this group is derived from carotene, the most important member. They are characterised by their ready solubility in oils

and fats and by their high unsaturated condition which endows them with great chemical reactivity. We owe much of our present knowledge of the chemistry of carotenoids to the labours of Karrer of Zurich.

Carotine is easily prepared from the carrot. It is an orange red crystalline substance and its remarkable tinctorial property will be evident when it is realised that only 0·25 gram of it is present in one kilogram of the dry root. It is a hydrocarbon having the formula $C_{40}H_{56}$ and it contains eleven double bonds. The multiple effect of the double bonds seems to be the cause of the intense colour, as well as the readiness with which it undergoes oxidation in air, or combines with several reagents.

The function of carotene in plants is only very vaguely guessed so far; it may absorb energy of certain wavelengths or it may play a part as catalyst in the oxidation-reduction system. In animal physiology it was formerly said to have no role, but recently it has come into great prominence as being the source of vitamin A. The possibility of a relation between certain lipochrome pigments (pigments of animal tissues) and vitamin A activity attracted some attention early in the history of vitamins. But it was soon pointed out that a strict relationship could not be traced. Many of the vitamin A preparations, especially animal oils, are only faintly coloured and the colour can be entirely removed without affecting their physiological activity. During recent years, however, Karrer, Euler and their collaborators have reopened the whole question in a systematic way and their results show that pure carotene can restore growth in rats suffering from a deficiency of vitamim A and that the vitamin A substance of spinach, cabbage and carrots is carotene.

More recently, a number of samples of palm oil have been examined by Drummond and Ahmad for the degree of their colour and their vitamin potency. The results of biological and spectroscopic experiments indicate that the whole of the pigment in the oil is carotene and that the vitamin A activity is entirely due to the pigment. In this connection it will be interesting to note that carotene is easily destroyed in solutions by treatment with absorbent charcoal. It could not be regenerated from the absorbent. This is attributed to vigorous oxidation on the surface of the charcoal. Both the decolourised solution and the fraction absorbed by the charcoal are entirely devoid of biological activity. In the palm oils, however, the pigment seems to be protected to some degree by some substance of the nature of 'antioxidant'. This ready oxidisability marks an essential difference between carotene and vitamin A of fish liver oils. The latter is not so easily absorbed by charcoal and is far more resistant to oxidation.

From the results so far obtained it has been concluded that though vitamin A and carotene are not identical they should be closely related because they agree in most of their properties. Vitamin A as such does not occur in the vegetable kingdom; the carotene of plants undergoes conversion into vitamin A in the animal organism. A series of observations on rats showed that the absorption of carotene takes place mainly in the intestinal tract and that it is greatly influenced by the mode of administration. When the diet is devoid of fats, even with such small doses as 0·01 to 0·05 milligram of carotene per day as much as 90 per cent of it may be excreted unchanged. With small additions of fat the absorption is better and when given in the form of palm oil the pigment is almost quantitatively absorbed. The animal originally depleted of vitamin A shows evidence of its presence especially in

the liver fat. The results indicate that the major portion of the carotene absorbed by the organism may be rapidly transformed into other substances, but the final formation of vitamin A is a rather slow process.

Amongst the attempts to discover a derivative of carotene which may be identical with vitamin A should be mentioned the work on the reduction products of carotene. One of these simulated vitamin A so closely in its physical properties that the two were compared biologically; the results were, however, inconclusive. Though it has been established so far that in animals the biological breakdown of carotene occurs, considerable differences may be encountered in various species. The results of Karrer's work on the chemical constitution of carotene make it probable that the modification of the complex unsaturated molecule in the organism would follow several paths. Reduction might be one of the changes involved, but there are grounds for the belief that vitamin A contains hydroxyl groups and hence oxidation should be one of the stages in the course of its formation.

The recent researches of Karrer in Zurich and Rosenheim in London have shown that carotene is not a pure substance, but represents a mixture of isomerides which differ in optical activity and physiological potency. This renders probable that the physical and chemical properties of vitamin A may be simulated closely either by structurally identical or closely related compounds which differ enormously in physiological properties. In a recent communication to the *Biochemical Journal* the diffusion constants of carotene and vitamin A in xylene have been reported. The ratio of the molecular weights so obtained indicates that the assumption of a very simple chemical relation between the two is untenable.

To sum up the present position, carotene in very small doses is able to perform the same function as vitamin A. All the vegetable products which are reputed for their vitamin A potency owe this property to their carotene content. In the animal system carotene undergoes slow conversion into vitamin A which is eventually stored up in the liver. Except for the remarkable colour of carotene it resembles vitamin A closely in several physical and physiological properties. However, the exact chemical relationship is not yet known.

A little reflection reveals several interesting lines of investigations relating to the protoplastic pigments of plants. Carotene and chlorophyll are found located in the same tissues of plants. They are born in the same house, live their life together and are evidently essential to each other. However, uptill now we have been able only to make vague guesses of their probable parentage and relationship. Carotene is closely related to isoprene C_5H_8, a substance of fundamental importance in plant chemistry, and through isoprene it is related to phytol, the alcohol of chlorophyll comprising nearly a third of its weight. Apparently there exists a common origin for carotene and chlorophyll but where exactly they begin to differ in the progress of their evolution has not yet been even vaguely understood. There seems to be little doubt that the common source of all plant products is starch which is capable of undergoing countless transformation resulting in the formation of different types of compounds.

Not only do carotin and chlorophyll occur together but they seem to function physiologically as oxidation-reduction systems and play their part in photosynthetic work. In animals carotene gives rise to vitamin A which is stored in the liver. The liver extracts not only cure pernicious anæmia, but

as has been pointed out above, cure albinism in plants and prevent the destruction of chlorophyll. It is also known that several green vegetables such as spinach, produce a similar cure though to a somewhat lower degree. Could the value of the liver extracts and green vegetables in this respect be due to carotene or to vitamin A or to some derivative of either? Any of this is quite probable. It will then be exceedingly interesting to investigate the inter-reactions of chlorophyll and carotene as to how the presence or absence of one affects the other. This is an investigation which is sure to end in results of great value to the plant physiologist.

A further suggestion could be made here regarding the usefulness of the evalution of foodstuffs against their carotene value after arriving at a definite specification as to its properties as a standard. Particularly for India where the majority of the population depend more or less entirely on vegetable products for sustenance, a mapping out of the value of the commoner foodstuffs for carotene would be a great step forward towards determining the adequacy or otherwise of our national dietary in this respect.

'NORTHERNS' COTTONS [1]

PART II—PHYTOTECHNOLOGY

BY M. SATYANARAYANA, B.A., B.SC. (AG.),
Asst. Lecturer in Agriculture, Agricultural College, Coimbatore

I. **Climatic influences.**—Though enjoying an annual rainfall of 24" to 30", because of the precarious incidence and irregular distribution of rainfall, the 'Northerns' cotton area may aptly be called a semi-arid tract in contravention to the accepted American classification. It is not at all uncommon to find in the tract, the cotton crop in some seasons receiving not a drop of rain after the sowings are finished; and still the ryots carry it on to maturity with all the moisture-conserving devices characteristic of dry-farming in arid and semi-arid tracts.

In India all experiences of meteorological phenomena relating to field-husbandry have been carried down from father to son. The adages and proverbs of any one tract comprise a text book of local farming dealing with results of both normal and abnormal happenings. The S.-W. Monsoon breaking in June supplies on an average 22" of rainfall and the N.-E. Monsoon between October and December 5". With 2" for preparatory cultivation and 3" to 4" for sowings and an inch and half in every fortnight in the growing period, good crops can be expected. Crops on black cotton soils, however, suffer heavily when good S.-W. Monsoon rains are followed by heavy N.-E. Monsoon rains protracting late into November.

According to the local vernacular proverb *makhalo vepte pubbulo molava-valey* the seed when sown in *makha* (when the sun enters the 4/9th part of the astral mansion Leo) should germinate in *pubba* (when the sun gets into the 5/9th part of the astral mansion Leo). Germination is observed on the fifth day after sowing; hence if the seed is sown on the 25th or 26th August, the germination is noticed on the 30th or 31st August, the first two days of *pubba-karti*. This is for guidance on an average black soil and provided the

[1] Part I of this article appeared in vol. xix, No. 8 (August 1931).

field possessed the right state of moisture for sowing. "In a country of precarious rainfall any attempt at precision of system must give way to nimbleness of adaptation to the vagaries of the weather"—KEATINGE. Land would have been prepared for the early crops like groundnut or kodo millet (*Paspalum scrobiculatum*), and yet no sowings would have been done when the Monsoon delayed. From August to early September, (i) Italian millet, or (ii) a mixture of Italian millet and cotton or (iii) a mixture of cotton and horse-gram is the order in which the cropping is adopted, depending on the period in which the sowing rains are received. When the sowing rains are delayed beyond the cotton season, sorghum in October and Bengal gram in November are the rule. With such vagaries of the season, the ryot is apt to be a fatalist, always making adjustments in cropping to suit the same. Unlike the practice in the southern districts like Coimbatore, the cotton in the tract is sown earlier than sorghum, due to an early commencement of the dry period.

II. **Soils.**—A good crop is an excellent index of the nature of the soil which bears it. Cotton is grown in the tract on quite a variety of soils. The ryots' nomenclature of the soil embraces tersely the proximate constituents as well as the behaviour towards particular crops. The *tuvva* (fine dusty) and the *baraka* (gravelly soils of laterite origin) were dealt with in Part I. *Yerra maska* (red loam) is commonly put under cotton.

Under black soils, the following are the common divisions:—*Kristna-regada* (Tamil—*karisal*) of a friable nature with a fair percentage of sand: *Kullu-regada* (Tamil—*Kakkarai*) with a larger proportion of the finer fractions of the mechanical analysis and rather bad for drainage: *Chavudu-regada* characterised by white alkaline efflorescence.

Adjoining the village sites are a type of land impregnated with the surface wash from the manure pits and the voidings of men and animals. Nitrification proceeds very vigorously in such soils. These are known as *gandu-regada*. Here crops grow rank and to force out bearing in cotton, topping is regularly resorted to.

Heavy rains in the growing period always help the cotton crop on saline lands; they create no disadvantage to that on red soils; however they cause harm to the crop on *kullu-regada*. On the contrary, good early rains and a drought in the growing period, would produce reverse effects on the above-mentioned soils. In fact from a qualitative and quantitative point of view, the cotton on *kullu-regada* in such a season equals that on loams as well as on every other type of soil and would be free from pest damage.

III. **Soil Management for the Seed Bed.**—(i) *Cultural*: After the harvest of the crops, no preliminary cultivation is started in the fields till the Telugu New Year. Lands set apart for cotton, which in normal holdings of 40 acres occupy a fourth of the area, are regularly ploughed with the country plough and the stubble of the previous crop uprooted. Ryots with larger holdings are satisfied by working the six-tyned drill without the hopper and the tubes (*oosigorru*) functioning as a cultivator followed by the *guntaka* (blade harrow). The isohyet of 24″ rain running more or less on the Yerramalais demarcates the tract, so far as the cultural operations are concerned. West of the Yerramalais as far as the Bombay-Deccan, the soil being deeper and the craking heavier, surface cultivation with the *oosigorru* and the *guntaka* is the rule. When the lands get foul with weeds they are periodically broken with heavy iron ploughs worked by teams of three to six

pairs of cattle and the soil thrown into big clods. Invariably such deep-ploughed lands are put to cotton. In lands thus broken, the clods on weathering crumble a little with the hot-weather showers and are then scuffled with the *pedda guntaka* (a heavy blade harrow) in the portion west of Yerramalais, or with the *bandi param* (frame of a cart weighted with sand bags and worked at right angles to its long axis).

(ii) *Manurial:* In a subject of the kind, while dealing with the manurial aspect, the treatments given to crops that precede and succeed cotton and the indirect influences of such treatments on cotton cannot be ignored. As a rule, no direct manuring is done to cotton, but occasionally sheep-penning is done prior to sowing. The preceding crop, chiefly sorghum, or the succeeding crop, when it is groundnut, receives cattle manure which is available at about Rs. 4 per cartload. When the native indigo trade flourished well, indigo seed and waste water from the vats used to be applied to the sorghum crop preceding cotton. Even now, bigger ryots in Nandikotkur taluk regularly grow crops of indigo and utilise the cuttings as green leaf manure; others growing the crop for seed, sell away the first cutting for green leaf manure at Rs. 20 per acre. In Prodattur and a few villages of Koilkuntla and Sirvel taluks, there is a temporary revival of the old indigo industry during the past few years. Due to the fall in price of groundnut, some ryots have chosen to grow indigo with a view to restore the normal balance in cropping and the fertility of land. All the systems of manuring the crop preceding cotton, indirectly help cotton and this fact is sufficiently known to the husbandmen of the tract.

IV. **Sowing Methods.**—(i) *Mixtures and rotations.*—The essential principle of dry-farming, viz., the choice of bio-types most suited to and surviving adverse conditions is well understood by the ryots of the tract. The introduction of drought-resisting Gadag cotton into the Nandyal valley from the drier Bombay-Deccan is an instance in point. Further, even in the same tract, cotton seed for sowings is generally obtained from red soil tracts or from tracts with slight alkalinity.

While in bare skeleton (1) cereal (sorghum with pulse or cucumber), (2) cotton (with pulse, oil seeds, etc. in mixture), and (3) pulse (groundnut or Bengal gram or indigo), form the rotation adopted, the system of cropping is really more complicated. Nowhere in the Presidency does cotton figure in so many mixtures as in this tract. Insecurity from unseasonal distribution is minimised by having one set of chief and another of subsidiary crops with different growing seasons and ripening periods; and such variance in duration and the ripening periods provide opportunities for the economical utilisation of animal and human labour as well as soil fertility. Howard in *Crop production in India* referring to root systems mentions that Red-gram *Cajanus indicus* roots penetrate and break up ordinary pans with ease. So do cotton roots in mixed cropping.

The exponents of dry-farming in the United States refer to *shade crops* and the 'header' system of harvest. These are not new to the 'Northerns' tract. The subsidiary crops above referred to are really the shade crops that prevent the direct action of the sun on the land and the consequent loss of moisture thereby. Mixtures of creeper varieties with those providing standards for the creepers also come under the same category. Soon after the sorghum heads or 'cumbu' heads are cut and the castor pods are collected, the standing stalks act as standards for the field bean, creeping green gram and other twiners grown mixed with the former. The uprooting

is done by the repeated use of the *guntaka*, usually three times. 'The whole system appears to be one designed to cover the land and thereby to prevent the bareness and the consequent loss to the soil, which would result from the sun beating down upon it and from the loss of moisture which it would incur. It is known also that the process of nitrification in soils is much more active when a crop is on the ground than when the latter lies fallow.'—Dr. VOELCKER.

With experience handed down from father to son through several generations the problems of this dry-farming tract have been solved in the isolation of their villages. Except in *renaud* (pure black soil) there is not much of pure cotton in the tract. Two rows of *korra* (Italian millet) and one of cotton is the rule. Occasionally one row of *korra* and one of cotton (*Kondru patti*) are found. This is intermediate between pure *korra* and the standard *korra-patti* and depends for its adoption on the season and the cultivator's domestic economies which determine the ratio between the food and the industrial crops. When the season is late, *korra* is abandoned and two rows of horse-gram and one of cotton are sown; or cotton-horse-gram mixture is sown in all the rows. The horse-gram twines around the cotton stems and when the former grows luxuriantly, interculturing is rendered difficult or impossible. Horse-gram comes to harvest and is pulled out in February, by which period cotton will be commencing to burst so that interculture will not be beneficial. In red loams of Aiyalur and Nandyal firkas, where *korra-patti* is sown with the early rains, green gram, gingelly, castor, gogu, etc. are mixed in both the cotton and *korra* rows. This is a bad practice as the spreading habit of some of the varieties prevent any intercultivation. After the harvest of *korra*, the N.-E. Monsoon rains would stimulate the green gram etc. to grow vegetatively, and adversely affect cotton.

With the fluctuation in the prices of industrial crops, two rows of groundnut (bunch type) with one of cotton is now in the experimental stage with the ryot. Before the N.-E. Monsoon has well-nigh spent itself, bursting takes place in such cotton. In a mixture of this kind it is desirable to defer cotton-sowing to a later date, leaving sufficient space between rows of groundnut. This sowing may afterwards be done by dibbling seed from behind a light plough worked in between the groundnut rows. The bunch groundnut is pulled out in 105 to 110 days and, later, the interspaces are cultivated for the benefit of cotton.

Other methods of growing mixtures of groundnut and cotton resemble those prevalent with sorghum and red gram of Guntur uplands, or sorghum and pulse (or castor) in Bellary district.[1]

(ii) *Spacing*.—From age-long experience, definite spacings, e.g., 18 ins. and 21 inches are observed for sowing cotton in the tract. The choice between these rests on the time of sowing, fertility of land, variety used, but more than all on the crops figuring in mixture with cotton. When cotton is sown in all the rows, the *patti-gorru* (two-tyned or three-tyned seed

[1] In *salu kandi* or *attedu kandi* of Guntur district, one of red gram to five of sorghum is the rule. Similarly in *pilla akkadi* of Bellary district one of pulse or oil seed to five of sorghums is the practice. In similarity with the practices of the adjoining districts, one row of cotton is alternated with five of spreading groundnut, in the tract. This practice is only occasionally met with. The cotton is sown in the *akkadi* following the end tyne in a six-tyned drill.

drill with 18 inches interspace) is used. When the six-tyned drill (interspace 10½ inches) is used to sow *kondru patti*, the distance between cotton rows is 2 × 10½ or 21 inches. In *korra-patti* (or bunch groundnut in place of *korra*), when the same six-tyned drill is used, the distance between the cotton rows is 3 × 10½ or 31½ inches.

After observing the distance in vogue between rows, the spacing between plant and plant in the row may be considered. Pertaining to this, the ryot's method of sowing closely in the row is attended with good results. Experiments conducted at the Agricultural Research Station, Hagari, between 1925–1927, conclusively proved that the ryot's method of promiscuous thick sowing in the row, or a narrow spacing of three inches in the row gave the highest yields. Notwithstanding the low seed rates in dry-farming, 'in cotton, thick seeding induces earlier maturity and for this reason is sometimes resorted to'—LEPPAN.

(iii) *Depth of seeding :* Referring to the depth of seeding in the dry-farming tracts of U. S. A., Widtsoe observes 'the consensus of opinion is that one to three inches are best in humid districts, but that everything considered, four inches is the best depth under dry-farming conditions.' In the Bellary district, the ryot always sows the sorghums at a depth of 3 to 4 inches appropriately weighting the gorru with crowbars, or the old axles of carts. The deep sowing is due to insufficient moisture at the surface. In Kurnool and the upland taluks of Guntur district, Bengal gram is sown at the four-inch depth or lower down. The conditions with cotton, however, are different. It is always sown shallow at about the two-inch stratum. The causes are not far to seek. Amongst all the types of soils, specially on the red loams (due to lateritic nature) and *tsoudu regada* (due to particles running into each other on account of the alkali), heavy rains, in the period between sowing and germination, attended by a run-off on the soil, render it impervious, resulting in a crust. This encrustation is called *dabbaku veyuta* in Bellary district and *pippettu* in Kurnool district. Unlike the sharp-pointed plumules of graminæ, the plumules of cotton enclosed in their seed coat are unable to penetrate the crust referred to. In places thickly sown, a number of them, with their collective force lever up the crust and come over the surface. It is quite a common occurrence to see at that part of the season ryots, especially those on the red soils, sowing their cotton a second time or a third time. In the rain-fed cotton tract of Tinnevelly, where no quick-sowing and covering implements like the *gorru* and the *guntaka* exist and only a country plough operates, a similar difficulty is overcome by broadcasting seed a second time after covering the first-sown seed. If on receipt of a rain and the consequent hardening of the surface the seed in the lower stratum does not germinate, the superficially-sown seed would still germinate.

V. **Growing Period:** (i) *Intercultivating :* Heavy rains in the early stages after sowing would bring about, especially in black soils, seedling blight, leaf spot and wilt. These affect the young crop but casualties are few. On the other hand, regulating the escape of soil moisture and tiding over droughts are the chief problems in the growing period; and interculturing with simple agricultural implements forms the next phase in the essentials of this type of farming. *Metla guntakas* are worked once with the three blades just by one side of the cotton rows and a second time with the blades coming on the other side of the same cotton rows. By so working, the interspace between rows is not completely covered and *dantis* (small blade

cultivators) are used for the purpose. So one interculturing is completed when the *metla guntaka* is worked twice, followed by the *danti* once. A pair of cattle would work three acres with *metla guntaka* each time, and six acres with the three *dantis*. Some ryots who cannot afford to put one cooly for each *danti*, use the *rekkala guntaka*, which consists of two *danti* blades attached to one beam.

In the first interculturing, only blades badly worn out (*ara palugulu*) are used, as the aim is just to scrape the soil to remove weeds and produce a light mulch without tampering with the reserve moisture underneath. The blades of the *metla guntaka* while working very near the plant rows also do ridging at the base of the plants in the row. In the second interculturing, the normal blades are used. Weeds in the rows are removed with the *kurchiga* (a bent weeding knife) by engaging women labour. In the third and fourth operations, *eda-sedyam* (intercultivation) *guntakas* (bullock hoes) are used. At this stage, crops like *korra* or bunch groundnut, would be off the field and cotton sown in mixture with these could be freely intercultivated. The *eda-sedyam guntakas* are made with blades of varying width to fit in the interspaces between cotton rows. In *korra-patti*, after the harvest of *korra*, the stubble is removed by working the country plough and *korra-patti guntakas*, fitting the interspace properly between the cotton rows, are next used to crush the small clods turned out by the country ploughs.

Four showers, followed by the four interculturings referred to with the various implements, at intervals of two or three weeks would be ideal in the growing period; but unequal distribution of rain in this period does not permit the soil to be worked so regularly and the number of interculturings are reduced to one or two.

In contrast with this tract is the 'Westerns' area where with more precarious rainfall and wider spacing a greater number of intercultivations (about six) are given the last two of which are done deeper by the driver weighting the implement by standing on it.

(ii) *Topping*.—In *gandu regada* which retains moisture pretty well, topping is regularly practised to prevent the plant developing a rank vegetative growth and to force bearing. When the rains happen to be excessive, the soil between rows is sometimes opened with a country plough to reduce the moisture content. This is done before the flowering period of the crop. Dr. Balls observes that stunted plants flower late and that a close correlation 'exists between the height of the young stem and the flowering date' and that 'this correlation vanishes when we reach the normal plants, which all flower at about the same time in spite of noticeable fluctuations in height.'

The attack of top shoots by various species of *Erias* is welcomed by several ryots, as side branching, especially much desired in lanky types like *Indicum*, is induced thereby.

Regarding forced bearing on account of topping, the physiological processes hastening maturity appear to be in close analogy with the following mentioned by D. D. Brown on cincturing citrus trees: 'All fruits in normal trees is the product of excess elaborated substances over root requirements. If the roots are obtaining more than their share, the trees grow very strongly at the expense of the crop.' However, Mr. Templeton's researches on 'The Effect of Topping Egyptian cotton plant' published recently, do not indicate an augmented yield from topping.

(iii) *Effect of winds*.—Influence of sea breeze on the sea-island cotton and of *uppam kathu* on *Tinnies* are too well known. Similarly for the proper

bursting of bolls and for the full development of the qualities of the fibre, the *pyru gali* (warm south-east wind) is essential for the 'Northerns' cottons. If instead, the chill north winds blow from December onwards, proliferations and malformations and damage from *Aphis gossyppii* result. In spite of a drought in the later period, if there is a timely start of the warm south wind, good cotton free from all pests is derived. 'On the other hand, long continued dry weather is bad for the staple, since it dries out the natural oil in the plant, leaving the fibres weak and brittle.'—HUBBARD. Furthermore, if a hot summer follows a cold winter, there would be a forced bursting of bolls resulting in a higher percentage of immature kappas.

VI. **Pickings.**—'Northerns' cottons come under class I of the Liverpool definition, when properly picked and supplied pure. Unfortunately, the methods of picking are anything but satisfactory. The housewife after washing the buffalo, finishing her dairy trade, cooking and eating her food, leaves her home and arrives on the field between 8 a.m. and 10 a.m. depending on its proximity to the village. The picking is done during the hottest part of the day (with the thermometer from 105°F to 120°F in the shade) and closed by 3 or 4 p.m. Not more than four times is the cotton picked during the whole of the bursting period. This is contrary to the practice in the Tinnevelly tract and is false economy. The picking wage is always in kind and ranges from 1/5th of the produce in mediocre and low yield to 1/10th in seasons of bumper production.

Occasional whirlwinds are a feature of any dry-farming tract. When such occur, the cotton is blown off the locule and gets entangled between the leaves or twigs of the plant. Further, the cotton on the lower monopodials gets badly soiled. To add to these, the fineness of the fibre and the silky nature of this cotton help in collecting a good amount of dry leaf and dust on it. While the Egyptian *fellaheen's* method of grading the kappas while picking into three different qualities and placing the same into three different coloured bags hung round his neck, is the system sought after by every cotton-growing country. Any amount of propaganda in the tract to improve on the crude methods of picking is of no avail. The women as they pick dump the kappas somewhere on the bare field, carry it home in their clothing and store it in some corner of the house.

In the valuation of cotton, points on and points off are marked out in each grade. 'Northerns' coming under the 'Good M. G. Southerns Contract' in the Bombay market and with 'M. G. Westerns, Good' as the basis, has the following grades:—'Fine,' 'Fully Good,' 'Good,' 'Fully Good Fair' and 'Good Fair.' In such valuation, besides tests like blow-room loss, eye judgment plays an important part. Clean cotton always upsets one's judgment by the impression it creates and is apt to be given a higher grade than its due. Badly picked cotton is depreciated much lower than the value which it deserves from its percentage of refraction. Further, dry leaf causes neppiness in the staple which affects the yarn.

When the crop is poor, the ryot at times picks the bolls green and turn his cattle into the field to graze. The green bolls are dried in the sun and the immature kappas obtained through forced bursting is adulterated with other cottons. This practice cannot be too severely condemned as the quality of cotton is affected and the yarn becomes inferior. Besides 'flabby immature fibres, when the inner tube is sealed from one extremity to the other, cannot absorb dyestuffs in printing or dyeing.'

PALATABILITY OF FEEDS

By T. MURARI, B.SC. (OXON), F.L.S.,
Superintendent in Charge, Livestock Research Station, Hosur.

In the management of Livestock one of the important points in feeding is the palatability of feeds. Palatability is as vague as it is important in the digestibility of feeds. However, Science has not yet succeeded in assessing the true value of palatability though it has been understood by the stockmen. Henry of Wisconsin and Stapledon of Aberystwyth have contributed to our knowledge in regard to this subject. The former has noted this feature in animals by alternating grain ration while the latter has closely followed the browsing animals and noted their likes and dislikes.

It is common knowledge to the stockman that when he changes the ration to the animal it does not take to the ration straightaway. For instance, in the case of silage, the animal that is not used to it, may not even touch it for the first day or so, but later begins appreciating the succulent feed and even gorges itself if the feeder is not careful. Apart from the nutritive value of the food, it is essential that the quality is good. The grain, cake or fodder should be fresh and should not contain insects and moulds. If the rations are thoroughly dried and stored properly the quality may be maintained for a considerable time. It must be added that along with freshness, general appearance or attractiveness has much to do with palatability. Just as a nicely dressed dish causes saliva to be set free in the human mouth, so does an attractive feed affect the animals. Palatability is affected by the texture of fodders. Highly lignified fodders are not preferred to succulent fodders. Very hard grains or cakes may be swallowed without proper mastication and the result is that their digestibility is adversely affected. A good example is found in cotton-seed fed without crushing.

So far, palatability has been described in general terms. It would now be interesting to note particular examples. To begin with, palatability varies between species. What the buffalo likes, the cattle may not appreciate. While the buffalo can consume large quantities of coarse fodder, the cattle may not be able to manage even half the quantity.

It is common knowledge that goats show very little likes and dislikes but the sheep is particular about his bite. When the goat can subsist on any type of leaf or grass, the sheep is particularly happy when it can get hold of a grass like the *harialli* (*Cynodon dactylon*).

Habit also plays a great part in the role of nutrition. Animals that are used to one kind of fodder do not take kindly to new types. For instance cows from Pusa were purchased and brought to Hosur. As they were used to oats in their ration, they did not take to groundnut cake for some days and the change to the local feed had to be gradual. Again the grazing in the farm is excellent. The cattle at Hosur are so particular that they will not touch the coarse grass in the tank beds and tank bunds, but the local cattle which have not proper grazing areas, do not show this partiality.

The spear grass is not generally liked when the awns have become lignified. The farm cattle do not like the awns because they very much prefer the grasses without them to those with spears, but it is remarkable to

see the starving local cattle gorging themselves with spears that have been removed and thrown away.

Stage of growth has also direct relationship to palatability. Even with grasses with unduly prominent awns, the cattle will graze them when the grasses have not matured. It will be noticed in general practice that cattle gorge themselves when there is a fresh growth. In addition to the stage of growth there is variation in the type of grasses. The Guinea grass is preferred to the Elephant grass, the spear grass to lemon and other coarse grasses and during drought even to *harialli*. It must not be forgotten that young *Kolukkattai* grass (*Pennisetum cenchroides*) is eaten greedily by all stock. *Kolukkattai* has also a pleasant aroma which, to the cattle, must be appetising.

When the animals are forced by hunger they will eat anything. It has already been pointed out that local cattle under starving conditions eat spears. Again, it is not an unusual sight in India to see cattle eating dried leaves and paper. During drought, animals eat even the aloe *Agave Mexicana*. It is interesting to watch cattle pealing off the epidermis so as to eat the very succulent portion within. Even prickly pears are appreciated if the thorns could be rubbed off.

Very often stockmen make the ration palatable artificially by the use of salt and condiments. The method is quite useful but should not be encouraged for feeding inferior feeds.

In conclusion it must be mentioned that palatability depends on the individual, for there is no doubt that without variation animals get tired of eating the same thing. To be a successful stockman he should not only have an idea of the palatability of feeds, but should also know his stock individually.

REFERENCES

HENRY AND MORRISON ... ... Feeds and Feeding.
R. G. STAPLEDON, I. W. FAGON, } The Animal Complex and
R. E. EVANS AND W. E. J. MILTON } The Pasture Complex 1927.

STUDIES IN RURAL ECONOMICS—I

BY N. M. BHUKTA,
Assistant Agricultural Demonstrator, Vaddadi.

Name of the ryot:—K. N., of Velema community.
Village:—Chodavaram, *Taluk*:—Veeravalli,
District:—Vizagapatam, *Year*:—1930-31.

This ryot's family consists of 6 adults (2 men, 4 women) and 2 children.

2. He cultivates 6·73 acres, of which 6·07 acres are wet and the rest dry. The wet lands are of a heavy alluvial clayey loam, and command a supply of water from the channels of the Sarada river. 2·30 acres of this area is also provided with a well. The dry land is of a sandy loam, typical of the dry land of the locality. The whole area was taken up on lease for Rs. 212-8-0.

3. The cropping of the land in 1930–31, the cash expenditure incurred, the quantities of produce obtained and the portion of it sold, and the amount obtained thereby are noted below :—

Crop	Area in acres	Cash expenditure	Produce in pounds		Produce actually sold	Value of produce sold	Remarks
			Grain	Straw			
1	2	3	4		5	6	7
		Rs A	lbs.	lbs.	lbs.	Rs A	
Dry land—							
Ganti [1] ...	0·66	2 2*a*	382	1,080	...	...	The ryot consumed or otherwise utilised 6,030 lbs. of paddy (equivalent to 3,060 lbs. of rice), and all the *ganti* and *chodi* produced, besides the small quantity of gingelly and cowgram. He incurred no additional expenditure in feeding his livestock (a pair of he-buffaloes, 2 she-buffaloes, two calves and one sheep) the straw produced having been supplemented by green grass cut or scraped and all the horsegram produced having been fed to his cattle in addition to the rice-bran and *kontu* obtained by pounding rice.
Horsegram, *Chodei* and cowpea (mixed).	0·66	...	186 230 54	180 320	...	...	
Wet land—							
Chodi [2] ...	1·12	4 0*b*	665	*	...	...	
Paddy (variety *Navakoti sannam*).	5·56	54 9*c*	10,230	18,500	4,200 (paddy)	105 0	
Sugarcane. (J. 247) 0·32 acre B. 208 0·19 acre	0·51	56 13*d*	166 mds. jaggery	...	162 mds. jaggery	170 0	18 cartloads of manure were obtained during the year from the stock he had. No dung cakes were made practically, the ryot having purchased fuel worth Rs. 5-2-0 (1½ carts) besides tree prunings (about 9½ cartloads) and other fuel from his holding.
Gingelly ...	1·02	0 12*e*	234	...	164	11 5	
Total ...		118 4	...	...	...	286 5	
Lease amount ...		212 8	...	...	...	...	
Grand Total ...		330 12					

[1] Tam. *Cumbu* (*Pennesetum typhoideum*). [2] Tam. *Ragi* (*Eleusine coracana*).

(*a*) 10 women for planting and 7 women for harvesting at 2 annas; (*b*) 16 women for planting and 16 women for harvesting at 2 annas; (*c*) Puddling 30 pairs at 12 annas per pair including the driver; pulling out seedlings 16 men at 6 annas; planting 81 women at 3 annas; harvesting 58 women at 3 annas; (*d*) For sheep penning Rs. 5; 3 folds at Rs. 2 per fold, Rs. 6; Trenching 3 men at 6 annas, Rs. 3; Bamboos purchased for propping, Rs. 9-13-0; 8 wrappings at Rs. 2 per wrapping, Rs. 16; Purchase of Ammophos 20/20 grade, 1 bag of 100 lbs., Rs. 11; Sulphate of ammonia, ½ bag (40 lbs.), Rs. 3; Forest tax on 2 carts of fuel for making jaggery, Rs. 3; (*e*) 6 women at 2 annas for harvesting; *Straw puddled in for the succeeding paddy crop.

Besides the cash income of Rs. 286-5-0 realised by the sale of the produce from the land, the ryot obtained Rs. 128-0-0 by sale of milk, curd, buttermilk, and ghee for which there is a good demand in the village, thus bringing his income to Rs. 414-5-0. Deducting the cultivation expenses paid in cash and the lease amount, he had an amount of Rs. 83-9-0 left for his other cash expenditure which was as follows:—

		RS	A	P
1.	Pulses purchased	4	0	0
2.	Condiments, kerosine oil, fuel, etc., purchased ...	16	4	0
3.	Vegetables, fish, meat, etc., purchased	18	0	0
4.	Tobacco purchased (2 maunds)	16	0	0
5.	Clothes	22	8	0
6.	Repairs to his house	1	10	0
7.	Expenditure on festival occasions, etc.	7	12	0
	Total ...	86	2	0

The ryot could thus almost balance his expenditure with his receipts, the small deficit having been met from a saving of about Rs. 50 said to have been made in the previous year when prices were more favourable.

A NOTE ON THE CULTIVATION OF *DHONDAKAYA** IN THE VIZAGAPATAM DISTRICT

By P. V. JOGA RAO
Student, B. Sc. Ag., III

Introduction.—*Dhondakaya* (*Coccinea indica*) is one of the most important and the most remunerative minor crop of the Circars during the last three decades. Previously, it was growing wild in some of the forest areas of the Circars and even now a variety is found wild in the jungles and as a weed in the black cotton soils. But this wild variety is bitter to the taste, whereas the cultivated variety is sweet. The latter is so sweet that tender fruits may be eaten in the raw condition. It was first introduced into Tallavalasa village by the writer's grandfather some thirty years ago, and has been under cultivation throughout the district since that time. Dhondakaya of this village is famous in the Circars for its taste and deliciousness. The ryots of this village treat it as a money crop like onions and chillies. The maximum production of the fruit is in this village and the chief marketing centres are Berhampore, Chicacole, Vizianagaram, Parvatipuram, Rajahmundry, Ellore and at times Bezwada. Wholesale vegetable merchants from these places will advance money to the ryots on contract even at the

* *Coccinea* (*Cephalandra*) *indica*; Fam. *Cucurbitaceæ*; Tam. *Kovakkai*; Mal. *Kovalkayi*; Kan. *Thondekai*; Ooriya *Thurada*; Beng. *Telakucha*.

time of planting and purchase fruits every week. In addition to the good remuneration afforded by this crop, it presents a beautiful sight, growing on arched *pandals*. This often attracts strangers travelling by bus who occasionally get down to enjoy its sight for a few minutes. Besides cultivation on a field scale each family will grow a few plants in the back-yard which now and then provide the supply of vegetables for domestic consumption. Its best fruiting period is the hot weather when other vegetables are dear and when most of the festivals and matrimonial ceremonies happen.

Botanical Characters and Propagation.—This plant is a creeper belonging to the family *Cucurbitaceæ*. The stem is square or pentagonal in section, the leaves are simple and palmately veined. The flowers are borne on axillary cymes, unisexual and dicœcious, i.e. male and female flowers appearing in different plants. All the cultivated plants are female ones and male plants are very rarely seen. This is the reason why the fruit is merely the enlarged ovary with the unfertilised seeds inside. Therefore seed propagation is found to be impracticable and necessarily vegetative propagation by planting the cut stems is resorted to. An improvement over this variety through seed propagation is apparently possible.

Insect Pests.—No serious pest is noticed on the fruits, but the leaves are found to be attacked by one of the species of *Euproctis*, a hairy caterpillar which voraciously feeds on the green matter leaving only the skeleton of the leaf. Now and then the red pumpkin bug (*Aspongopus janus*) of the family *Pentatomidæ* is found to suck up the juice from the stem. The nymphs of this bug are orange red in colour with black legs and antennæ and a large black blotch on the back. But this is a minor pest which can be easily controlled by hand picking. Till now we are fortunate in not having any serious pest on the crop.

Soil and Season.—The plant grows in all well-drained and well-prepared deep friable and loamy red soils under irrigated conditions. It grows also in black soils but makes too much of vegetative growth which results in poor fruiting. The crop is mostly cultivated in garden lands commanded by well irrigation, the water being lifted by *piccotahs*. The crop occupies the field for about seven to eight months, i.e. from February to end of September.

Preparatory cultivation.—Immediately after the rains of the north-east monsoon (December-January) about 5 or 6 ploughings are given with the country plough. Then the land is properly levelled, beds prepared and drains dug to facilitate easy flow of water. Just before the last ploughing, manure is applied either by penning sheep or by applying cattle manure at the rate of twenty-five cartloads per acre. Then beds and channels are formed with the hand *danthi*, the size of the beds being 4 x 4 feet. Again at the time of planting each bed receives a basketful of well-rotten cattle manure. In the centre of each bed a loose shallow pit of one foot diameter is made and the manure well mixed with the soil. Planting is done in the month of February and the method consists in cutting the stems of the previous season into pieces of one foot length and planting them vertically in the soil with about two-thirds portion exposed. The cuttings of the stem should have at least a minimum thickness of $\frac{1}{4}$ inch. Care should be taken to see that at least a quarter of the cut stem goes into the soil, and that they are not planted in the inverted position. Each bed shall receive about 3 or 4 cuttings planted 4 inches apart.

After-cultivation. (Irrigation, propping and hoeing).—The first irrigation is done by pot watering immediately after planting, each bed receiving about half a gallon of water per time. Pot watering is continued every day for one week and every alternate day during the next week. By the end of the fortnight the cuttings will put forth tender shoots and by the end of the month the new stem grows to a height of about 6 inches. This is the proper time for the helpless young shoot to receive a support. For this purpose brushwood from any hedge plant of about 2 feet length are stuck up all round the plant. When the creeper outgrows the height of the brushwood a permanent support in the shape of an arched pandal is given. Casuarina branches will answer this purpose well and the height of the arch should be at least 4 feet so as to facilitate a man to sit underneath for hoeing, weeding and picking fruits. Hoeing is begun after the first fortnight and two or three subsequent hoeings are given once in a week or ten days. After completing the arch work, water is let into the beds from the nearest well with the help of the *piccotah*. This lift irrigation is to be given once in a week till the commencement of the rains in June-July, depending on the soil moisture and rainfall.

Harvesting and marketing the fruits.—Flowering begins in March and fruits will be ready for the first harvest in April. Picking is done by boys or girls, who carry small hand baskets with them. Care should be taken in picking so that neither too ripe (indicated by the red colour) nor too tender fruits are collected. The yield will be maximum during the hot weather months (April and May) and gradually goes down from June to the end of September. During this time there will be heavy rains on account of which the leaf becomes pale and the plant becomes shrivelled up.

Every year about Rs. 5,000 worth of fruits are exported from this village to other places. The usual selling rate by the ryots to the vegetable merchants is at 2,000 fruits per rupee. But at Rajahmundry and other places these fruits are sold at a retail price of 0–2–0 per seer of 80 tolas, the number of fruits in a seer being about 80. For every picking in an area of 25 cents the average number of fruits obtained is 15,000 which fetches a price of Rs. 7–8–0. On an average there will be twenty pickings in one season and therefore an average ryot of this locality cultivating an area of 25 cents can get three lakhs of fruits costing Rs. 150.

Cost of Cultivation of the Crop. Average holding of 25 cents

Items of Expenditure	Bullock pairs at 12 As.	Men Coolies at 6 As.	Women Coolies at 3 As.	Cost
Preparatory Cultivation—				RS A P
Eight ploughings with country plough	8	8	...	9 0 0
Levelling with hand danti ...	...	2	...	0 12 0
Preparing beds and channels ...	...	4	...	1 8 0

Cost of Cultivation of the Crop. Average holding of 25 cents—(*contd.*)

Items of Expenditure	Bullock pairs at 12 As.	Men Coolies at 6 As.	Women Coolies at 3 As.	Cost
				RS A P
Manuring—				
Sheep penning (300 goats or sheep for one night) ...	...	...	...	3 0 0
Cattle manure (before planting) three cartloads	...	...	...	3 0 0
Spreading	...	...	2	0 6 0
Seeds and Sowing—				
Cost of cuttings for 600 beds at 0-0-2 per bed	...	...	...	5 0 0
Digging and planting stems ...	...	4	...	1 8 0
Irrigation—				
Pot watering for fifteen days ...	...	8	36	9 12 0
Subsequent channel irrigations once a week (twenty irrigations at 3 each)	...	60	...	22 8 0
After-cultivation—				
Hoeing and weeding at five men per time for eight hoeings ...	...	20	...	7 8 0
Propping brushwood, casuarina branches, etc. including labour	...	...	...	6 0 0
Harvesting—				
Labour for picking fruits (twenty pickings April-August, once a week at 6 As. per picking) ...	...	...	40	7 8 0
Contingencies	...	...	...	4 2 0
				70 4 0

	RS A P
Gross income ...	150 0 0
Expenses	70 4 0
Profit	79 12 0

From the above figures the approximate profit for an acre of cultivation is found to be Rs. 300. Although the figures include all sorts of expenses the ryot in actual practice will not spend so much for harvesting, purchasing stems for planting, purchasing brushwood, etc. Ryots generally need not purchase cuttings as they can preserve them from the previous season, or they may borrow from other ryots free of cost. Such items of expenditure can be economised by the ryots in actual practice which will add to their income.

EXTRACT

THE MINERAL REQUIREMENTS OF DAIRY CATTLE

(From an article on 'Animal Nutrition' by Dr. C. Crowther, M.A., Ph.D., in 'Agricultural Research in 1930', John Murray, London, 1931)

The study of the significance of the various mineral elements in animal nutrition, and their distribution in common feeding stuffs and fodders, has now become almost world-wide, and is producing a formidable literature that is difficult to survey. In the case of dairy cattle fortunately the situation has been recently reviewed by Crichton (*Journal of Dairy Research*, vol. ii, No. 1) in a comprehensive monograph covering the requirements for growth, milk secretion and reproduction, supplemented by a bibliography of 124 references to work published up to the end of 1929. Despite this voluminous mass of work bearing on the subject the general conclusion is drawn that 'our information is exceeding scanty.' . . . .

Our knowledge is greatest with regard to the two elements, calcium and phosphorus, and the main points from Crichton's review of the existing information on the bearing of these upon the well-being and productivity of the dairy cow may be briefly summarised.

In the case of the half-grown animals, good pasture supplies an abundance of all the mineral elements necessary to maintain optimum growth and health. In the later stages of development, pasture deficiencies may adversely affect both growth and health, as in the case of the now familiar phosphrous deficient areas in South Africa. Calcium deficiencies are probably more common in this country, but there is no direct evidence as yet that pastures grazed by cattle are so poor in calcium that this deficiency affects the rate of growth and health, although a wider and more careful survey of our pastures may reveal such cases. In indoor feeding of half grown animals there is no evidence that the ordinary rations used in practice are deficient in calcium or phosphorus to such an extent as to cause obvious signs of malnutrition or retardation of growth.

Coming to the case of the lactating cow, good pasture will usually supply both calcium and phosphorus in suitable proportions, and moreover along with the factors (e.g. vitamin D) that make for assimilation of calcium. On poor pastures, however, deficiency of phosphorus may be so extreme as to limit milk production, but we are unable to say as yet whether deficiency of calcium in poor pastures may be so extreme as to affect milk yield.

In indoor feeding of milk cows, the concentrates commonly used, especially the cereals, though relatively rich in phosphorus, are poor in calcium, and for any but comparatively low milk yields are definitely deficient in this element. Such deficiency may adversely affect both milk yield and reproductive capacity.

In most of the observations that have been made during periods of heavy milk yield, it has proved practically impossible to maintain the store of calcium in the cow's body. On rations with a low calcium content, the drain on the body reserves may be reduced by the addition of calcium salts to the food, and under such conditions it is also desirable to ensure the presence of factors, such as vitamin D, which aid calcium assimilation. 'Optimum conditions for this would appear to be obtainable by feeding fresh green leguminous pasture, or failing that, leguminous hay cured with a minimum of exposure, and by exposing the animals to sunshine and providing a certain amount of exercise. Even then the addition of a calcium supplement, with or without cod-liver oil, would probably increase the amount assimilated.'

Crichton inclines to believe that in most heavy milking cows, there is a progressive depletion of calcium from the tissues, so that at the end of lactation there is actually less calcium in the animal's body than at the beginning, but the evidence on this point is conflicting. Thus recent American experiments with high yielding cows indicate that with suitable rations, reinforced by additions of calcium and phosphorus, although at the height of lactation losses of calcium from the cow occurred, these were subsequently made good as the milk yield fell . . . . .

From a survey of Swedish conditions Hansson concludes that in that country the milch cow will always need an application of salt to its food, and often also supplements of lime and phosphorus, but other minerals will probably rarely be required, apart from certain districts in which there is evidence that very small additions of iron and iodine may be helpful. As regards salt supply, he suggests a daily allowance according to milk yield at the rate of about 1·5 gm. per litre of milk (roughly $\frac{1}{4}$ oz. per gallon). For lime and phosphoric acid, a daily maximum of 40 to 50 gm. (barely 2 oz.) of each is suggested. His final word, however, for safeguarding the mineral supply for both dairy cows and young stock is a strong recommendation of the improvement of pastures, a conclusion at which Sjollema also arrives in his survey of the mineral problem with reference to conditions in Holland.

AN AGRICULTURAL TOUR

(By A STUDENT OF B.Sc. Ag. II)

The annual tour of the second-year students this year was confined to a six-day visit to Mettur and Palayakottai. Leaving Coimbatore the previous night, we reached Mettur on the morning of January 5. A general stroll in the morning revealed to us the general lay-out of the big project which has by now become very famous in South India and around which a big colony has sprung up.

In the afternoon we visited the Power and Test houses and saw the dam line. The Power-house is the pivot of the colony. Electricity at a voltage of 33,000 is obtained from Sivasamudram (distant 62 miles) and is received at the Mysore end of the Power-house. Consequent on the difference in frequency between the Sivasamudram and Mettur plants, power is transmitted to the latter after suitable transformations. The power so transmitted is utilized for various purposes, the chief of which are lighting the colony, running the compressed air plants for pneumatic work, driving the liquid oxygen plant, working the black and red concrete-laying towers and working the stone crushers. Two of the four air compressors develop 105-h.p. and are capable of compressing per minute 419 cubic feet of air to 100 lb. pressure per square inch. The other two take on 120-h.p. and have a capacity of 569 cubic feet. Compressed air is stored in specially constructed huge cylinders and is used in diverse ways such as boring

operations, cleaning the water filters etc. Liquid oxygen is prepared by compressing air to 3,000 lb. per square inch allowing the boiling nitrogen to escape and reducing the temperature to −180° C. The final impurities are removed by treatment with potash. The 'L.O.X.' as it is called is used for blasting and detonating purposes. The special advantage in its use is that the workmen can resume labour immediately as no noxious or harmful gases are liberated. The actual process of blasting is simple. Special cartridges of sawdust alone or mixed with aluminum powder prepared in brown paper packets are saturated with L.O X. The required number are then transferred to bore holes and a fuse applied.

The Test house is an efficient Engineering laboratory where various samples of concrete and cement used in building the dam are tested before being used.

The dam line is a huge block of masonry estimated to measure 5,000,000 cubic feet. It runs east to west and is nearly a mile long. It is 18 feet wide at the top which is 801 feet above sea level and gradually increases in width according to the batter reaching a maximum of 167·48 feet at its bottom (610 feet above sea level) and is pierced by high and low level sluices and the hydro-electric turbines. For facility in construction, the dam is divided into three portions. The depth of the foundation varies at different places according to the depth of the rock, the maximum being 220 feet.

This reservoir is regarded to be the third biggest in the world, and the pressure on the dam being enormous (15 tons per square foot), advantage is taken to generate electricity from the water stored under such great pressure. For this purpose four sets of hydro-electric pipes specially made of riveted steel have been built into the left flank of the dam and occupy about 240 feet of length of dam. The head water under which the pipes operate varies from 60 to 160 feet according to the quantity of water in the reservoir. From 5,300 to 15,000-h.p. will be developed by each pipe between these two heads of water. With an average of 125 feet head the total horse-power is about 33,000. The outflowing water from the turbines follows the course of the river and can subsequently be used for irrigation purposes.

On Wednesday we visited the towers, the stone-crushers, the water works, the drainage station and the sewage farm. The towers are said to be the biggest in the world and are 306 feet high. They are worked by elaborate power-driven mechanism. The towers mix and dump the concrete. They are capable of propelling themselves on wheels at the rate of 10 feet per minute.

The stone-crushers are also amongst the world's most gigantic ones. These break huge blocks of granite to pieces of various sizes and these stones are graded into different classes by sieves. A bird's-eye view of the whole colony can be obtained from Mulling's seat (930·14 feet above M.S.L.)

The Mettur water works being the most up-to-date one of its kind in the whole of the Presidency, it merits more than cursory attention. A large and deep pool on the left bank through which water flows even during summer has been selected as a suitable site for the pumping station. The maximum suction lift of the electric pumps is only two feet. The pumps discharge into a thousand feet long 12 inches rising main which delivers the water into a chamber outside the chemical house. The raw water passes through a stilling chamber provided with a special measuring weir. An instrument called 'Fluscograph' which is operated by a float and situated in a tank in the chemical house and in communication with the weir automatically records the rate of flow. Suitable arrangements are also made for the automatically regulated inflow of alum solution into the raw water, the dosage depending on the turbidity of the water. The 'flock' or deposit of suspended impurity is drawn off through valves situated at the lowest point of each tank. After clarification in the coagulation tanks, the water flows into the Patterson Rapid Gravity filters where the water passes through a filtering medium of graded sand and pebble 45" deep. It then enters a network of pipes through a series of small nipples with face downwards and subsequently passes through inspection chambers into a collecting channel. The water is then chlorinated by a 'Chloronone', by means of which an accurately measured volume of chlorine gas is released from a cylinder of liquid chlorine and mixed with the water. After chlorination the water flows into two low level service reservoirs with a capacity of 200,000 gallons each. A portion of the water is pumped to two high-level water reservoirs of 100,000 gallons each and these supply wash water for the filters, the Salem camp, quarries, etc.

The drainage system is completely underground. The two main sewers serving in the northern and southern half of the camp discharge into a chamber at the sewage

pumping station. This water is pumped to the sewage farm. The farm has an area of 50 acres with a soil of light sandy loam very suitable for sewage irrigation. In the initial stages elephant grass and guinea grass were grown and the fodder scarcity in the locality at once created a ready market for these. Later, the growing of cholam, cumbu, cotton, castor, chillies, gingelly, plantains and tobacco has been taken up with very good results. The daily discharge of about 150,000 gallons sewage is enough for 15 acres. During the rains however as much as 40 acres are under cultivation. The farm though mainly started to consume the sewage water and ensure the sanitation of the colony is now a source of profit to the Government.

Our activities at Mettur concluded with a hockey match on Wednesday evening with the local team which we won by 3 goals to nil. We had some practice games in tennis and ping-pong also. On the whole our stay at Mettur was very much enjoyed and our thanks are due to the various gentlemen of the place for their uniform cordiality and courtesy.

Thursday the 7th was spent in the journey from Mettur to Palayakottai with a few hours at Erode *en route*. The day was hot and dusty but still some of us had a stroll at Erode and saw the exquisitely laid-out public park. At dusk we reached Palayakottai, 19 miles south of Erode. Palayakottai was in several respects a contrast to Mettur. The stifling atmosphere of Mettur with the constant din of machinery and the rumbling of trolleys gave place to the serene calm of Nature's tranquility manifested in the vast expanse of meadows and valleys and the slow meandering Noyyal.

The hospitality and affability of the Pattagar and his lieutenants soon put us at our ease and our every convenience was very solicitously attended to throughout the period of our stay. For all these and host of other similar kindnesses (including the lavish scale in which the commissariat was supplied, specially in the matter of milk, curd and ghee), we tender our grateful thanks to the Pattagar and his capable staff.

The Pattagar is a cattle breeder *par excellence* and many distinguished visitors have paid him glowing tributes. He has a stock of 2,000 head of cattle and he maintains this strength in spite of the annual sale of about 400 animals. He is the most outstanding breeder of 'Kangayams' and it is interesting that his cattle are reared in a natural environment where they grow semi-wild until broken to work prior to the cattle fairs. His stock is classified into bulls, bullocks, cows and heifers and each group is herded into large pasture lands with an acreage of 150 to 200. On an average 2 to 2½ acres maintain an animal and there are about 4,000 acres under pasturage. The staple grass is the *Kolakatlai* grass (*Pennisetum cenchroides*) which comes up luxuriantly in that locality. There are numerous paddocks and as one gets exhausted the herd is driven into another. The herd of cows include a few bulls in active service, about 50 cows being allowed to each bull. One herdsman is attached to a herd and it is his duty to report to his master when and by what bull a particular cow was served. Maternity and parturition take place in the field itself and again it is the herdsman that triumphantly carries the calf to the owner. The Pattagar has a very accurate and almost uncanny knowledge of the genealogy of every animal in his herd and it is really a treat to see him trace the ancestry back to 32 years of any animal one may point out at random.

As a farmer, the Pattagar is no less efficient. Clean cultivation is his watchword and every one of his fields is properly attended to. His personal supervision even of minor details, leaves no room for any slipshod work. He has large areas under tobacco, chillies, cotton, cholam, cumbu, etc. Equally on a par with his worth as a cattlebreeder and farmer is his reputation as a landlord. There are about 300 families under the Pattagar. Each family has to supply one adult's labour daily. The worker gets his midday meal free. The relationship between the landlord and his tenants is very cordial and strongly reminiscent of the ancient feudal system.

Our pleasant stay at Palayakottai will always be a memorable one for our class. We returned to headquarters on the 11th January, 1932.

Notes and Comments

Eri Silk Culture.—As a cottage industry to help the lot of the many unemployed among us, the cultivation of eri silk worm and the production of eri silk is an ideal one. The worm that produces this silk is quite unlike the ordinary widely cultivated mulberry silkworm and feeds on the castor plant which is extensively grown all over our Province. It has also other features which would appeal to orthodox Indians who are averse to the killing of living beings ; while in the case of the mulberry worm the chrysalis inside the cocoon has to be killed either by stifling or drying it in the sun for purposes of getting the silk reeled out ; in this castor worm the adult moths can be allowed to emerge cutting through the cocoon. In addition, the eri worm can be reared in most places especially in damp moist tracts like the coastal areas where the mulberry silkworm can be reared only with some difficulty. Attempts at rearing this insect were made at the Agricultural College, Coimbatore, several years ago and over twelve continuous broods were reared with success. The main difficulty experienced in those days was the failure to get a ready market for the small quantities of cocoon reared out from time to time. We are now glad to learn that the Director of Industries, Madras, who appears to be very enthusiastic over the future possibilities of this industry, is arranging to find an easy sale for the small quantities of silk cocoons and yarn that may be produced as a cottage industry by farmers and householders. This and the comparatively easy and cheap methods of rearing this worm will, we hope, help to push up this interesting industry in this country.

Agricultural Experiment in Mysore.—It is very interesting to note the scheme of experiments which the Mysore Department of Agriculture is arranging this year with the members of the Mysore Agricultural and Experimental Union. Those members of the Union who are anxious to carry out any of the experiments are supplied with the necessary seed, manure etc., and all that they have to do in return is to agree to carry out the experiments and report the results as required. The experiments formulated include (1) Trials of selected strains of *ragi*, groundnut, cotton, paddy and sugarcane ; (2) Trial of manures for sugarcane, paddy and areca ; (3) Trial of methods of control against insect pests of cane, stored produce, coffee, citrus and lablab ; and (4) Trial of measures to check fungus pests especially of *sholam* and potato. The plan is well worked out and these trials by different persons are sure to produce some tangible and reliable results untrammelled by departmental or official considerations. This method is, in our opinion, well worth copying by any association of farmers.

Rice Research Scheme for India.—With the idea of increasing the production and quality of rice produced in different parts of India, the Empire Marketing Board in Great Britain has provided a grant for a five-year scheme of research in problems connected with paddy cultivation. The grant amounts to over two lakhs and the Imperial Council of Agricultural Research in India is organising the scheme. While the latter body has to finance the work in other provinces, the Empire Marketing Board has offered to bear a part of the cost of such schemes in Burmah and Bengal, the chief rice-growing areas. It is understood that Madras is to have a research

station in this connection and the same, we learn, is to be at Berhampore in the Ganjam District. Whatever the idea with which the scheme has been started, research work on a very important crop like paddy is certainly one well worth encouraging.

New Syllabus for the B. Sc. Ag. Degree Examination.—We are gratified to hear that the revised syllabus for the B. Sc. (Ag.) degree examination has been approved by the Academic Council of the Madras University at a recent meeting of that body. It now remains for the Senate to formally approve of it and the Syndicate to adopt it. As far as we know, the most important change made appears to be the holding of three examinations, one at the end of each year, instead of the two held at present. The idea of the first examination appears to be to weed out candidates who do not show sufficient aptitude for the different sciences which form the basis for the study of agriculture. We hope to comment on the new aspects of the syllabus in a future issue.

Protection for Fruits and Vegetables.—The Ministry of Agriculture and Fisheries in Great Britain has recently issued an order imposing different rates of import duties on fresh fruit, fresh vegetables and flowers. These include currants, grapes, cherries, plums, etc. among fruits; asparagus, beans, cucumbers, carrots, lettuce, green peas and mushrooms among vegetables, and various fresh-cut flowers. The duty ranges from ½ penny per pound to 30 shillings per cwt. The duty is only payable during certain fixed seasons of the year. This measure of protection is evidently imposed with the idea of increasing local fruit and vegetable production and prevent importation from abroad on a large scale. There is no doubt that great quantities of tropical and sub-tropical horticultural products from the Continent, America and the West Indies find a good market in England and the duty might check such importations to some extent.

The Indian Science Congress, 1933.—By an oversight we made a mistake in stating that *Allahabad* has been fixed as the venue of the next Session of the Indian Science Congress. The next Congress is to meet at *Patna* in Behar. We regret the error.

Cotton Control Bill.—A bill with this title is proposed to be introduced in the Madras Legislative Council shortly. The object of the bill is explained thus: The quality and the reputation of the Karunganni cotton which is the special feature of the Tinnevelly area and which plays a prominent part in the economic prosperity of the cultivators in that area on account of the great demand for this cotton, are being threatened by the admixture of other cottons, in particular *G. neglectum* (*Pulichai*) both in the field and in the factory. In the draft bill it is proposed to take power to notify from time to time after sufficient notice to the cultivators, all kinds of cotton that may in the opinion of Government require to be proscribed. Power is also proposed to be taken to uproot the proscribed cotton plants cultivated in fields and seize cotton found elsewhere in the notified areas. Provision has been made for the examination and analysis by experts, of the cotton seized, before launching prosecution. The usual clauses for making the necessary rules are also added.

Land for the Educated Unemployed.—An A.P.I. message to the Madras papers states that Dr. G. T. Hongorani, President of the Karachi Hindu Mahasabha, has initiated an interesting scheme for the relief of educated unemployed persons in Sind, whereby some Zemindars have agreed to give

eight to fifteen acres of land, together with seeds, bullocks and implements for cultivation, to each such unemployed person, who will be entitled to half the earnings from cultivation, the other half going to the Zemindar. An important condition is that the men should be prepared to do all the necessary manual labour. The message adds that twenty-five youths have accepted the offer and are proceeding shortly to settle on lands near Jacobabad, Larkana, Nawabshah and other towns. The problem of the educated unemployed is as keen, if not keener, in the Madras Presidency than anywhere else in India. We would commend the example of the Sind Zemindars to the attention of the major Landholders and Zemindars of this Province.

ABSTRACTS

Some factors concerning Earliness in Cotton.—LUDWIG, C. A. (*Jour. Agr. Research*, 1931, vol. 43, pp. 637–659). Experiments on the square-maturation periods of five upland varieties of cotton in South Carolina showed :—(1) The relative length of boll-period is dependent upon hereditary characters. Upland and Asiatic cottons have shorter boll periods than Egyptian and Sea Island cottons. (2) Neither the amount of nitrate applied as fertilizer, nor the time of application had a perceptible effect on the square or boll period. (3) Variations in the spacing of the plants had no appreciable effect on either the square or boll period except possibly a slight shortening of the boll period in wide-spaced plants, which was masked by the result of other influences. The earliness of the crop from close-spaced plants is attributed to other factors and not to a shortening of the boll period. (4) Stripping forms from the plants had no perceptible effect on the square period. Stripped plants grew taller, produced more late blooms and bolls, matured a greater percentage of the late set bolls and remained green longer in the autumn than unstripped plants. (5) The usual cultivation period and a length-ened period produced an increase in square and boll periods, over no cultivation. This is attributed either to a genuine lengthening of the period or to an apparent lengthening caused by increasing the number of bolls which matured late in the season. (C. N.)

Studies on the Toxicity of Gossypol.—GALLUP, W. D. (*Jour. Biol. Chem.*, vol. 93, pp. 381–405). Gossypol is the toxic principle of cotton seed ; the injurious effects of raw cotton seed and cotton seed meal as feeds for animals have been traced to their gossypol content. In experiments with rats, it is found that normal animals well supplied with vitamins were less affected and were able to withstand much larger quantities of gossypol than those depleted of their Vitamin A store, and receiving sub-normal amounts of the vitamin. Further, it is shown that in certain cases, removal of excess of calcium from the feed was attended by fatal results. These findings are believed to be of importance in their relation to the fatal results so often encountered in the common use of cotton seed products in rations undoubtedly deficient in certain vitamins and perhaps unbalanced in mineral content. (T. R. S.)

The decomposition of Green Manures grown on a soil and turned under, compared to the decomposition of Green Manure added to a Fallow Soil.—SMITH, N. R., and HUMFELDT, H. (*Jour. Agr. Research, 1931*, vol. 43, p. 715). Have compared the effect of growing rye or vetch on the land and turning it under (Treatment A) with growing it elsewhere and ploughing it in (Treatment B), on (1) the rate of evolution of carbon dioxide, (2) accumulation of nitrates in the soil, (3) soil acidity, and (4) plate counts of micro-organisms. Treatments (A) and (B) made no difference in the total amount or rapidity of carbon dioxide evolved, which generally reached a peak on the 3rd or 4th day after green manuring. After 12–14 days, the amounts given off were only slightly higher than that given off by the untreated soil. The effects of treatments (A) and (B) on the soil microflora and nitrate accumulation show marked differences. In both cases (A) and (B) in the early stages of decomposition of green manure, the plate counts of micro-organisms varied directly with the rate of evolution of carbon dioxide ; but after the early stages, there was an inverse relationship in the case of (B) between nitrate accumulation on the one hand and the plate counts and carbon dioxide evolved, on the other ; whereas, in the case of (A), there was no such inverse relationship. The inverse relationship in (B) was maintained even at advanced stages of decomposition, in presence of sufficient lime. In treatment (A), there was a steady increase of Nitrate Nitrogen from beginning to end of experiment, while in (B), there was an initial decrease in the first 4 days, followed by an increase, the peak being reached in 14 days. In limed soils,

nitrates decreased at the end of the experiment, while unlimed soils showed a steady increase. Treatment (A) increased the number of fungi in the soil, while (B) had no such effect. In (A), the number of micro-organisms showed two maxima, an early one corresponding to decomposition of the tops and a secondary one later, due to decomposition of roots. Neither treatment (A) nor (B) affected the pH of the soil. (C. N.)

A Note on the Reclamation of a Greenhouse Soil containing Sodium Clay.—TAYLOR, E. M., WOODMAN, R.M., and HANLEY, F. (*Chemical News*, vol. 153, No. 3735, p. 309). By supplying brackish water containing 1·6 per cent of sodium chloride from 1926 to 1928, the greenhouse (virgin) soil at Clenchwarton, Norfolk, was partially converted into sodium clay and rendered unfit for tomato cultivation. Removal of top soil to a depth of 12-14 inches, and replacement by soil from a neighbouring field, followed by addition of organic matter, did not improve matters, as an analysis of the top soil again showed the presence of 0·2 to 0·26 per cent of NaCl, due probably to an upward movement from the sub-soil. Application of magnesium sulphate at the rate of 10 cwt. per acre, followed by flooding with rain water, for two seasons, brought down the salt content to 0·06 per cent and showed marked improvement in the yield of crop. (C. N.)

The effect of artificial drying upon the vitamin content of Alfalfa.—HANGE, S. M., and AILKENHEAD, W. (*Jour. Biol. Chem.*, vol. 93, pp. 657–65). Alfalfa (lucerne) is known to have a high nutritive value and further a high Vitamin A content. But during drying under field conditions in the process of making hay, most of the vitamin is lost. This has been traced to the action of enzymes, which under the favourable conditions of temperature and humidity during slow field-drying bring about the destruction of the vitamin. Rapid mechanical drying with either heated air or hot flue gases, has been shown to be effective in preserving the Vitamin A content to a great extent. (T. R. S.)

Synthetic Rubber.—CAROTHERS, W. H., IRA WILLIAMS, COLLINS, A. M., and KIRBY, J. E. (*Jour. Amer. Chem. Soc.*, 1931, vol. 53, pp. 4203–25). The Du Pont Company of America are erecting a plant for the manufacture of synthetic Rubber, called *Duprene*, as follows: Lime and carbon when heated in the electric furnace produce calcium carbide, which on treatment with water yields acetylene. This gas is passed into an ammoniacal solution of cuprous chloride, when it polymerises to vinyl acetylene, which on treatment with hydrogen chloride yields *Chloroprene*. This liquid spontaneously polymerises on standing to a jelly-like mass, the 'plastic polymer,' which when heated for a short time at 110°C, yields an elastic mass, the 'synthetic rubber.' The finished product appears more dense, more resistant to water absorption, less strongly swelled by hydrocarbons and much more resistant to oxidation than natural rubber. It is further more highly resilient and does not soften when heated, but very slowly hardens to a vulcanite material. It is of interest to note that no sulphur is necessary for its vulcanisation, as mere heating effects the purpose. (C. N.)

The Preservation of Sugarcane Seed.—SARTORIS, G. B. (*Facts about Sugar*, vol. 26, 1931, p. 536). (1) Sugarcane seed preserved over calcium chloride and carbon dioxide, at room temperature, maintained viability for 8 months. (2) The total number of seedlings from the stored seed compared favorably with the number secured from immediate germination of a given amount of fresh seed. (3) Seed preserved with calcium chloride germinated very well after 2 months of storage and seed stored for 8 months germinated fairly well. (Author's summary).

Studies of Lignin in Wheat Straw with reference to Lodging.—PHILLIPS, M., DAVIDSON, J., and WEIHE, H. D. (*Jour. Agr. Research*, 1931, vol. 43, pp. 619–26). In order to test the correctness of the two current theories put forward to account for the 'lodging' of cereal plants at the close of their vegetative period, viz., (1) the older theory of Davy and Liebig which attributed it to deficiency of silica, and (2) the later theory of Sacchs and Welton which attributed lodging to several causes, principally deficiency of lignin in the culms of plants, the authors carried out analysis of lodged and unlodged wheat plants, for lignin, methoxyl, cellulose, silica and ash content. Wheat stalks from sodium nitrate plots which had 'lodged' contained a higher percentage of methoxyl, cellulose and lignin than 'control' plots where no lodging had taken place, thus disproving Sacch's theory. Sodium nitrate caused a distinct decrease in the silica content of the straw and the results confirm Liebig's theory that lodging is due to deficiency of silica in the straw. Other interesting facts brought out by the comparative analyses were (1) early applications of sodium nitrate caused an increase in the lignin content in proportion to the amount of fertilizer applied; later applications had no such effect; and (2) in the early stages of growth, the ash content was higher in the stalks from the plots to which sodium nitrate had been applied, but at the stage when 'lodging' occurred, the stalks from the 'control' plots showed a higher ash content than that from the fertilised plots. (C. N.)

Effect of Stage of cutting on yield and quality of Lucerne.—TURPIN, H. W. (*Farming in S. Africa*, 1931, vol. 6, p. 388). Experiments covering a period of 7 years, show that the most desirable stage at which to cut lucerne for hay is the '10 per cent flower' stage, i.e. when about 10 per cent of the total flowers are fully open. Comparison of 3 varieties (Hunters River, Provence and Chinese) showed that about 10 tons of hay per acre could be obtained at the above stage, with a higher proportion of leaves (40–50 per cent) than at other stages. (C. N.)

Composition of Lucerne hay cut at different Stages.—SPUY, M.J.V.D., and STEAD, H. A. J. (*Farming in S. Africa*, 1931, vol. 6, p. 401). Analysis of hay made from lucerne cut at different stages of growth showed the following differences:—

	Stage of cutting.			
	Bud.	10 per cent flower.	50 per cent flower.	100 per cent flower.
Yield of dry hay ... ... lb.	30,195	36,064	35,512	35,144
Ash ... ... percentage.	10·8	10·4	10·1	8·2
Fat ... ... ,,	3·6	2·9	2·4	2·4
Crude protein... ... ,,	26·0	24·2	20·9	18·2
Crude fibre ... ... ,,	24·5	28·1	32·8	36·5
N free extract ... ... ,,	35·1	34·4	33·8	34·7

The figures would indicate the advisability of cutting lucerne at the 'Bud' stage but the determination of the total digestible nutrients per lb. of hay, show that these are highest at the 10 per cent flower stage, and show a superiority of 15·4 per cent over the bud stage in respect of the cost of the digestible nutrients present per ton of hay. It is concluded that cutting lucerne at the 10 per cent flower stage combines good quality with high yield. (C.N.)

Butter-fat (Ghee—Its nutritive value, adulteration, detection and estimation).—GODBOLE, N. N., and SADGOPAL (*Pamphlet issued by the Department of Industrial Chemistry, Benares Hindu University, Benares*, pp. 48).—In this interesting pamphlet, Dr. Godbole and Sadgopal have examined most of the methods in vogue for the detection and estimation of adulteration of butter-fat (Ghee), and conclude that the following methods are satisfactory:—(1) *Qualitative detection of adulteration.* The fat is examined in the Wollny's Butyro-refractometer. Pure butter-fat (cow or buffalo) shows at 40° C, variations of refractive index between 40°·00 to 43°·00. Note through the eye-piece the colour of the fringe at the line of separation when taking the reading. For pure butter-fat, the fringe is light violet or colourless; for vegetable oils, orange or green; for animal fat adulterants, blue or greenish blue. (2) *Quantitative estimation of adulterants.* The authors give particulars for the determination of what they term the (A) and (B) values of the fat. The magnesium salts of the lower fatty acids in butter are soluble in water, while the magnesium salts of the higher fatty acids are insoluble. The number of cc. of tenth-normal silver nitrate necessary to titrate the soluble magnesium salts are denoted by the number (A). (B) represents the number of cc. of tenth-normal alkali required to titrate the butyric acid present in the fat. For pure butter-fat, (A) varies from 6·27 to 7·4 and (B) varies from 33·13 to 37·44. Adulteration tends to decrease the (B) values in all cases and the (A) values also in most cases. By a comparison of the (A) and (B) values, the amount of adulteration can be estimated. (C.N.)

The Calcium and Phosphorus Supply of Dairy Cows—LINTON, R. G. (*Agriculture and Livestock in India*, vol. 1, part vi, pp. 673–87), stresses the importance of a sufficient supply of Calcium and Phosphorus during the period of lactation, when the gross losses of these elements may amount in a period of lactation to as much as 25 per cent of the total bone reserves of the cow. Halnan in his new survey of maintenance requirements suggests a standard for maintenance of 5 lbs. S. E. and 0·6 lb. P. E., and for milk at 2·3 lb. S.E. and 0·54 lb. P.E. per gallon of milk. Kellner's figures for Ca and P for maintenance are 32·5 gm. Ca and 10 gm. P daily for a 1,000 lb. cow. Milk contains 0·118 per cent of Ca and 0·10 per cent of Pod on the average (Rowett Res. Inst. averages are 0·166 per cent CaO and 0·229 per cent P). On the above analysis, the amounts

of Ca and P secreted per gallon of milk will be 5·38 gm. Ca and 4·5 gm. P. Adding these figures to the maintenance ratio for Ca and P given above, and assuming that about 20 per cent of the minerals injested in the feeding stuff are assimilated by the animal, the writer has arrived at the following feeding standard for a 1,000 lb. lactating cow :—

Maintenance plus milk (3·5 per cent fat.)	S.E. lb.	P.E. lb.	Writer's Standard		Kellner's Standard	
			CaO gm.	P_2O_5 gm.	CaO gm.	P_2O_5 gm.
1 Gallon milk	7·3	1·14	59·4	32·5	41·2	17
2 ,, ...	9·6	1·68	86·3	55·0	49·9	24
3 ,, ...	11·9	2·22	113·2	77·5	58·6	31
4 ,, ...	14·2	2·76	140·1	100·0	67·3	38
5 ,, ...	16·5	3·30	167·0	122·5	76·0	45

The writer's standard is compared above with Kellner's standard based on 32·5 gm. Ca and 10 gm. P for maintenance and 0·87 gm. Ca and 0·7 gm. P, in addition, for every pound of milk. The lower values given for Ca and P in Kellner's standard, correspond to an utilization ratio of 62 per cent of the Ca and 64 per cent of the P injested by the animal. The writer opines that this ratio is high and quotes experiments to show that the utilization percentage varies from 10 to 50 per cent depending on the kind of material, and recommends the use of fodders containing above 0·7–1·0 per cent CaO and 0·5–0·7 per cent P to ensure better utilization of Ca and P which in turn improve the assimilation of Vitamin D. (C.N.)

Gleanings

Progress of Agricultural Science.—' Modern science, in short, has been so successful in increasing man's power over Nature, that it has brought us harvests far more bountiful than what we know what to do with. Yet, although we may think in our pride that we have achieved a wonderful control over Nature, our control is really very limited, our tenure uncertain, and our margin of safety very exiguous. How long mankind will have the wit to go on developing more powers, we do not know. It is quite certain that any slackening of control or failure to utilise scientific discovery by any one group of cultivators would speedily eliminate them through pressure of more enlightened and therefore more successful competitors. It is however, not so much human competition, as the opposing natural agencies that must continuously be watched. The weather can still defeat our best laid farming plans. Over large parts of our Empire, there is a continuous struggle for possession between insects and man, and the margin of victory, even when we get it, is never very great.'—Sir JOHN RUSSELL (*Nature*, December 19, 1931).

New Tobacco Plant has no Nicotine.—'Tobacco minus Nicotine is produced from the leaves of a remarkable plant raised in Germany. This botanical freak is the reward of experiments conducted under the direction of the Ministry of National Economics at a Research Institute established in the midst of the tobacco-growing fields of Pfalz. Although an extract from the leaves is virtually as harmless as drinking water, the "smokes" made from the plant are said to have all the flavour of ordinary tobacco. An unexpected by-product of the experiment was the discovery that the leaves could also be used to prepare a succulent salad. As if that were not enough, the salad may be flavoured with oil extracted from the same plant, according to Dr. Paul Konig, Director of the Institute.'—(*Popular Science Monthly*, February, 1932).

Present Trend of Science.—' One way of expressing the present trend in Science is to say that Physics becomes more mathematical, Chemistry more physical, Biology and Geology more chemical . . . . . The *two great trends* (in Chemistry) are : an ever-increasing exactness, and a broadening toward, and an inter-penetration with, the

neighbouring Sciences.' The twofold result is simultaneous growth, both in breadth of view and in depth of insight.'—(Prof. HENRY C. SHERMAN in *A Quarter Century of Learning*.)

Preparation of Vinegar from Coffee Fruit Pulp.—' The raw material is the pulp which covers the two seeds or beans of the Coffee fruit, and which is freed from the seeds in the "wet process" of Coffee preparation. The pulp is reduced to a mash in order to secure rapid and uniform fermentation. This mash is pasteurised at 75° C. for 45 minutes and then inoculated with a culture, e.g. *Saccharomyces octoporus*. The temperature is kept between 23° C. and 25° C. and a good fermentation sets in within 24 hours, reaching its climax on the fourth day. After 12 days, the fermentation is complete and clarification must follow. The liquid is acidified in barrels filled in with wood chips slaked in previously prepared strong vinegar and the temperature kept at 35° C. The vinegar which results is of a clear Rhine wine colour, has a smell like pear oil, and a taste resembling old whiskey. The taste disappears within three or four weeks of storage and the colour clears up somewhat. The specific gravity of the resulting product is 1·0154 and the total acid content, as acetic acid, is 4·6 per cent.'—(*Industrial and Engineering Chemistry*, vol. 23, No. 10, p. 1108).

Frozen Pulp retains true Fruit Flavor.—' Experiments in the food research division of the Bureau of Chemistry and Soils, United States Department of Agriculture, have developed a new type of frozen fruit pulp which promises a new outlet for the fruit-grower and packer, a new fruit base for the ice-cream manufacturer and soda-fountain operator, and a new product for direct consumption in the frozen state. By pulping the pitted fruit, adding a sugar syrup of proper concentration, mixing it thoroughly and then freezing at a very low temperature, chemists have developed a product with a remarkably smooth texture and full retention of the original flavor. Experiments have included peaches, apricots, plums, cherries, pears, raspberries and strawberries.'—(A. E. B. in *Scientific American*, December, 1931).

Soy-beans as the Ideal Human Food.—' Nearly half of the world's total population uses Soy-beans daily as a protein food, replacing meat. A hundred generations of Chinese have been raised on this source of protein, and Dr. Horvath called this one of the world's most extensive biological experiments. Its protein or meat-like constituent, is extremely well balanced, containing some necessary amino-acids, that milk and meat do not provide. Forty per cent of the Soy-bean is protein, while twenty per cent is oil. It contains all the vitamins and counteracts acids within the body. Dr. Horvath explained that one pound of Soy-beans, costing wholesale, two cents, contains as much protein and fat as two pounds of beef. A new Austrian process is now being used to remove the beany taste from Soy-bean flour and make it suitable for wider general use.'—(' Science News Letter ' in *Allahabad Farmer*, January, 1932).

Use Rubber Solution to protect Plants.—' A new rubber product has been invented to protect plants in storage during the winter months. Dipped in this solution, the stalks are coated with rubber a thousandth of an inch thick, which protects them from diseases of other plants and tends to kill minute germs or insects by shutting off their air-supply. The rubber coating holds the plants back two or three days after they are planted; but when they begin to grow, they do so more rapidly than untreated plants.'—(*Popular Science Monthly*, February, 1932).

Cross-Pollination in Cotton.—FIKRY, M.A. (*Tech. Bull.*, No. 18, *Roy. Agr. Soc., Egypt*).—' A study of the frequency of natural crossing between adjacent varieties of cotton, for which de Vries coined the useful term 'vicinism', has been made by Dr. M. A. Fikry. He planted strips of Red Leaf Acala Cotton, which is homozygous for a dominant red leaf factor, in a field of Maarad Cotton having green leaves. The plants are visited by insects, especially the honey bee and another bee of the genus *Nomia*, but wind is negligible as a factor in crossing. By making two pickings of Maarad seeds from successive ridges at increasing distances from the Acala, and determining the percentage of red seedlings in each case, the conclusion was reached that 4 per cent of the seed from each plant in a cotton field is crossed, that is, there is 96 per cent of self-fertilization. A gradient of pollination, beginning with the source of pollen, gradually falls to zero at about 40 metres, which is the maximum range to which pollen was transmitted. The amount of vicinism will no doubt vary, depending especially on the frequency of insects and the distance between the plants, but the figures obtained are a measure of the precaution necessary to maintain purity in a cotton crop.'—(*Nature*, December 26, 1931).

Analysis of Cane Juice in relation to Phosphoric acid and Potash content of the Soil.—LOCSIN, C. L. (*Sugar News*, 1931, vol. 12, pp. 620–621, Abst. in *Facts about*

Sugar, 1931, vol. 26, p. 541). The writer tabulates the average results of numerous analyses of cane juice that were tested for phosphate and potash, together with corresponding soil analyses by the Citric acid method. The field experiments made on the soils of the Victorias cane districts have so far corroborated similar work by the Hawaiian chemists, who have found that soils yielding cane juice with less than 0·01 per cent of phosphoric acid will probably respond to phosphatic fertilizers, and that a content of less than 0·05 per cent of potash in the juice indicates the need for potash fertilizer. As different cane varieties have different feeding habits, the existence of a general standard may be doubted, but it will be easy to establish an approximate standard for each variety which would be a useful guide in fertilizer practice, where field experiments or soil analyses are not available.—(*Facts about Sugar*, vol. 26, p. 531).

Review

Green Manuring.—Technical Communication No. 22 from the Imperial Bureau of Soil Science, London 1931, 32 pp., price 2sh.

This is a valuable contribution from the Rothamsted Experimental Station, England, wherein the recent literature concerning the application of green manures to different kinds of soils, has been reviewed and classified under suitable heads. Though it is difficult to draw definite conclusions from the literature cited yielding results often of a contradictory character, the following may be taken as some of the more important conclusions on which there is general agreement :—

(1) Green manures including those used as cover crops have a beneficial effect in preventing soil erosion by wind and rain, and offering shade protection ; in breaking the hard pans in the sub-soil and offering greater scope for root development of the succeeding crop ; and also in improving the physical texture and moisture-holding capacity of the soil.

(2) Investigations on the increase in Carbon content of soil due to application of green manure, show that 50–75 per cent of the Carbon applied as manure, is lost in the form of gaseous products within 50–60 days of application, the loss of organic matter being greatest in presence of sufficient lime.

(3) In regard to nitrogen, the increase in the soil nitrogen and the availability of nitrogen obtained from the green manure depends on the C : N. ratio of the manure applied. Materials, e.g. legumes, containing 2 per cent and more of nitrogen, increased the available nitrogen of the soil, while materials poorer in nitrogen, e.g. straw and roots, decreased ' available soil nitrogen', and produced harmful effects on the succeeding crop.

(4) Green manure cut at immature stages, i.e. before flowering, nitrified more rapidly and increased the nitrate concentration of the soil to a greater extent than mature plants ; within a plant, the leaves nitrified more easily and proved more beneficial than the stem or root.

(5) Green manuring does not affect appreciably the pH of soils containing sufficient lime. In poorer soils, legumes slightly increase soil acidity and lime requirement, while non-legumes decrease the lime requirement.

(6) A period of 2 or 3 weeks must be allowed for the proper decomposition of green manure, before the succeeding crop is planted. Partially decomposed green manure has a harmful effect on the germination, especially of oily seeds, e.g. Cotton, flax, Soy beans, etc., the effect being attributed to the decrease in oxygen, increase of carbon dioxide and also to the growth of parasitic fungi. The germination of starchy seeds and cereals like corn, oats, paddy and wheat was not adversely affected.

(7) Green manures increase the solubility of the plant nutrients in the soil. Available potash, phosphoric acid, calcium and magnesium of the soil are measurably increased by the addition of green manure. This result is attributed to the greater decomposing power of the soil solution saturated with the acids from the green manure plants, and also to the absorption of nutrients from the deeper sub-soil layers by the green manure crop.

(8) In several cases, better results were obtained by the addition of fertilizers like superphosphate and lime to the green manure crop than to the succeeding main crop. The addition of a small quantity of farmyard manure hastened the speed of decomposition of green manure. Green manuring was found in several cases to render the succeeding crop immune to plant diseases.

(9) The literature cited shows that the residual effect of green manure lasts for a maximum of 2 to 3 years only.

(10) The harmful effects of green manuring, reported from several quarters, are due to (*a*) insufficiency of rainfall and non-decomposition of green manure in the soil ; (*b*) the loss of soil moisture by the growing of a green manure crop, especially in dry tracts where it is more advisable to plough in green manure grown elsewhere ; (*c*) the water-logging of soils to which green manuring is applied and insufficient aeration, under which conditions the green manure adversely affects the succeeding crop ; the remedy in this case is proper drainage ; (*d*) the harbouring of plant diseases and pests by the green manure crop ; (*e*) excess of shading of the main crop e.g. tea, by the green manure crop.

The pamphlet concludes with two valuable appendices, Appendix I giving a list of the important green manures grown and the main crops for which they are used, and Appendix II giving a bibliography of 437 references, drawn mostly from experiments conducted in the British Empire and America.

The Bulletin gathers together valuable literature, on the subject of green manuring till now of a scattered character, but the review or bibliography cannot be said to be comprehensive, as there is an almost complete omission of all Continental work (German and Russian), and moreover, certain important aspects of green manuring, which have been engaging prominent attention in recent years, have not been included, e.g. the chemical changes undergone by the green manure when applied under wet-land and dry-land conditions ; the scope and place of green manuring in dry farming ; the effect of application of green manure on the base exchange capacity of the soil and on the soil colloids ; the relative advantages of growing green manure in the land and importing it from outside ; the effect of green manuring on the soil, micro-flora, etc. (C. N.)

College News and Notes

Students' Club Day.—The Students celebrated their club day on the 22nd February evening, the usual sports connected with the celebrations being held the previous evening and on the morning of the 22nd. The function began with tea at 4 P.M., and the fancy dress competition provided considerable amusement during the tea. The number of competitors was quite large and some of the disguises were really original. The first prize went to P. Gopalakrishnan who was disguised as a Sanyasin and the second and third prizes were won by students S. Varadarajan (fortune teller) and M. Subbareddy (Hindu-Muslim-unity) respectively. At the public meeting held later in the evening under the presidency of Dewan Bahadur C. S. Ratnasabapathi Mudaliar, M. L. C., there was first a short variety entertainment with music, magic, mesmerism, etc., by the students. The club secretary and the games secretary read their respective reports for the year. The club report showed that a good portion of the club receipts had been set apart for extending the club building. The president gave away the several prizes, and in his concluding speech gave some sound advice to the students. He also appreciated the forethought of the students in setting apart as much as Rs. 1,000 towards extending their club building. Among the prize winners in the sports connected with the club day, mention may be made of student Doraisamy who snatched away the largest number of prizes in the indoor games. The Parlakimedi Cup for the best all-round sportsman of the year was presented to student K. M. Narayan of Class II. Students Danapandian and Ramanujulu were presented with colours in Tennis and Hockey respectively. The intertutorial hockey cup was won by Mr. C. Narasimha Ayyangar's wards. The Victory cup and the Parnell cup were both won by students of class III.

University Affairs.—It is understood that Rao Bahadur M. R. Ramaswamisivan, retired Principal, Agricultural College, has been offered by the Madras University and has accepted the Sir S. Subramanier University lecture on *Agriculture* to be delivered during the 3rd week in March 1932.

Messrs. C. Tadulingam, Rao Sahib T. V. Rajagopalachari and P. S. Jivanna Rao attended the meeting of the Academic Council held at Madras during the first week of February and we understand the revised syllabus of the B. Sc. Ag. course has been accepted.

An Old Boy.—Information has been received that Mr. A. V. Richards, B. Sc., Dip. Agri. (Cantab) who is the eldest son of the late Mr. A. J. Richards for several years lecturer in Animal husbandry at the College, and who was a student of the local Agricultural College for about 6 months, has been deputed by the Ceylon Government to undergo postgraduate training at the Imperial College of Tropical Agriculture, St. Albans, Trinidad. Readers of the *Madras Agricultural Journal* will remember that Mr. R. Cecil Wood, a former Principal of the Coimbatore Agricultural College, is at present Professor of Agriculture at the Imperial College of Tropical Agriculture.

Visitors.—Mr. Rene Dumont, Director of the Rice Research Station, Tonkin, French Indo-China, visited the Paddy Breeding Station on 25th February. Mr. J. H. Simmonds, M. Sc., Plant Pathologist, Queensland, Australia, came to Coimbatore and spent three days, making himself acquainted with pathological work in Madras.

A batch of students from the Agricultural School, Trichur, under the leadership of Mr. Kunhi Sankaran Nayar, L. Ag., Farm Manager, Central Farm, Trichur, visited the Agricultural College, Research Institute, Central Farm and the Dairy.

Mr. K. T. Achayya, Sericultural Expert to the Government of Madras, delivered a course of special lectures to the students of the Agricultural College on Sericulture.

Correspondence

I. Price of Pedigree Bulls

MR. R. D. ANSTEAD, M.A., C.I.E., retired Director of Agriculture, sends us the following interesting information from Bournemouth, England :—

Sir Gomer Berry has recently sold from his famous herd of Scotch Shorthorns at Tring, a bull, 'Basildon Rosicrucian,' for 2,000 guineas (Rs. 28,000) for shipment to Australia. This bull was awarded the supreme championship at the Royal Show at Manchester in 1930, and has a pedigree which illustrates the benefits to be obtained by continuous careful selective breeding. His sire, 'Millhills Rosicrucian,' was sold in 1929 for the large sum of 3,500 guineas (Rs. 49,000) and also sent to Australia. His dam is a noted cow, and her grand-dam was purchased for 900 guineas (Rs. 12,600) at that time an outstanding price. The Australian dairy farmer considers that, even in these times of world-wide financial distress, it pays him to give very high prices for pedigree bulls which are to be the foundation of his future herd.

II. Graft Mangoes—Time of Transplantation

MR. O. M. MENON writes from Minbu :—I shall be glad if you will kindly inform me what is the most suitable time for transplanting graft mangoes, and also the most reliable firm from whom the plants should be obtained. The garden is to be prepared in a place some three miles to the north-east of Palghat. As the supply of water is to be obtained from the river near by, please say whether you advise the use of any cheap pump, if so the maker's name, and the firm from which it should be obtained may please be stated.

ANSWER. The most suitable time for transplanting mangoes is the beginning of the rainy season ; in Malabar, generally rains commence early in May, and so you may plant mango grafts in the month of April just before the rains and keep watering them till the rains are received. Mango grafts are available with S. K. I. Abdul Rahiman Sahib, Nurseryman, Salem, who, we understand, has supplied thousands of grafts, throughout Malabar, with considerable success. Particulars of suitable pumps may be had from Limaye Brothers, Broadway, Madras.

Weather Review (FEBRUARY 1932)

Rainfall data

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars ...	Gopalpore ...	1·4	+ 0·8	1·4	South ...	Negapatam..	0	− 0·8	0·8
	Calingapatam	0·6	+ 0·2	0·6		Madura ...	0·8	+ 0·4	0·8
	Vizagapatam.	1·6	+ 1·1	1·6		Pamban ...	0	− 0·7	0·2
	Cocanada ...	0·5	+ 0·2	0·5		Palamcottah.	2·2	+ 1·1	2·2
	Masulipatam.	2·9	+ 2·5	2·9					
Ceded Districts.	Kurnool ...	0·8	+ 0·7	0·8	West Coast	Trivandrum.	1·4	+ 0·8	1·4
	Bellary ...	0	− 0·1	0		Cochin ...	1·0	+ 0·1	1·0
	Cuddapah ...	0·1	0	0·1		Calicut ...	0	− 0·2	0
						Mangalore ...	0	− 0·1	0
Carnatic...	Nellore ...	0·9	+ 0·8	0·9					
	Madras ...	0·7	+ 0·4	0·7					
	Cuddalore ...	0	− 0·7	0·6	Mysore and Coorg ...	Bangalore ...	3·5	+ 3·4	3·5
						Mysore ...	0	− 0·3	0
Central ...	Vellore ...	0·6	+ 0·2	0·6		Mercara ...	0	− 0·2	0
	Salem ...	2·3	+ 2·0	2·3					
	Coimbatore Town ...	2·7	+ 2·4	2·7					
	Coimbatore Res. Inst. ...	2·3	+ 1·8	2·3	Hills ...	Kodaikanal ..	1·8	+ 0·4	1·8
	Trichinopoly.	0	− 0·5	0·1		Coonoor ...	0·6	− 2·1	0·6

General summary of weather conditions.—Weather was fine with lower temperatures than usual at the beginning of the month. A Western disturbance crossed over from the North-west and lay as a diffuse area of low pressure over the head of the Bay from the 2nd to the 5th and affected the weather over the whole of the area, and pressure distribution was irregular and the barometer below normal till the 12th. On the 19th thunderstorms appeared over the Circars and extending into the Deccan gave sporadic showers over almost the whole peninsula till the end of the month.

Rainfall was above normal over the presidency with the exception of south Coromandel coast, Malabar north, parts of Mysore and the Nilgiris.

Temperature was below normal at the beginning and the end of the month.

Weather Report for the Research Institute Observatory :

Report No. 2/32.

Absolute Maximum in shade	92°·1	
Absolute Minimum in shade	55°·2	
Mean Maximum in shade	89°·7	
Mean Minimum in shade	65°·3	
Total rainfall in month	2·27″	
Mean rainfall for February*	0·46″	
Departure from normal	+ 1·81	
Number of rainy days	1	
Mean daily wind velocity	1·03	m.p.h.
Mean 8·00 hours' wind velocity	1·68	,,
Mean humidity at 8·00 hours	72·7%	
Total hours of bright sunshine	270·3	
Mean daily hours of bright sunshine	9·3	

Summary of general weather conditions.—During the first half of the month conditions were settled and pressure remained steady. A fall set in during the second and third weeks accompanied with unsettled weather and a few local thunderstorms. A

severe local storm gave 2·22 inches on the night of the 27th, the bulk of the fall occurring during 45 minutes. The fall at the Cotton Research Station about half a mile to the North-west of the Observatory was 2·4 inches on the same night. Temperature was below normal during the first week and the last week of the month.

P. V. R. and P. K. M.

Departmental Notifications

Gazette Notifications.—Mr. Y. Ramachandra Rao, Entomologist, on other duty as Deputy Locust Entomologist to the Imperial Council of Agricultural Research, Quetta, is granted two months' leave from the date of relief. Mr. Samuel Jobitharaj to be temporary Superintendent, Agricultural Research Station, Berhampore, in the Rice Research Scheme, from the date of taking over charge.

I Circle.—P.L. Narasimham, A.D., Narasapatnam, l.a.p. for one month and 10 days from 15-2-32 to 24-3-32 with permission to affix Easter Holidays. **II Circle.**—P. Lakshminarayana, A.A.D., Narasapur, posted to Rajahmundry. **III Circle.**—M. Krishnaswamy Iyengar, A.A.D., Allagadda, extension of l.a.p. on m.c. for 2 months and 8 days from 24-12-31. A. Krishnaswami Iyer, A.D., Koilkuntla, will be in additional charge of the Allagudda sub-circle. **V Circle.**—K. Sitarama Iyer, A.D., extension of l.a.p. on m.c. for 4 months from 3-2-32. **VI Circle.**—A. M. Muthiah Nattan, A.D., Dindigul, l.a.p. on m.c. for 11 days from 7-2-32 and extension of l.a.p. on m.c. for one day on 18-2-32. **VIII Circle.**—D. S. Subrahmania Iyer, A.D., Pollachi, under orders of transfer to Annur to be A. D., Palladam.

Paddy Section. M. Narasimham, Assistant, l.a.p. for 15 days from 22-2-32. P. Uthaman, Assistant, l.a.p. for 21 days from 3-3-32 with permission to avail Easter Holidays.

Millets Section. T. Narayana Rao, l.a.p. for one month and 13 days from 11-2-32 with permission to avail Easter Holidays.

Entomology Section. K. R. Ramamurthi, Artist, l.a.p. for one week from 10-2-32. **D. A's. office orders.**—P. N. Krishnaswami, Offg. Asst., V grade, Entomology section, transferred to Cotton section to officiate as Asst., Cotton section, vice S. Sundaram on other duty. C. S. Balasubrahmaniam, B.A., appointed as officiating Asst., V grade in the scale of Rs. 85—5—120 in the Entomology section vice John A. Muliyil on other duty. M. R. Balakrishnan, Assistant, l.a.p. for 2 months from 26-2-32. S. Rajaratnam Chetty whose appointment as temporary Assistant to the Soil Physicist, will cease from 1-3-32 is appointed as officiating Assistant, Chemistry section, from 2-3-32. S. V. Kuppuswami, whose officiating appointment as Assistant in the Chemistry section will cease from 1-3-32 is appointed as Assistant to the Soil Physicist from 2-3-32.

APPENDIX

ADDITIONS TO THE LIBRARY DURING DECEMBER 1931

A. BOOKS

1.	*The Elements of Marketing* ...	P. D. Converse	1931
2.	*The Agricultural Extension system of the United States.*	C. B. Smith and M. C. William	1930
3.	*On the identification of Timber with special reference to the more important or common Madras trees.*	G. Viswanathan	1931
4.	*A Compilation of culture media for the cultivation of Micro-Organisms.*	Mex Levine and H. V. Schoenlein	1930
5.	*Dairy Bacteriology, 2nd Edition* ...	Orla Jenson	1931
6.	*The Bureau of Entomology : Its History, Activities, and Organization.*	G. A. Weber	1930
7.	*A Text Book of Economic Zoology.*	Z. P. Metcalf	1930
8.	*The Plant Rusts (Urelinales)* ...	J. C. Arthur	1929
9.	*Ingenious Mechanisms for Designers and Inventors.*	F. D. Jones	1930
10.	*Manual of Statutory Rules and Orders. (Corrected up to 1st October, 1930.)*	Publication of Government of India.	1931

B. REPORTS—(a) *Annual Reports.*

(1) Principal, Agricultural College, Mandalay, 1930-31. (2 to 5). Agricultural Chemist, Agricultural Engineer, Entomologist and Mycologist, Burma, for 1930-31. (6) Sericultural Operations for 1930-31, Burma. (7 to 16). Agricultural Stations—Mandalay, Agricultural College Farm, Akyab, Allanmy, Hmawbi, Kanbalu, Mahlaing, Mudon, Myaungonya, Pyinmana, Tatkon, 1930-31, Burma. (17) Agricultural Work in Southern Shan States 1930-31. (18) 2nd Report of the Imperial Agricultural Bureau Executive Council, 1930-31. (19) R. A. S. England—Agricultural Research in 1930. (20) Kenya Colony and Protectorate Agricultural Department, 1930. (21) Trinidad and Tobago Agricultural Department, 1930. (22) St. Kittis Nevis Agricultural Department, 1930-31.

(b) *Special Reports—The League of Nations Publications—*

(1) Its Constitution and Working (Revised Edn.), 1930. (2) A Survey (January 1920—December 1926. (Revised). (3 to 6). The League of Nations from year to year: 1926-27; 1927-28, 1928-29; and 1929-30. (7 and 8). Political Activities. Vol. I and II. (9) The League of Nations and the Protection of Minorities of Race, Language and Religion. (10) Financial Administration and Apportionment of Expenses. (11) Arbitration, Security and Reduction of Armaments. (12) The reduction of Armaments and the organization of peace. (13) The Financial Constitution of Austria. (14) Economical and Financial Organization. (15) Social and Humanitarian Work. (16) The Health Organization of the League of Nations. (17) The League of Nations and Intellectual Co-operation.

C. Bulletins, Memoirs, etc.

U. P. Agricultural Department. (1) No. 56. The Firm Tractor in India.
(2) No. 58. C. 402—A New Variety of Long Staple Cotton.

Empire Marketing Board, No. 44. Dairy Research.

T. P. 19. Production and Trade of Gambia.

Tea Research Institute, Ceylon, No. 6. The Experimental errors of Field Experiments with tea. *Iraq Agricultural Department Memoir,* No. 15. Annual Report on Cotton, (1929).

Union of South Africa. Bull. 93. Poultry Management. *Kenya Agricultural Department.* Bull No. 15. Diseases and Ailments of Swine. No. 16. Diseases affecting poultry in Kenya. No. 17. A Study of the ticks in the Kenya colony. No. 18. Calf-Rearing. No. 19. Essential Oils. No. 20. Horse Sickness.

U. S. Agricultural Department Farmers' Bulletins.

No. 1467. Commercial Varieties of Alfalfa. No. 1666. Insecticides, Equipment and Methods for controlling Orchard Insect Pests. No. 1672. Diseases of Peams in the Southern States. No. 1674. Food for Children. No. 1677. Planting and Care of Lawns. No. 1679. Pop Corn. No. 1687. Removing spray Residue from Apples and Pears.

Kentucky Agricultural Experiment Station Bulletins.

No. 296. Bacillary white Diarrhœa and related Diseases of Chickens. No. 297. Potato Flee Beetles. No. 302. Quality as a factor in the price of Kentucky lambs. No. 303. Farms Tenancy in Central Kentucky. No. 304. The effect of Vitamin D. Supplements on laying hens. No. 306. Virus Diseases of Tobacco in Kentucky. No. 307. Share Leasing Contracts. No. 308. The Potassium, Chlorine and Sulphate content of Kentucky Tobacco as related to grade. No. 309. The relation of some Tobacco viruses to Potato Degeneration. No. 312. The Budget Method of Improving farm Organisation and Management. The Genetics, Breeding and Improvement of corn and cotton—A Bibliography (1889-1929).

D. Translations

(1) The Preservation of seeds in an atmosphere deprived of Oxygen as a means of prolonging their germinating ability. (2) Production of grass seeds for meadow cultures. (3) Cultivation and Improvement of Swedish grasses.

E. Leaflets, Miscellaneous Publications, etc.

Madras Agricultural Department Leaflets. No. 31. The Mosaic Disease of Sugarcane. No. 42. The Rice Hispa. Guide to the Imperial Library, Calcutta. No. 69 *England—Ministry of Agricultural Leaflet No. 70*: Cabbage Moth Caterpillars; *Imperial Bureau of Plant Genetics.* Oat breeding Bibliography; *Cyprus Gazette Agricultural Supplement*; Green Manuring and Abstracts; *U. S. Department of Agricultural Miscellaneous Publication No. 105*: A graphic Summary of American Agriculture based largely on the Centres; *Michigan Extension Service Circular* 245: Directors of Farm Co-operations, their duties and responsibilities; *Philippine Agricultural College Experiment Station Circular No. 16*: A simple farm record for the Farmer.