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EDITORIAL

The Mysore Agricultural Colonisation Scheme. The Government of Mysore have just sanctioned a scheme of land colonisation for her young agricultural graduates. The colony is to be started in the Irwin Canal area where excellent facilities for irrigation exist. The scheme which would cost the Durbar Rs. 20,000 for 10 colonists consists in leasing out to each colonist 115 acres of land for a period of six years and advancing a sum of Rs. 1500 for capital expenditure such as the construction of a farm house and cattle shed, purchase of work animals, implements etc. On the security of the crops raised, another sum of Rs. 500 will be advanced annually towards working expenses but recouped every year as soon as the crops are harvested. If the colonists succeed in their endeavours the land would be transferred to them at the end of six years at a reasonable upset price based on the present market value of the land and the sum recovered in ten equal annual instalments. The colonists who should be agricultural graduates or the products of the state Agricultural School at Hebbal will be selected by a committee under the chairmanship of the Director of Agriculture, Mysore while the working of the colony will be supervised by the manager of the Irwin Canal Farm.

We are aware of some colonisation schemes started in several parts of India, but barring the one in the Punjab, the success which has attended such endeavours has not been of a high order. The Mysore scheme is different from others in several respects and augurs well for the enthusiastic agricultural graduate who has both the educational equipment and the will to carve out his own future. The land to which he sets his foot is fertile and irrigation facilities goods for raising crops like sugarcane, cotton and tobacco which should pay a handsome return. Above all, the terms of the contract are generous and a good future awaits the right type of unemployed agricultural student. The Mysore Government has to be congratulated in undertaking a well-thought out scheme, the success of which appears as assured as that of several other ventures undertaken by the Durbar.

Indian Sugar for Britain. It is a matter for satisfaction that the persistent representations of the Indian Sugar Syndicate and the Indian Sugar Mills Association have brought some relief to the sugar industry of

the country. His Majesty's Government has now communicated to the Government of India an offer from the British ministry of food to purchase 100,000 tons of Indian sugar. It will be recalled that the industry which is now the second largest in India found itself in a perilous position at the close of the last crashing season when it was faced with a surplus of about 400,000 tons of sugar. When in 1937 the Government of India ratified the International Sugar Agreement by which all exports of sugar by sea to countries other than Burma was banned, it was not realised by many that the Indian industry would have to face such a serious problem in the short space of three years. An increase in the area under cane and the prospect of a bumper crop during the ensuing season had greatly added to the difficulties of the situation. The action now taken by the Government of India to restrict the import of Java sugar and lift the ban on Indian exports should have a salutory effect on a nascent industry which was faced at once with the problem of accumulated stocks and an annual production much beyond the needs of the home markets. We trust that the decision of His Majesty's Government to purchase some of the surplus sugar from an empire country is only the first step in a far-sighted policy which will not only save the Indian industry from a distressing situation but also help to conserve the sterling resources of the Empire.

Fruit Introduction, its Problems, and Place in National Wealth. *

By M. BAPINEEDU, B. Sc., (Cornell), M. Sc., (California),

Parliamentary Secretary to the Hon. the Minister for Public Information, Madras.

Introduction. In times gone by, India was known as the garden of the world. But today India is in poverty. Midas starving amidst the heaps of gold, does not afford a greater paradox. Why should there be periodic visits of famine and pestilence in a country where land is fertile, sunshine in plenty, winter injury negligible and the growing season long and favourable for good agriculture? In the utilization of our natural resources lies the real foundation of national prosperity.

Fruits and their place in Indian life. In this land, sages, philosophers and prophets seem to have lived on an exclusive diet of milk and fruit. Even in the present day there are thousands who live chiefly on fruits. On religious days many confine their diet to fruits. At weddings and temple worship fruit is indispensable. If anyone visits a friend, a relative or an officer it is a common custom to make an offering of fruit. Fruit is a cosmopolitan food. With fruit, a natural food, there is no distinction of caste or creed. The average meal in India is incomplete without pickles or chutneys, products of fruits and vegetables. A poor labourer is satisfied if some pickle is added to his meagre meal. Orange and lime juice have become indispensable in enteric and other ailments. In a hot country like ours fruit juices must be in greater demand than aerated waters. Coconut milk is already a popular beverage that is both refreshing and healthy. The fruit juices must be similarly popularised, so that their consumption may become a natural habit. We should have as our ultimate object and motto, a fruit a day for every man and woman of all ages and classes. Our fruits fresh, dried and canned, should easily find ready markets in European and other foreign markets.

Present Production and trade. As against all these immense possibilities for expansion of the fruit industry we are today actually faced with a position that is at once alarming from the national health point of view and ruinous from the view point of national economy.

The Departmental marketing surveys have shown that, we have now a total area of a little over 400,000 acres planted to fruits. Mangoes with 240,652 acres, bananas with 142,140 acres, oranges and limes with 21,000 acres form the main commercial fruits. Grapes (250 acres), pineapples (350 acres) and pears (500 acres) are the next in importance. Cashewnut

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is another important commercial product under fruits and nuts and is the only exportable commodity at present, accounting roughly for 8,000 tons of kernels per year. Fruits like guavas, custard apples and sapotas have not been surveyed. However, it has been estimated that the orchard value of all fruit crops at present in the Province is to the tune of Rs, 5,00,00,000. Of this apparently vast production, the exports to other provinces account for only a small quantity of mainly 564,000 mds. of mangoes, 2,50,000 mds. of bananas, 117,000 mds. of pineapples, 25,000 mds. of limes and very small quantities of pears and grapes of the aggregate value of about Rs. 2,171,000 per year. On the other hand, we actually import fruits of the value of Rs 162,000—grapes worth Rs. 1,27,000 oranges worth Rs. 492,000 pineapples of the value of Rs. 12,000 and limes of the value of Rs. 5,000 per year, making a total of Rs. 798,000 leaving a favourable net export balance of only Rs. 1,373,00 per annum of fresh fruits. Cashewnut exports also account to a total export value of about Rs. 10 lakhs per year. But this is not all the story. This country is a large importer of canned fruits and fruit products and is likely to depend more and more on foreign supplies in future, if no steps are taken to prevent such a state of affairs. At present India imports annually about Rs. 11,00,000 worth of canned and bottled fruits, of which this presidency alone takes about Rs. 2,00,000 per year. Imports of jams and jellies to India are of the annual value of about Rs. 7,00,000 of which Madras accounts for about Rs. 1,00,000. During 1937—38 imports of confectionery were of the value of Rs. 18,79, 891; pickles, chutneys, sauces and condiments Rs. 6,21,675, and vinegar Rs. 20,931. Besids these there are still, the fruit juices and beverages, fruit essences and artificial or synthetic fruit drinks, for which no reliable figures are available.

Opportunities neglected. With the immense diversity of soil and climatic conditions, this country assuredly offers very vast possibilities for the production of the choicest varieties of almost every fruit known to the world. India is recognised to be the original home of a number of fruits which are now grown extensively in other parts of the world. In fact, the fruit industry in this country has assumed such an anamolous position that, it has now become a necessity to re-introduce from abroad the selected varieties of these very fruits which once were our country's pride. The famous Washington Navel of the New world, Australia, and Africa were according to some authorities originally introduced from the Eastern part of India. The famous lemon industry which has now become the chief source of citrus beverage is recognised to have its original home at the foot of the Himalayas. But to-day we take pride in having a few stray imported trees of these fruits in some of our gardens as mere local curiosities. What a commentary on our inertia! Even in the case of mangoes of which we hold almost a monopoly of production, we look to a Wilson Popene of the United States for the essential technical information on its culture. While the United States of America has undertaken systematic hybridisation on this

fruit, we in this province have just commenced planning a few preliminary experiments on this crop only during the past five years.

As one of the most important of the rural industries and as one of the main sources of our national health and wealth, fruit deserves much greater attention than has been given to it in past. Fruit research has been almost badly neglected for so long a time by the state, that we are just where we were about a century ago. It was formerly considered that tea, coffee and such other non-fruit plantation industries merited our attention more than fruit culture whose development was essential both for national economy and national health. While South Africa and Australia built up a flourishing export trade in fruits, which became a main source of wealth to the British settlers of those countries, the fruit industry in India was left in a static condition. Even the few enthusiasts who wished to work in the line were discouraged and accorded no facilities. The histroy of the gigantic expansion of fruit growing industries in Palestine and Brazil during a short space of two or three decades and of the canning industry in Hawai to the present state of being the leading industry of the islands are all matters of recent history which clearly demonstrate to us the enormous scope of extension possible in this country if due encouragement and guidance are given.

Fruit Introduction: Some notable results therefrom. Among a large number of methods open for improving the fruit industry I shall confine myself to-day to only one aspect, namely fruit introductions. The epoch making developments that have resulted in other parts of the world by fruit introductions serve to emphasize the value of such work in the present stage of our development. The romantic history of the introduction of Washington Navel orange in California in 1870 by one William Saunders, Superintendent of the Gardens in Washington, which has resulted in the growth of the Californian Citrus Industry to the present day annual farm value of 135 million dollars, is an outstanding instance in point. It has been aptly said that the introduction of the original batch of two trees of this variety into California proved as important in Californian history as the discovery of gold. Nay, this discovery was far more important than that of the precious metal, for this fruit has not only come to be recognized as the second most important exportable produce of California, but has also given continuous work to millions of people; but what is still more important, it is an all-important source of valuable vitamins of dietetic value which has improved the health and happiness of the peoples both of United States and a number of foreign nations.

An enquiry into the origin of the cultivated fruits discloses the fact that there were three distinct centres from which the migration has taken place in more than one direction. These were distributed in the three continents, two in the old world, Asia and Europe, and one in the New.

Old World.:—1. Southerneastern Asia—including China, India and Malay Archipelago. The fruits indigenous to those regions are as follows.

Sweet orange, mandarin, common jujube, apricot, peach, Kaki, litchi, citron, bitter orange, Indian jujube, mango, jak, dwarf-date, banana, coconut, lemon, lime and grapefruit. 2. Temperate Europe and Asia—caucasian region. Raspberry, Strawberry, almond, pear, pomegranate, gooseberry, olive, fig, pistachio, walnut, date, plum and apple.

New World. Tropical America. Pineapple, anonaceous fruits, cashew-nut, guava, pumpkin, sapodilla, avocado, tomato and cactus.

It is very significant and suggestive to correlate these regions with the centres of ancient civilization. The constant mingling of races and the consequent intercourse with other countries broke these centres, and as a result most of the fruits have become quite cosmopolitan. Take for instance the sweet orange, which is indigenous to Cochin China. It is sold in every country store in the United States and is cultivated at its best, in largest acreage in California, which is at the other end of the world.

Fruit Introduction in India and abroad. The introduction of fruits is popularly considered to be the job of a novice. This belief is based on an utter ignorance of the importance of this work. Fruit introduction as carried out in this country by amateurs has led to an enormous waste of national energy and wealth although it must be admitted that it has also conferred a few benefits.

The famous blood red orange of the Punjab introduced by a medical man, the Batavian orange of the Circars and the Mozambique oranges of Bombay and of Central Provinces possibly imported by the Dutch and the Portuguese settlers are instances of private enterprise, which have developed into large scale commerical industries in a short space of time. In a lesser way we have the grape growing industry near Kodaikanal Road and the Manilla orange in the Courtallam area, both of which go further to emphasize the value of foreign fruit introductions, but at what cost ?. Innumerable plants have been obtained from elsewhere and planted by growers in every part of India, only to prove a source of utter disappointment to the growers after some years. Let me give an illustration. Everyone of us knows that Jahangir is one of our choicest mango varieties. This variety, however, is known to be a very shy-bearer, so much so, that it has no place in a commercial garden. Despite this fact some nurserymen advertise it and offer it at fanciful prices. The unwary grower, in the belief that the variety would truly be an acquisition may plant a large area, which ultimately is found to lead to an economic loss. Similarly, the famous Washington Navel orange has been introduced in large numbers in all parts of India at considerable expense, but has not yet proved superior to our local oranges either in yield or quality. Yet nursery men are still selling to the public hundreds of plants of this variety. There are still more instances of persons introducing into the tropical plains of the Presidency such plants of the temperate regions like apples, peaches and plums. All such activities may bespeak of the grower's enthusiasm but hardly do credit to his horticultural intelligence or experience.

In contrast to this, let us compare the methods adopted in a country like U. S. A. There the first step in plant introduction is the exploration. It is the trained explorer who first goes out in search of the fruits; fruits that are new or those that are of value for breeding work. He studies the natural habitats and the peculiar growth and fruiting habits of every fruit tree he comes across. Being fully conversant with the conditions of his native home, he is able to pick out those of possible value and send them over to the Plant Introduction Office.

The galaxy of such world famous fruit explorers sent out by the United States Federal Department of Agriculture like David Fair-child, Wilson Popence, P. H. Dorset, W. T. Swingle, and Frank Mayer have truly contributed inestimable wealth and happiness to the States and have inspired the research workers and fruit growers all over the world. Even the private nurserymen of America have contributed no mean share in the enrichment of the fruit wealth of their country. Which of the prominent citrus growers in the world do not remember with silent gratitude the name of Charles Volz, a Californian nurseryman who was responsible for the introduction of sour orange and demonstrating its value as a rootstock for sweet oranges ? The value of this discovery alone is evidenced from the fact that, about 75 per cent of citrus trees grown in the world are to-day worked on the sour orange rootstock. Even so, the gigantic expansion of the fruit industry in the New World owes not a little to the fruit introductions and varietal trials carried out by two Florida nursery men, George Ludley and E. Reasoner.

The Plant introduction Bureau in America is a special organisation which identifies the plants introduced, tests them under controlled conditions at select centres, studies their peculiarities and requirements and finally selects those which are promising for large-scale tests. It is only after the large scale tests are completed, that plants are distributed to the public for commercial planting.

In the initial stages, however, the private nurserymen of India have also undoubtedly contributed much for the enrichment of the fruit wealth of this country. But it must be remembered however, that our fruit nurserymen are of a stamp quite different from the class one usually comes across in foreign countries. Poverty and lack of state help and scientific training have prevented the Indian grower and nurseryman from playing his legitimate part in the development of the Indian fruit industry. It is true that even in more advanced countries of the west, the nurserymen usually play only a secondary part in plant introduction, but in this country the state has necessarily to bear the full burden. In reality however, it has been the other way round, till very recently. We owe most of the little improvements in the fruit industry of this presidency to private enterprise, and not to the state. The origin of several thousands of acres under mangoes, primarily under such varieties as *Chinnaswarnarekha* of the Circars, *Mundappa* of the West Coast, *Jahangir*, *Imampasand*, *Allampur*, *Baneshan* and a number of *rasams* of the Andhra Desha and the *Vadlapudi* orange of the same tract

are all traceable to certain individuals who had the love and foresight of the pioneer. These and various other unrecorded instances prove the value of such work in the nation's progress. The glory of the work of these various benefactors to the human health and prosperity remain unrecognized in contrast to the reverence paid to such discoverers in other parts of the world.

Limiting factors in fruit culture. Of the four important limiting factors—moisture, soil, light and temperature, the fruit grower can modify the first two by irrigation and use of fertilizers but he cannot change light and temperature. It is universally admitted that temperature is the most important factor in determining the flora and the vegetating zones of different places, particularly in the distribution of food crop sections of the world. Temperature has a direct bearing upon fruit growing. Gardener, Bradford and Hooker thus summarise the influences of temperature.

1. It delimits zones beyond which the growing of specific fruit becomes commercially hazardous becase of lower winter temperature.

2. It delimits zones beyond which the growth of certain fruits becomes unprofitable because of high temperature.

3. Makes certain areas unprofitable for some fruits because of low summer temperature.

4. Turns good land to that of doubtful value for several fruits because of danger from spring frosts.

5. Within areas ordinarily safe for growing certain specific fruits an occasional deviation from normal may cause considerable damage.

6. Some insects and diseases are more or less dependent on proper temperature for their optimum development.

Heat is such an important factor that the fruit zones of the world which correspond to the life zones of meridian 34 are determined by the total units of temperature.

This is a broad and general division of fruit zones. Different varieties of the same fruit differ in their range of temperature. The same variety is not successful in the different tracts under the same climatic zones. That the same varieties of apple, grape, date, orange and peach grown in the similar crop zones are not uniform in their quality, is well known. The Washington navel orange is not successful in Florida, while the California grapefruit is inferior to that of Florida. Some of the non-astringent Japanese persimmons develop astringency in California though grown under apparently similar soil conditions as those found in Florida.

Moisture :— This plays an important role in fruit introduction. Moisture means rainfall, its time and the amount and also the relative humidity. Irrigation may make up for the insufficient rainfall but humidity and the time of rainfall limit the fruit production. The time of rain is closely related to successful fruit production. Rains during the blooming and fruiting period are detrimental to the pollination and ripening of fruit. The

possible effects are (1) bees will not work on a cloudy and rainy day, (2) stigmatic fluid becomes thin, (3) pollen may be washed away or anthers may burst, (4) the maturity of the fruit may be delayed and (5) splitting and souring may occur. Water has its own influence upon the yield, size, colour and composition of the fruit.

Light :— Light affects plants in intensity, quality and duration of exposure. It affects the flowering, fruiting and the quality of fruit. Fruit on the outside of the tree and fully exposed to light is inferior and often ruined, while the fruit screened by foliage is of the finest quality. Duration of light is very effective in the metabolic processes and carbohydrate formation. The longer the duration of light, the higher is the amount of plant food manufactured. The length of day is unique in its action on sexual reproduction. The blossoming and fruiting of a species may depend on whether the length of day in a new region is favourable or unfavourable.

Wind. This has injurious effects upon the tree and the fruit. The stems and branches bend away from the normal direction of growth and finally break. High winds during the fruiting season destroy the whole crop by stripping the fruit from the tree. Wind interferes with the pollination as the insects are not active in a strong wind. Wind location should be observed in locating the orchard site. Wind prevents the germination of pollen grain.

Soils. Fortunately most of the fruits are not exact in the soil requirements. Fertilizers and manures may correct the soil defects. Hard pans and too acid or alkaline soils should be avoided. Elevation, texture of soil, presence of forest trees as wind breaks, all enter into local climate of the orchard site.

Plant Diseases, In introducing a new plant, one should take extreme precaution in preventing the entrance of any pest or disease with it.

What the Government is doing. The importance of research work on fruits came into prominence in this country as a result of the post-war depression in agricultural prices. The Royal Commission on Agriculture has clearly emphasised the importance of fruit development. This recommendation has since achieved greater importance as a result of the work of nutrition experts. All these factors were responsible for the new orientation in the policy of the Imperial Council of Agricultural Research who have now sanctioned a number of fruit research schemes in different parts of India. With the starting of one of these schemes at Kodur in Cuddapah district the work of fruit introductions and variety trials naturally loomed large in the activities of this station. At present the station possesses valuable collection of over 100 reputed varieties of mangoes from all over India, Burma, Ceylon and Phillipines, and a still more vast collection of all the reputed varieties of citrus and those of lesser importance that are indigenous to this country. In fact, the collection has already attracted the attention of workers abroad, who have sought the help of the station to

introduce some of these varieties in their respective countries. While this collection will be a valuable source of selecting the varieties according to regional needs and according to the local fancies and prejudices of the growers and the consumers, it will also prove to be a valuable material for pursuing the hybridization work in future. It is regrettable that sufficient funds and facilities have not been provided for augmenting this collection and for starting similar variety collection centres in other representative tracts of this province. I am convinced that such stations are urgently required to be opened at Kodaikanal, for the hill fruits, in the agency tracts of the Circars for fruits suited to the humid regions and also perhaps in the Tamil districts for increasing the fruit wealth in that part of the province. Certain fruits of temperate regions have been introduced on the Nilgiris at different times but perhaps not entirely in a systematic manner. The work that has been done on the Nilgiris is not likely to be of practical value to the Kodaikanals. The most important tracts have been suggested but it is possible to multiply the fruit stations by selecting other tracts also, such as the Shevaroys, Lower Palani hills, Curtalam area and the Wynaad tract of the west coast.

Fruits that can be introduced. It needs no emphasis to be told that this Presidency has multiplicity of conditions which favour the profitable cultivation of many fruits. The dry and hot weather conditions prevailing in the Ceded Districts afford a vast scope for the introduction of choice varieties of dates, a crop which has contributed so much wealth to countries like Iraq, Egypt, some portions of South Africa and United States of America, possessing similar environmental conditions. The rain-fed tracts of the Circars agency, lower Palni Hills and Wynaad of the West Coast already grow excellent varieties of loose jacket oranges, and I see immense scope for developing these industries by the importations of better varieties. Even in the uncultivated forest areas, possibilities exist for the development of cultivaton of vast number of profitable varieties of fruits like zizyphus, custard apple, jak and perhaps some choice types of mangosteens also. There are yet other types of fruits like persimmons, litchees, rambhutan, durrian, avocadoes etc. which can find a number of congenial places in the presidency. The last mentioned fruit, has a protein content, which is about 2 per cent higher than that in other fruits. Temperature does not seem to limit the development of the avocado industry in S. India. The avocado is a boon to vegetarians. It takes the place of meat. Add an avocado to each meal of an average labourer and it would certainly change his constitution. It is an excellent diet in wasting diseases such as tuberculosis, and a blessing to victims of diabetes, diseases very common in India.

Fruit introduction is only one aspect of the complicated problem in the improvement of fruit industry in this province. Nevertheless, it is an important aspect, particularly so in the initial stages of fruit research in a country like India. Selection of trees of outstanding merits, controlled hybridization and investigations into the improvements of propagations and

orchard practices as well as effective control of fruit diseases and pests are other important problems that cry for solution. Above all, we have yet to commence intensive investigations into the fruit canning and fruit by-products manufacture. This has specially become very important at the present age when frequent gluts and low prices have given a set back to the fruit growing industry. Unless means are devised for diverting the surplus produce into a profitable outlet as the fruit canning factory, one can never guarantee reasonable returns to the growers nor can one hope to meet the increasing demands for canned and preserved fruits in this country. I immediate action is not taken in this matter not only the fruit industry stands to suffer but eventually a stage will be reached when it will become impossible to oust the foreign products from our internal markets.

Transport of fruit is another serious problem that requires immediate attention. In this case it is very necessary that detailed investigation should be undertaken in the cold or gas storage of fruits so as to determine the maximum period of storage life and the optimum storage temperatures during transport for each and every commercial variety of fruit. At least one cold storage plant at Madras and another at an important growing centre like Kodur appear to me to be urgently required for tackling this problem. It must, however be pointed out that the improvement of transport of fresh fruit is limited by the prevailing rules and regulations of the railway companies over whom we have no control.

An Appeal and an Assurance. In conclusion let me explain to you what the present Government of this province stands for and how it is striving to materially improve the lot of the rural classes. As a nation dwells in the village, the rural problems occupy the first and best of our attention. Debt Relief Act, Prohibition, Land Laws (Tenacy Reforms), Cloth Bill; and National Planning or Industrial Revival are the order of the day. As students of Agriculture we must look ahead with a broad vision and find ways and means to improve our national wealth. Improving the present crops, introduction of new crops and getting better prices for the peasant's produce are some of the ways in this direction. In this work the Government expects every one of you to extend to it your hearty co-operation. As Confucius has said "The well being of a people is like a tree; agriculture is its root; manufacture and commerce are its branches. Break these away and the tree dies". The present Government cares for the tree, for its every limb and parts thereof. The fruit industry which is one of the important limbs can depend upon the government to have its interest well-protected and well nursed by every means in its power.

The Wax Beetle—*Platybolium Alvearium*, B in South India.

By M. C. CHERIAN, and V. MAHADEVAN.

(Agricultural Research Institute, Coimbatore).

Introduction. In August 1937 specimens of a Tenebrionid beetle found inside the hives of the Indian honey bee in Coimbatore were sent to the Imperial Institute of Entomology, London, for identification. On examination it was found to be a new genus and Blair (1938) has described it under the caption *A new genus and species of Tensebrionid beetle in bee hives in India.* In the concluding paragraph of his note he has called for more precise observations as to the status of the beetle in the hive. A study was therefore made of the beetle with special reference to its status and this paper gives information on the observations made so far.

Description of Adult. Blair has described the beetle as follows :—

"Rather more than twice as long as wide, dark castaneous, rugose-punctate above. Eyes above obliquely transverse, canthus as wide as lateral length of eye ; frons densely rugose-punctate and raised in a small elevation above each eye; clypeus more finely and sparingly punctate ; antennae with third joint scarcely longer than its apical width, fourth wider and strongly transverse, fifth to eleventh yet wider, subequal in width, set with large deep punctures interspersed with fine setigerous punctures. Thorax rugosely, punctate throughout, the expanded margins redder than the disc. Elytra each with nine carinae, the eighth and ninth abbreviated about the level of the base of the last abdominal segment, the fifth at about the same level, the fourth and sixth usually uniting behind it ; intervals between carinae densely punctate, but less coarsely and closely than the thorax, obscuring the striae. Under side more shining than above and except on the prosternum, finely and more sparsely punctate. Length 5·6 mm."

From the external appearance of the beetle it is not possible to distinguish the sexes.

Ghosh (1936) mentions a beetle—*Bradymerus* sp. found in the hives of the Indian bee. According to him, the beetle and its grubs infest the combs and are quite at home with the bees in the hive. Further, he states that the beetles eat the combs especially somewhat old ones. As named specimens of the beetle are not available in the Coimbatore collections it is not possible to say whether *Bradymerus* sp. mentioned by Mr. Ghosh is the same as *Platybolium alvearium* or not.

Life History. *Eggs:* Eggs are laid in groups in crevices between the brood chamber and the base board or between the super and the brood chamber. The maximum of such groups was observed to be 13 and the minimum 3. The egg is white, smooth and shiny and elliptical in shape. It is just over 1 mm. long and about 0·25 mm. broad. The incubation period is from 4 to 5 days. The beetles are sparse egg layers and take long intervals for laying eggs.

Grubs. Soon after hatching the grubs scatter themselves in various directions and begin to feed upon the wax particles on the floor board. The newly hatched grub is about 2 mm. long and 0.2 mm. broad. The head capsule is coppery in color and the remaining portion of the body pale white. The full growm larva is 11 mm. in length and 1.5 mm. in diameter and yellowish red in color. The head capsule is much narrower than the body and deeply coppery, the mandibles being brown. The body is only slightly hairy but hairs are long and pale white in color. The whole larva is more or less cylindrical. Generally the grubs are seen very close to the portions of the floor board where the brood chamber rests. The larval period is pretty long and varies from 103 to 120 days, the average being 112 days. All these grubs were fed with the normal food (particles of wax, etc., found on the floor board). The grubs when fed with pollen removed from the food materials stocked in combs were found to thrive better than on wax and such grubs looked better and healthier than those fed on wax and the development was also much more rapid. Such larvae were observed to have attained the pupal stage in the course of 36 to 42 days the average being 39 days.

Pupae. The larva, two days before pupation, is found to be inactive. The pupa is 6 mm. long and 2.5 mm. wide. It is pale yellow in color when first formed but undergoes changes of coloration and on the 5th day becomes coppery in color. The pronotum is highly prominent with a number of short hairs. The femora and tibia of the front and middle legs are visible over the elytra whereas those of the hind legs are locked under them The apex of the abdomen has two pairs of spines, one curved upwards and the other almost straight and shorter than the first. The dorsae surface of the pupa is smooth; the ventral surface has a number of short hairs. The pupal period lasts 6—7 days. The total life cycle varies from 113 to 132 days in the case of larvae fed with normal food and 46 to 54 days in the case of larvae fed with pollen only.

Longevity of Adults. The adult beetles fed with normal food (wax) live for a longer period varying from 100 to to 180 days, the average being 148 days. They were also fed with pollen; among such adults the longevity was reduced and the average life was only 43 days. Adults when fed with cholam powder did not live for more than a month. Adults without food did not survive for more than 18 days.

The Nature and Extent of Damage. It has already been mentioned that the beetle grubs breed mainly in the particles of combs and powdery matter on the floor board. The grubs therefore do not actually attack the combs. The beetles are seen on the grooves of the brood chamber as well as those of supers where frames rest. They feed on the combs and bore into the cells. When they remain motionless in such places they will very often be overlooked due to their color which resembles that of the old combs coated with propolis.

The extent of damage done by the beetle varies depending on the number of beetles found. Though found practically throughout the year they are not observed in large numbers and in a strong colony very little damage is done by the adults. In weak colonies and in hives without bees the beetles do some damage by feeding on the combs. As a result of examination of large number of hives the authors have come to the conclusion that *Platybolium* should be considered only as a minor pest of the bee colonies though it is capable of doing some damage to stored combs and those kept in hives without bees.

Control Measures. Hives should be examined regularly once a week and the eggs, grubs and pupae destroyed by cleaning the floor board thoroughly by means of a brush or by wiping it with a piece of cloth. The beetles can also be handpicked without difficulty and destroyed.

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A Survey of Fruit Cultivation in Kadayam.

By G. VENKATAKRISHNAN, B. Sc., Ag.,

Agricultural Demonstrator, Srivilliputtur.

Introduction. The importance of fruit as an integral part of our daily food has been of late increasingly recognised for their rich vitamin content and their therapeutic and prophylactic properties. The researches of Col. McCarrison and Dr. Akroyd, have proved the notoriously poor quality of the average South Indian diet and roused us from our apathy towards the dangers of malnutrition. These nutrition experts have recommended eating of more fruits as a panacea for all the prevailing deficiency diseases. The Government are alive to the demands of the situation and have started a campaign of "Grow more fruits". Attempts in this direction consist, not only in exploring the possibilities of fruit cultivation in the plains wherever facilities exist, but also in helping the fruit industry in places where it is in a nascent condition, or in a languishing state. The fruit growing area in and around Kadayam in the Tirunelveli District comes under the last category. With a view to suggest measures to resuscitate the industry to a profitable level, a preliminery survey of the tract was done in January 1939. This paper deals with the study of the present fruit growing conditions in this region and the possible lines of improvement.

Situation and nature of the tract. The Kadayam tract which lies to the North-west of Tirunelveli District is favourably situated in the orbit of the two monsoons. The annual rainfall is 38 inches on an average; 25 inches of which are received during the North-east monsoon; 8 inches during the South-west monsoon and the rest during the hot weather months. The climate is equable, the well water is free from injurious salts and is good for orchard irrigation. The soil is well drained. It is red gravelly in nature with sand sparsely mixed. The depth of the soil varies from 3 to 6 feet. Apart from nature's bounties, which are available in abundance for fruit cultivation, the tract enjoys easy access to the neighbouring urban markets through railways and excellent roads.

Fruit cultivation in the tract. Taking advantage of the favourable conditions a few enterprising landowners started lime cultivation in small areas 30 years ago. Their pioneering attempt met with signal success. Not only the area under limes has expanded to the extent of 200 acres at present, but the fruits of the tract have also captured the Trivandrum, Quilon and Cochin markets and hold almost a monopoly over them. The tract exports about 50,000 maunds of limes annually to the above markets. Lime is the only fruit of commercial importance in this area and is grown in holdings varying from 20 cents to 6 acres, spread over about 100 gardens. Next to acid-lime, tight jacket orange is a most popular citrus variety occupying 30 acres in Katlamalai Estate lying in the environs of Kadayam. These find a sale in the local markets. The third important fruit crop is the

plantain. *Nattu Vazhai* and *Kathali* are two important varieties grown for local consumption in about 460 acres distributed over the whole area. The former variety occupies a larger area and is cheaper. The latter is better relished on account of its flavour and fetches a higher price of 2 to 4 annas per bunch. Mangoes are also cultivated in about 131 acres spread over small holdings varying from 20 cents to an acre. The popular varieties grown are *Neelam, Bangalora, Mulgova, Banganapalli* and *Dwarf Mulgova*. In addition, a good number of country varieties are being cultivated despite their poor quality and low yields. The total output of mangoes is on the whole poor for the area grown and inadequate for local consumption. Therefore large quantities of this commodity are being imported every year to satisfy the local demand. Of the other fruit varieties grown, mention may be made of the new introductions that bid fair to be successful are jack, Kamala oranges, sapotas, pineapple, pomegranates and grapes. These are grown in isolated patches in the midst of commercial fruit crops amounting on the whole to about 30 acres. Though these are foreign to the tract they come up vigorously and yield well. The possibilities of growing these varieties successfully on a commercial scale is evident from their excellent adaptability to the changed environments.

Methods of Cultivation. The chief commercial fruit crop of the tract being acid-lime, the methods of cultivation followed for this are briefly mentioned below. The plantations are started with seedlings preferably two years old. The spacings adopted vary to a great extent from 12 to 25 feet between plants. No inter crops are raised usually. Basin irrigation is commonly followed. The plants are watered up to the base of the stem. Such a method is construed to be unsuitable, if not injurious to growth and aeration of the roots. The frequency and depth of irrigation also vary from garden to garden, irrespective of the optimum water requirements of the crop.

Manuring. Regular manuring of the plants is done from the time they start bearing. The manures are applied in two doses. The first dose which consists of 5 to 10 baskets of cattle manure per plant is applied in June—July about the close of the fruiting period. The second dose is given in December—January in the form of green leaf manure at one head-load per plant. Kolingi, Avarai, and Vagai are the chief green leaf manures. The use of artificials as manure is rather rare though it seems to have a promising future. One Mr. K. K. Lakshiminarayana Iyer of Kadayam tried bone meal at 10 lb per plant in conjunction with 75 lb of green leaf manure and obtained 5 per cent more yield per plant over the control.

Fruting Period. The trees begin to bear from the third year of the planting. But from the 8th to 25th year peak productions are usually obtained ; each tree gives about 4000 fruits per year.

Diseases. The common diseases prevalent in these orchards especially on limes, are canker, gummosis and die-back. But no serious attempt

has so far been made to apply suitable remedial measures to control their spread.

Marketing. Nearly 85 per cent of the limes produced are exported by rail to Trivandrum, Quilon, Kottarakara, Tuticorin, Punalur, Tiruchendur Nagarcoil, Marthandam and even to the far off towns like Virudhunagar, Trichinopoly and Madura. The rest of the produce, which is transported to the neighbouring shandies and towns by carts and buses finds easy sale there. Marketing is done by contractors and local merchants who take the produce on lease from these gardens. In this connection it should be, mentioned that a Co-operative Society started in this centre for marketing of fruits has not been functioning satisfactorilly owing to the unhealthy competition set up by the middlemen and merchants among the fruit growers. The following table gives the quantities of lime fruits exported during the several months of the year 1938.

Monthly movements of limes from Kadayam.

Months.	*Quantity in Maunds of* 82⅔ lb.
January	6350
February	1900
March	3000
April	2750
May	5080
June	4070
July	4300
August	2900
September	1800
October	2650
November	4150
December	6000

Financial returns. As in many other agricultural commodities the depression has of late affected the lime industry. The fall in the market price is nearly 50 per cent which can be judged from the fact that the present rental value per acre is only Rs. 500/- as against Rs. 1000/— in the last decade. Apart from the agricultural depression other contributory causes for the low ebb of the industry is the lack of organisation between the growers for efficient marketing; nor have they made any serious attempt to adopt improved and systematic methods of cultivation to compensate the diminished returns, through increased production and reduction in the cost of cultivation One more reason which is of recent origin is the serious competition of lime fruits from Ayyampalayam and Kannivadi tracts of Madura District in the Trivandrum and Quilon markets. In the above tract limes are raised under rainfed conditions on the hill slopes in and around Kannivadi. The fruits from the above regions are therefore available at much cheaper prices. Further in the Travancore markets the demand for limes is low during the rainy months which coincides with a heavy production in the Kadayam tract and elsewhere. The scope for alternative markets during periods of heavy production has not been explored and glut prevails everywhere.

Suggested methods of improvements. *Selection.* From the survey of the fruit cultivation in this region it is evident that the present state of the industry needs improvement over a wide range, from the selection and cultivation methods to that of marketing of the produce. The first and foremost attempt should be to replace the existing varieties which are uneconomic and of an unknown or doubtful pedigree by those of outstanding merit. A number of exotic varieties of repute must be introduced for trials in this tract and the most suitable and consecutively high yielding types should be propagated. Increased production through improved varieties could to a great extent make up for the fall in the income of the fruit grower.

Varietal cropping. It is not sound economics to stake all the investment upon one variety such as the acid-lime when fair prices are not assured for many months in the year. It is desirable to grow in addition a number of other varieties of fruits such as Cheeni oranges from Kodur, pomeloes, sapotas, jak, pomegranates, grapes etc. which can provide the grower with continuous and regular income all through the year. In other words the first grower should allocate the area under various fruits suitably to get an economic and continuous income all the year round instead of sticking on to lime growing alone.

Off-season bearing types. Some of the valuable forms of off-season types can be grown with success in addition to early, middle and late season varieties for getting a continuous supply of fruits over a long period with profit. In one garden belonging to Mr. A. V. Subramania Mudaliar at Alwarkuricei a few off-season bearing varieties are being grown and they are found to fetch a good income.

Selection in the nursery state. In selecting acclamatized and reputed varieties for the plantations rigourous elimination of the plants which are poor in growth and susceptible to the diseases must be made. This will ensure starting of the orchard with vigorous and consecutively heavy yielding types.

Cultural practices. The cultural practices followed are crude and unsystematised. The same methods are followed irrespective of the habits of the varieties. The spacings given to the fruit trees are either too close or too far with no uniformity for particular varieties. Standardised methods of spacing necessary for each variety should be followed to produce the maximum yields. In this tract it would be suitable and economical to have 20 feet spacing for acid-limes and pomegranates, 30 feet for oranges and up to 40 feet for mangoes In addition planting of trees in lines by adopting the square system or quincunx method would be more advantageous.

Manuring. The system of manuring followed is not specialised with reference to the requirements of each variety. A judicious system of manuring suitable for each crop with profitable use of artificials wherever possible should be inculcated.

Irrigation. The method of irrigation practised is neither economical nor quite beneficial to the plants. Ring irrigation should be practised by virtue of which shallow basins round the plants must be widened leaving a bund round the basal portion of the stem, so that irrigation water may not reach the trunk. The present method of shallow irrigations at frequent intervals can be replaced by copious irrigations at longer intervals

Application of remedial measures for the common diseases. The trees should be periodically examined for any pests and diseases. As a preventive measure against the spread of any disease the affected or dead portions must be pruned off. In orange and lime gardens it is essential to remove periodically water shoots and dead branches. Whenever any disease appears, standard remedial measures should be immediately adopted to check their spread. Of the diseases on lime in this tract 'canker' is a serious one. It is characterised by yellow mottled patches and brown corky spots on the leaves, tenderstems and fruits. In severe cases it gives a scabby appearance to the fruit and makes it less attractive for the market. The juice content of the fruit is also reduced. Pruning and spraying with Bordeaux mixture has been found to be an effective remeady against the disease.

'Gummosis' is another serious disease which affects the stem. A liquid oozes out from the affected portion and the bark cracks. The bearing capacity of the plant is reduced, ultimately the plant may die if neglected. Application of Bordeaux paste to the affected portions is recommended. (Bordeaux paste is prepared by mixing one part of copper sulphate with three parts of lime in water to a thick consistency.)

Die-back. This is a disease which is common in orchards where drainage is lacking and the soil deficient in lime. The shoot portion starts drying up from the tip downwards. In such cases the disease can be checked by promptly pruning off the affected part up to the healthy portion of the stem or branch and applying Bordeaux paste to the cut surface.

Encouragement of fruit canning and bye-product industry. As an adjunct to fruit cultivation it would be profitable to start canning of fruits and manufacture of by-products. During periods of heavy production which create a glut in the market it would be better to utilise the surplus produce for preparing preserved products of fruits instead of resorting to underselling the produce. Manufacture of lime beverages, squashes and cordials which find an easy sale during summer months should be encouraged. Preparations of citric-acid, essential oils, and fruit candies as bye products will be another enterprise in this direction. The canning of fruits like mango, jak, orange, pine-apple and the preparation of products like banana, figs, flour and crisps are not warranted under present conditions but can be taken up as and when the fruit industry of the tract develops.

Marketing. Facilities for quick and easy marketing occupy the key position of the fruit industry. The marketing system should be efficient

aiming at quick disposal of the produce at favourable rates. It is due to lack of organisation in this centre that the fruit grower is not able te get a square deal for his produce.

A system of grading of the fruits must be adopted so that the market value of the fruits may be enhanced. A well organised Sale Society on a co-operative basis must be started which will not only reduce the cost of export but also ensure fair prices for the grower all the year round. Such a procedure will effectively replace middlemen, who hold a grip over the marketing organisation at present.

Another important recommendation is the extension of the fruit growing area on account of the commercial possibility. The area to the north of Kadayam up to Tenkasi and up to Tirunelveli in the south has plenty of natural resources for fruit gardening. These regions can be exploited with profit. Large scale production will not only improve the opulence of the fruit grower but also lead to the cheapness of the commodity and ultimately to greater consumption by even the poorest class of people.

A further step in the campaign would be to encourage f uit growing by ryots with small holdings, so that every cottage can boast of a fruit orchard of its own to satisfy its requirements. The success of such schemes will have far-reaching results in the long run.

Acknowledgment. I am indebted to Sri K. C Naick, M. Sc. (Bristol) for his valuable guidance in the conduct of the survey.

A Note on Chrysanthemum Cultivation in Vellaikinar, Coimbatore.

By A. SANKARAM, B. Sc.

Introduction. The cultivation of flowers on marketable scale has of late become a profitable enterprise among the ryots of villages situated in the neighbourhood of towns and cities. Of the different flowers that have a demand in the market in South India, Chrysanthemum is the most common. The village of Vellaikinar is situated five miles from Coimbatore town. Many ryots of this village cultivate this crop in their garden lands. The crop comes in rotation either after Cambodia Cotton or Cholam.

Soil and preparatory cultivation. A successful crop is seen in localities where the soil is a fairly deep medium loam, with good irrigation and drainage facilities. After the harvest of the previous crop, the field is given 6 to 8 ploughings with a country plough and thus brought to fine tilth in the month of March-April. The field is next thrown into beds and channels with a mamutti.

Season. The preparatory work comes to a close at the end of April and planting will be in progress in May soon after some showers are received. The planting material consists of the root-stocks taken from a previous crop which has been exhaustively harvested. About 2 to 3 cents of the main field, if reserved for the rootstocks, will be sufficient to transplant an acre.

Manuring The crop responds to heavy manuring. Generally about 30 cart loads of farm yard manure per acre are carted and ploughed in before planting.

Irrigation Just before planting the whole field has to be watered. On the fifth day after planting, a like irrigation will be given. As the crop requires copious watering, regular irrigation every week is essential. On the whole about 34 irrigations are given during the period of ten months (May—March) in which this crop is in the field. Two weeks after planting a hoeing is given. Afterwards the plots must be well hoed and weeded at regular intervals.

Picking. During the ten months' duration of the crop it gives two flushes. The first flush is from October to December after which the main flowering stems (vegetative portions only) are pruned off. The side suckers will then begin to develop and within about 1 to 1½ months the second flush commences. Picking is generally done once in six days either early in the morning or late in the afternoon. A small knife with a curved blade facilitates easy and quick harvest of the flowers. Women coolies are usually engaged for the harvest.

Yield. For each flush, about 10 pickings will be taken A single picking yields about 25 baskets of flowers containing 4 to 5 thousand flowers per basket.

The cost of each basket varies from 4 annas to 2 rupees, according to the season and the demand for flowers in the market. It is a general practice with the ryots to grow chillies, bendai and onions on the edges of the irrigation channels of this crop. These give an additional income of Rs. 5 to 10 per acre.

Economics of Cultivation. The cost of cultivation comes to Rs. 160 including picking charges. Calculating the income at Re. 0—8—0 per basket of flowers, the gross income from an acre will be Rs. 250. The net gain will thus be Rs. 90 per acre. There is a contract system of disposing of the crop in which case the contractor has to pay Rs 100 per each flush—the picking and watching charges being borne by the contractor himself. The net gain for the ryot in this case will be about Rs. 80 per acre.

Conclusion. It will be a paying proposition indeed, to take up the cultivation of flowers by ryots of villages situated within five miles from towns and cities as there is a good demand for the flowers.

Cost of cultivation per acre—details.

Preparatory cultivation	Rs.	12	0	0
Manures—30 cart-loads of F. Y. M., carting, spreading etc.	,,	32	0	0
Planting	,,	1	8	0
34 irrigations @ Rs 2 per irrigation	,,	68	0	0
Weeding and hoeing	,,	9	0	0
20 pickings for the two flushes @ 10 women per picking	,,	37	8	0
Total.	,,	160	0	0
Yield—500 baskets valued at 0—8—0 per basket ...	,,	250	0	0
Net gain ...	,,	90	0	0

Acknowledgment. The author wishes to express his thanks to Sri. T. Nataraj, B.A., B. Sc. (Ag) for his valuable suggestions on the paper.

Tea Cultivation in South India.

By E. A. STONE

Manager, Gajam Mudi Estate, Anamalais.

(Continued from Vol. XXVIII Page 169)

Nitrogenous Cover crops. Various plants of the leguminosae family are grown in tea for green manure, and for helping to stop soil erosion. The method of planting adopted is to sow the seed thinly over about 1½ feet width every other row of tea as soon after pruning as possible. (It is partly for this reason that the branches from pruning tea are usually stacked in every other row, so leaving alternate rows for planting cover crops.) Earth is lightly scratched over the seed with a *kokra*. The best times for planting are in the showery weather preceding and following the heavy monsoon. Species of Crotalaria, *Tehprosia Vogelli, T. Candida* and species of Indigofera are planted. Some Indigoferas like *I. endecaphylla* are planted from cuttings and spread over the surface of the ground giving a good protection from erosion in wet weather, but unfortunately they tend to die back entirely in dry weather, so being of no use to stop "dry wash". Some planters claim that on steep cultivated hillsides as much soil is lost in the dry weather by being pushed down by the labourer's feet and slipping of its own accord, as is lost in wet weather by wash. The other varieties mentioned are planted by seed, and being planted after the tea has been pruned, have plenty of room for quick growth. Cover crops of this kind are regularly cut back to about 1' to 1½' from ground level, so producing plenty of loppings for mulching over and covering the ground, and eventually rotting and supplying the ground with more nitrogenous food than has been taken out. (The various processes from fixation of atmospheric nitrogen through to its final oxidisation into nitrates for the use of the leguminous plants by Nitrosomonas, Nitrobacter and kindred bacteria, will be well-known to my readers). Once the plants are allowed to seed, they become woody and little or no more loppings will be obtainable from them, so they should be lopped when they start flowering, or when they bush out and start interfering with the tea. After about two years from planting the seed the leguminous plants become woody and useless and are rooted out. Anyway, by this time, the tea bushes have grown to a complete cover of the ground.

The dadap tree *(Erythrina lithosoperma)* being a legume is also grown for mulch especially on hill tops. It is very hard to get dadaps to grow satisfactorily in old tea especially on the poor soiled hill tops where they are most wanted, and the only satisfactory way is to rear basket plants from seed (in the same way as tea – see 1st. article) and when planting out surround the plants with farm yard manure or compost. Dadaps will grow satisfactorily from cuttings in young clearings, and in sheltered hollows and lower slopes. Rows of dadaps are grown between the grevillia rows,

but as the dadap tree gives a dense shade it should be lopped twice a year. Many planters allow the dadap tree to grow up as a single stem to about 8 feet and branch from there. My own view is that the young tree should be pollarded at 4 feet first, taking the next cut at 7 feet and standardising further cuts at 10 feet, lopping off completely all hanging branches and all growth in towards the centre of the tree. In this way dense shade under the centre of the tree is got rid of and an easily climbable sturdy tree able to withstand the monsoon gales is produced, which will produce great quantities of mulch. The dadap unlike tea, thrives on lime, and the condition of sickly trees can be improved by its application.

Manuring. In these days of restricted crop not much artificial manure is being used except on the oldest estates. Estates which from their first opening have been carefully looked after and cultivated and soil erosion on them stopped as far as possible, can keep up a steady crop for many years without deterioration. I have not much experience therefore of artificial manures, except that I know that for increasing crop i. e. leaf, nitrogen is necessary, and therefore nitrates are applied. For improving the strength of the bushes and the growth of wood, phosphates are used. But for improving the soil and bushes generally well composted cattle manure, factory rubbish, and jungle loppings are excellent, and very cheaply made if the work is properly organized, and if transport is easy. The first necessity is centralised cattle sheds, the nearer the factory the better. Periodically the factory rubbish can be taken and well mixed with cattle manure and loppings from the jungle (if the jungle is not so far away as to make cost of transport prohibitive) and heaped. The heaps need turning over and re-mixing about once a month, and watering in the dry weather and in 4 or 5 months a well rotted manure with quite a high nitrogen content will be obtained. To be worth making, it must be done cheaply, and this rough process is cheap. Complicated weighings and measurings, and temperature takings increase cost and will not produce a much superior manure. In this way, quite a small estate with 50 to 100 head of cattle on it will be able to produce 300 tons of compost manure annually, which put out and forked in at 10 tons per acre will do a lot to improve 30 acres a year of bad hill top. This compost is especially useful for getting nitrogenous crops to grow in bad soil.

(To be continued).

SELECTED ARTICLE

Production of Fertilizers in India.

By N. N. Sen Gupta, M. Sc., A. I. C. Superintendent, Government Test House, Alipur.

The principle underlying the use of fertilizers, namely, the necessity of adding plant food to the soil, was understood in a general way even in the early days of civilization. It was only about a century ago, however, that the science of plant nutrition and the requirements of the soil for certain elements, in which it is liable to be deficient, began to be clear as a result of the researches of de Saussure and Liebig on the Continent and Lawes and Gilbert in England. The versatile Lawes was not only one of the most brilliant pathfinders in agricultural science but was also the first manufacturer of a chemical fertilizer, namely superphosphate. Phenomenal progress has since been made in the manufacture of chemical fertilizers in Europe, America and Japan, and today the combined world production in the case of some of the important fertilizers is computed in terms of millions of tons. The fertilizer industry by its effect on the cost of production of sulphuric acid has given a tremendous impetus to the development of the heavy chemical industries. Since the World War of 1914—18 the synthetic manufacture of fertilizers has been greatly developed.

The intelligent use of fertilizers has become an integral part of the agriculture of the advanced countries in Europe, in America and in other parts of the world. This cannot be claimed of India; indeed, until comparatively recently the use of fertilizers by the ryot was insignificant in spite of the field experiments carried out at the different agricultural research stations in this country. The poverty of the ryot was the main impediment. In recent years, however, as a result of a combination of circumstances, including the lowered prices of fertilizers and the systematic propaganda conducted by commercial firms, the use of fertilizers by the cultivator has become considerably in excess of that on tea and coffee estates which were at one time practically the sole consumers of these commodities in India. Even now the consumption by the cultivator represents a small fraction of that which will be possible if the circumstances alter sufficiently so as to make the use of fertilizers general.

Imports and exports In this article it is proposed to deal briefly with the production of fertilizers in India, but before proceeding to discuss production it will be well to understand the extent to which fertilizers are at present being imported into and exported out of this country. The exports consist almost exclusively of organic fertilizers manufactured from bones and animal and fish refuse which are slow acting and also unpopular in India due to religious prejudice. The imports and exports for 1938–39 are shown below.

Imports

	Tons	Value in rupees
Nitrate of soda	2,137	2,23,891
Sulphate of ammonia	76 748	82,99,126
Muriate of potash	1,829	1,82 606
Superphosphate	6,788	5,65,290
Ammonium phosphate	2,569	3,95,166
Fish manure	2,349	72,538
Other fertilizers	7,032	7,78,757
Total	99,452	105,17,324

Exports

	Tons	Value in rupees
Bones for manurial purposes	15,424	11,84,473
Bone meal	25,072	14,85,764
Fish manure	4,710	3,79,374
Guano	178	19,045
Horn meal	1,007	1,04,833
Sulphate of ammonia	1,313	1,36,455
Other fertilizers	5,546	4,11,341
Totol	53,250	37,21,685

To roughly 100,000 tons of fertilizers which are at present annually imported it is necessary to add approximately 20,000 tons of sulphate of ammonia and 2,000 tons of superphosphate produced in the country and also the amounts of the various indigenous organic manures consumed, before the total approximate, consumption of fertilizers in India can be arrived at. When it is considered, however, that the world's present annual production of sulphate of ammonia and superphosphate alone is of the order of 4,000,000 and 15,000,000 tons respectively, the comparative smallness of India's total consumption would be obvious.

Nitrate of potash. The manufacture of nitrate of potash is a very old industry of Northern India. Although potentially a fertilizer of unusual value owing to the presence of both nitrogen and potash in it, the material is not used to a large extent as a fertilizer. This is due partly to its high cost of production as compared with that of other nitrogenous fertilizers, and partly to the fact that it is in demand as a constituent of explosives. As is generally known, it is found in a crude form as an efflorescence in the surface soil where it is formed as a result of the decomposition of nitrogenous organic matter and the bacterial nitrification of the resultant ammonia. In order that nitrate of potash may be formed, potash salts must also be simultaneously available in the soil.

Saltpetre. The crude saltpetre from which nitrate of potash is obtained varies in composition and usually contains a large proportion of sodium chloride. The refining consists in removing impurities including sodium chloride. Crude saltpetre and also the earths from which saltpetre is extracted are used locally as a fertilizer, but the bulk of the meterial is refined into nitrate of potash for purposes of export. The use of the refined material also as a fertilizer is not unknown.

The production of saltpetre is at present on a much smaller scale than it was at the beginning of the nineteenth century when the export amounted to 80,000 tons per annum. The average annual export during recent years has not exceeded 8,000 tons, but presumably the present European war will again stimulate its production and export. A large number of refineries exist in the Punjab, the United Provinces and Bihar for the production of saltpetre.

From the figures given above it will be seen that some 2,000 tons of nitrate of soda is still being imported annually into this country. In the past it has been imported in much larger quantities, but apparently it has in recent years not been able to compete successfully with sulphate of ammonia. The world's entire requirement of nitrate of soda is met from Chile where it is found as a natural deposit, and there is no possibility of its manufacture being undertaken in this country.

Sulphate of ammonia. The most important fertilizer from the point of view of Indian manufacture is undoubtedly sulphate of ammonia. Some 90,000 tons

of this fertilizer are now being consumed annually in the country, and it may confidently be expected that its consumption will continue to increase. Ten years ago the total consumption in India was between 20,000 and 25,000 tons, and the increase by 300 per cent within a decade indicates the rate at which its use is spreading among the cultivators Of recent years, and of course, before the present war started, its price had been considerably lowered and the firms concerned in its sale maintained an organization for propaganda and ready availability of the material. It is not too much to expect that its price will, after the present war is over, be lowered further in order that the use of this fertilizer may be more widespread.

Until the advent of the Haber-Bosch process of synthetic manufacture of ammonia about two decades ago, sulphate of ammonia was produced entirely as a by-product in the manufacture of coal-gas and metallurgical coke. At present the synthetic production probably exceeds the total quantity made as a by-product. The nitrogen present in the coal is given off as ammonia as a result of destructive distillation resorted to in the production of both gas and coke. The gas containing ammonia is first stripped of its tar content and is then conducted through a plant, known as the saturator, which contains sulphuric acid. Sulphate of ammonia is produced as a result of interaction between ammonia gas and sulphuric acid, and this collects as a paste at the bottom of the saturator. The paste is removed, dried and neutralized with sodium carbonate. In India the production of sulphate of ammonia dates back to 1909, and the fertilizer has so far been made practically entirely by coke plants operating in the coal-fields and also by those attached to the iron and steel factories of Bengal and Bihar. It is probably not yet generally known that the Mysore Chemicals and Fertilizers Ltd. are about to place on the market sulphate of ammonia made synthetically at their factory situated in Mysore. This marks an important new development in the production of fertilizers in this country.

The East Indian Railway's coke plant attached to the Railway's collieries in the Giridih coalfield was the first to produce sulphate of ammonia in India. The coke plant was erected in 1909. and for the first six years the acid required for the recovery of ammonia was purchased from Calcutta. In 1915 an acid plant was added which has since supplied the requirements of the sulphate of ammonia plant. The Bengal Iron Company were the next in the field and erected their by-products recovery plant at Kulti in 1915. The Tata Iron and Steel Company at Jamshedpur followed in 1916, and subsequently several other concerns, such as the Loyabad Coking and By-products Recovery Plant in the Jharia coalfield, the Indian Iron and Steel Company near Asansol and the Bararee Coke Co. near Dhanbad, began to produce sulphate of ammonia. It is understood that the newly-founded Steel Corporation of Bengal do not contemplate manufacturing sulphate of ammonia. With the exception of the East Indian Railway Coke Plant and the Bararee Coke Co., all the Indian producers of sulphate of ammonia as a by-product are members of the British Sulphate of Ammonia Federation, and the price of the commodity as sold in India is, therefore, controlled by the Federation. The largest Indian producer is the Tata Iron and Steel Company, and the total production has so far not exceeded 20,000 tons per annum.

Reference has already been made to the Mysore Chemicals and Fertilizers Ltd. This firm proposes to manufacture about 7,000 tons of sulphate of ammonia annually, and the production has probably already been commenced. It is anticipated that practically the entire output of this factory will be consumed in the Mysore State by the sugarcane cultivation and the coffee and tea estates. The factory manufactures sulphuric acid by the contact process and are the first to produce ammonia synthetically in this country. The synthetic process

adopted is known as the 'Chemico' process which is presumably an adaptation of the original Haber-Bosch process worked out in Germany and later adopted by the Imperial Chemical Industries at their works at Billingham. In principle the synthetic production of ammonia consists in combining three volumes of hydrogen with one volume of nitrogen in the presence of a catalyst; in practice, however, the process is a complicated one. Further developments in the manufacture of sulphate of ammonia will presumably be along the lines of synthetic production, but the output from coke plants should also increase as the iron and steel industry expands further.

Phosphate of ammonia. Considerable quantities of calcium cyanamide have in the past been imported into India, but owing to the increasing popularity of sulphate of ammonia its consumption has been on the decline. No cyanamide is produced in this country and none is likely to be produced, although in a note published in 1917 Dr. (later Sir) L. L. Fermor, formerly of the Geological Survey of India, suggested three possible sites for the establishment of this industry in India. A comparatively recent addition to the range of inorganic fertilizers is phosphate of ammonia which is now being imported into this country in substantial quantities. It is produced synthetically and is a double fertilizer in that it supplies both nitrogen and phosphorus to the soil. No attempt has yet been made to produce it in this country, although in view of the recent developments in Mysore there does not seem to be any reason why it cannot be made in India.

Superphosphate. The import of superphosphate has for some years been of the order of 7,000 tons per annum, and some 2,000 tons are manufactured in this country. This fertilizer is produced on a vast scale in different parts of the world, and some years ago when the Tariff Board investigated the position of the heavy chemical industries in this country, it was thought that with suitable protection from the State the manufacture of superphosphate could be developed. The difficulties attending the manufacture of this fertilizer are (1) lack of suitable rock phosphates and (2) the comparatively high cost of production of sulphuric acid in the country. Deposits of phosphates are available in the Trichinopoly district of Madras and in the Singhbhum district of Chota Nagpur, but their high iron content renders them unsuitable for the manufacture of superphosphate. Superphosphate can also be made from bones, and although the latter are plentiful in the country, they can usually be exported to fetch higher prices than are paid for imported rock phosphate. These are some of the factors which have inhibited the development of the superphosphate industry in the country. But the time may yet come when as a result of the double movement of expansion of the heavy chemical industries and increased purchasing power of the ryot a successful superphosphate industry will be established in India.

Only two firms in India have so far seriously attempted to produce superphosphate in this country from crushed bones. One of these, Messrs Dharamsi Morarji Chemical Co. of Bombay, had a comparatively ambitious scheme for production of this fertilizer, but the expectations were not realized. They continued to produce on a small scale for some years and have since abandoned this manufacture. Messrs Parry and Company of Madras are still producing superphosphate at the rate of 2,000 tons per annum, most of which is made from bones.

Basic slag obtained as a by-product of the steel industry is an important phosphatic fertilizer in England and under certain soil conditions has been known to produce remarkable results. The Indian slag is poor in phosphorus and its grinding to the requisite degree of fineness is consequently not considered to be an economic proposition.

Potassic Fertilizers. Potassic fertilizers, mainly in the form of muriate of potash, are in ordinary times imported largely from Germany and Palestine. India does not produce any potassic fertilizer except in the form of nitrate of potash which has already been discussed. Potash salts are present among the beds of rock salt in the Salt Range of the Punjab, and the question of their exploitation for manurial purposes was considered by the members of the Government Salt Department and the Geological Survey of India, but the prospects were thought to be highly doubtful.

Organic Fertilizers. India produces considerable quantities of organic fertilizers at or near Calcutta, Madras, Cawnpore and Karachi. The exact figures for production are not available, but the export figures given earlier in this articles indicate the sales of production. Unsteamed bone-meal is produced in those bone mills which crush bones for gelatine. The portion of the bones which gets powdered in the process of crushing is marked as unsteamed bone-meal. Steamed bone-meal is obtained by steaming bone pieces (usually greasy bones) in digesters under a pressure of 60/75 lb. for 2-3 hours. After drying, the steamed material is crushed to a fine powder Steamed horn and hoof meal and steamed leather meal (charmon) are produced by the same process as steamed bone-meal. Sterilized animal meal is derived from animal carcasses, etc After skinning, the dead animals are introduced into superheated rotaries and converted into dried pulp which is crushed in disintegrators. Owing to its disagreeable smell, export is difficult and the material is largely used in mixed fertilisers for tea gardens. Fish guano is obtained from the refuse of small fishes which are caught in large numbers in the Sunderbans and on the Malabar coast. This material is also difficult to export and is consumed largely in the country admixed with other fertilizers. All the organic fertilizers mentioned above are produced in substantial quantities in India. Another type of organic fertilizer which is produced in the country and used to a considerable extent by the cultivator is oil-seed cake meals. These are by-products of the oil pressing industry, and those varieties, which are not fit for use as a cattle food, find their way largely into the soil. (*Indian Farming* 1 (1940 : 211).

Ezperiments with Waste Products as Cattle Fodder in Famine Areas.

(From the Principal Information Officer, Government of India).

Investigations have lately been made by a senior worker from the Animal Nutrition Section of the Imperial Veterinary Research Institute at Izatnagar, in some of the famine stricken areas in the Punjab, Rajputana and Sind, to find out what local green roughage, if any, which when added to the agricultural and factory wastes like groundnut husk, rice husk, corn hearts, reed, bajra husks, molasses, etc., locally available, would maintain cattle even in famine conditions. Food experiments, it is understood, with these substances are being undertaken immediately at Izatnagar so that the results may be available at an early date. The chemical analyses of these agricultural and factory wastes do not, it is said campare unfavorably with wheat *bhoosa*, the roughage which is being supplied by Government organisations in these famine areas: These areas, which border the Rajputana desert, happen to have the best breeds of cattle in India. The soil is rich and in normal times crops and fodder grasses grow luxuriously, but no serious effort seems to have been made at conserving roughage for times of scarcity or tapping new sources of cheap fodder supply during famines.

For the last three years there has been no rain, with the result that there has been a complete failure of crops. Majority of the best breeds of cattle in

these areas have died of starvation or have been sent to places where some fodder is available or disposed of at ridiculously low prices. In Hissar in the Punjab for instance, there are now barely 700 milch cows as against over 16,000 in 1935. There is large incidence of deficiency diseases. Most of the animals have developed depraved appetite and all that comes before them is eaten up. There is less milk yield; conceptions are fewer, calf production is low and premature calves are being dropped. The Governments concerned have been making efforts to relieve difficulties caused by famine conditions. But a great setback in animal production and high cost for good bullocks in future may well be apprehended.

Some of the worst affected areas, which are in Jaipur State, Rahtak and Hissar districts in the Punjab, and Tharparkar, Sind, were visited. In the plains of Jaipur, where the soil is rich, nothing grows at the moment except in small plots near the wells which are watered by lift irrigation. Most of the wells have dried up and the capacity of the others to irrigate has been considerably reduced, but,even with water scarcity, groundnut is being grown in large quantities. The groundnut oil is being used by the people and the pressed cake for animals, while husk is thrown away as a waste. No grain is given at all to milch cows or working bullocks. Only cotton seeds and cakes are occasionally available. Pipal, Acacia, Neem, Shisham, Shrub-berries and Kher are the tree fodders used for cattle, but the trees themselves are now completely denuded of leaves. It has been found, however, that the greater the scarcity of water the more profuse is the growth of shrubberries. These are being cut, allowed to dry and then the beaten-out leaves are being used as cattle fodder. Bajra is another crop which occurs in abundance. Camels and sheep and goats look slightly happier as compared with cattle. Camels, in addition to Pipal and Shisham, take Neem and Acacia leaves, but the cattle browse on them with great reluctance. That explains why mortality due to starvation is much less in camels and sheep as compared to cattle. The rocky area of the State has the advantage of retaining, after rainfall, a comparatively little more moisture. A large portion of these rocks is covered by Jhojhu and Dhak trees which give luxurious growth of leaves in spring, but Dhak is not relished by cattle, while goats and sheep take it. This, however, is not an area with a large number of cattle. It is only during the scarcity period that animals are sent here for grazing.

In Rohtak, Punjab so great has been the scarcity of fodder that it is difficult to find even a tree with leaves except those which may be toxic to cattle. There is no green crop in the field except Calatropis and other poisonous plants. Roots of grasses have been dug up by the village people for providing some sort of food to the animals. Dry leaves from shrub-berries are being used as fodder.

In Fatehabad in Hissar, which is one of the worst affected areas and where the soil is rich and grows all kinds of crops, some of the animals have now been forced into such states that they browse upon a plant locally called Bhohi, which is not usually eaten by animals, and the result is diarrhoea and in severe cases death. Night blindness is common in cattle, but not in camels and goats. Calatropis grows in abundance and so does reed. *Acacia*, *Pipal*, and *Jhal* are the tree fodders used for cattle. The Government of the Punjab are doing their best to help the people with subsidies. The Government have also opened famine centres and sell wheat *bhoosa* to the poor at reduced prices.

At Karachi investigations were made as to the possibility of using local agricultural or factory wastes as fodder. A vast area round Karachi grows cotton and a big firm in Karachi prepare decorticated cake and oil from cotton seeds.

At Naukot, in Sind, on the border of the desert, where large herds of cattle are owned in times of prosperity by an average villager, the undergrowth during rains is satisfactory, but there is nothing there now except the characteristic xerophytic plants, i. e. Cactus (thorny, hence not taken by any animal), *Jhal* (taken by camels, goats and sheep), *Bhumbar* (thorny, but taken by camels), *Dela* (browsed on by camels) and *Bhui* and Calatropis which are not eaten by any animal, except in an occasional bite by a hungry goat, but in these famine times hunger is driving the animals to these plants.

ABSTRACTS

The Pneumatic Tyre. J. A. Williamson. *Agri. Gaz. N. S.* Wales, 50: (1939) 643—646. In a series of tests at the Leeton Rice Research Station Mr. J. A. Williamson has shown that many advantages are to be obtained by fitting pneumatic tyres to farm and orchard lorries, rice headers and other cultivation implements. Reductions in drawbar pull of approximately 50 per cent. were recorded in dynamometer tests, in addition to increased speed of work, earlier working of wetland, less damage to soft land, and many other benefits of particular value to the irrigation farmer or orchardist. These advantages, however, were limited to machines and lorries hauled by horses or tractors. While the pneumatic tyred tractor proved efficient under good farming conditions, it was not as satisfactory as the steel wheeled or the crawler tractor under wet sticky soil conditions. (Author's abstract).

Changing the nature of plants (melons) by grafting. (Russian) S. P. Lebedeva, *Nov. Sel. Khoz*, Moscow, 1937, No. 16, p. 42. Grafting has made possible the spread of melon cultivation from the subtropics to Moscow. Suitable stocks are essential. The following results of grafting were established:— (a) alteration in time of ripening, (b) increased flowering induced by grafting on pumpkins, (c) female flowering in scion increased by increase in flowering of stock, (d) yield of ripe fruits on scion increased by presence of 1—2 fruits on the stock, (e) habit of fruiting changed from secondary to primary shoots and hence earlier fruiting obtained by use of a suitable stock such as *C. maxima*, (f) better rooting in pumpkin as a result of grafting with melon, (g) earlier fruiting in grafted pumpkins. The following practical conclusions were drawn:— By grafting melons on pumpkins the yield increases from 17 tons per ha. to 40 tons per ha. Melons grafted on pumpkins ripen 10—19 days earlier than otherwise. Fruits from grafted melons have a better flavour and show sugar increase of 12—14 per cent. The life of the melon plants grafted on pumpkins is appreciably longer than that of ungrafted melons both under shelter and in the open. Grafting on pumpkins on excessively wet soils can prevent 'neck-rot'. The results of grafting on the progeny are as follows better seed quality, increased percentage of successful graft, earlier maturity, higher yields, and hardier plants more resistant to diseases. (*Horticultural Abstracts* 9 (1939): 26).

Manganese sulphate as a corrective for a chlorosis of certain ornamental plants. Dickey, R. D., and Reuther, W. *Bull. Flo agric Exp. Sta.* 319, 1938, p. 18. Experiments carried out in Florida showed that chlorotic disorders among such ornamentals as Bougainvillea, Allamanda, *Psidium cattleianum* (Cattley guava), *Thunbergia grandiflora*, *Bignonia venusta* and *Agyneja impubes* can be controlled by spraying with manganese sulphate. In the case of crape myrtle, *Lagerstroemia indica* L., soil treatments with manganese sulphate were as effective as spraying the foliage with the same material. (*Horticultural Abstracts* 9 (1939): 49.

EXTRACTS

A New System of Field, Orchard and Garden Irrigation.

In view of the primary importance of economy in capital outlay, as well as cost of operation and transportability of equipment, we have been greatly impressed by what we have seen of the "Sigmund" irrigation equipment, which is now being marketed in this country by Messrs. Guthrie Allsebrook & Co., Crown Street, Reading, and is eventually to be produced here.

Artificial rain-making is a relatively new procedure, and although various types of equipment have been in use over sufficiently long periods to enable their merits to be tested, it has been borne upon Messrs. Guthrie Allsebrook & Co. that there is need for something different from what has hitherto been standardised, and certainly something more flexible or mobile than the fixed type of plant some farmers and intensive market gardeners have employed.

It has, of course, been ascertained that "falling rain" is more suitable to our crops than channel irrigation, and for this "falling rain" the following requirements have been specified: (1) produce fine "rain" rather than heavy drops, and distribute it evenly: (2) apply the "rain" speedily to save time; (3) moderate installation cost; (4) moderate operating cost; (5) simplicity of application; and (6) capacity to feed the crop with liquid manure or chemical fertiliser during watering.

The "Sigmund" system is declared to fulfil all these requirements. It is available in several sizes, but in each instance, from the garden type to large capacity field equipment, the principle is substantially the same, in that a jet of water of given force is delivered in an ingeniously interrupted fashion. That is to say, the delivery from the jet is distributed mechanically but intermittently in such a synchronised way that a long spray and a short one can become almost simultaneous, so that there is uniform coverage throughout the area from the position of the monitor itself to the extreme circumference of the area described by the jet as the monitor rotates.

The garden monitor rotary "rainer" as its name suggests is expressly for gardens, gold-courses and other such conditions where there is a modest area to cover and the available rate of water flow is limited as by, for example, the size of the feed pipes, a tap, etc. It can be operated from a mains water supply or from a small pump, and it will deal with a whole tennis court efficiently at one setting. Fine rain and even distribution are secured, while the choice of three jet sizes enables particular needs to be fulfilled precisely.

In respect of larger areas, the jet is projected from a fire nozzle and a faithful imitation of rain is the outcome. Unlike the garden "rainer", which is fed from a hose, this largest field monitor is fed from movable-pipe lines. The pipes themselves, we have had an opportunity of seeing, are extremely light, and three 18 feet sections can be moved by ordinary labourers as required from time to time, even when they are of main pipe line dimensions. At various intervals along these pipe-lines, there are nipples on to which hydrants are fitted in an easy coupling manner, and from these hydrants lateral pipe lines can be run almost as required, and a monitor fixed at the end of each of them. Thus from a semipermanent centre main, which can remain in place until the pump is moved, a most extensive layout can be obtained with minimum of labour, as the laterals can be moved to and reconnected to suit whatever plot may be in need of watering, and as a matter of fact, two lines or monitors can be working at a time while a third is being fixed up.

The mains are, in fact, lightweight, easily transportable steel tubes laid above ground, and they, may, for example, be set out for an early potato crop, and removed when this is dug for, say, strawberries, etc., or they can, if required, be moved about much as one would handle hose-pipes, although of course, with a little more, but not excessive effort. Patent "Express" couplings facilitate fixing together, but unlike other types of rapid couplings, which usually have loose parts likely to be mislaid, these "Express" couplings have two parts only and a specially formed rubber ring.

There are two main types of field monitor. One throws a jet which strikes a "spoon" in contrast to the rotary wheel on which a jet impinges in the garden type. The effect of the water striking this spoon causes it to be diverted from its normal path, for the "spoon", as it is hit, throws up a shower of spray which falls near the "rainer" and also as the "spoon" is hit, so is it given a turning impulse. Upon the 'spoon' being released from the force of the jet the movement imparted to the spoon arm tips a catch and allows the apparatus to turn on its ratchet base. At the same time, the motion of the "spoon" arm moves a pointed finger or needle, which splays the jet, and this second interruption means that the "rain" is not only delivered at maximum and minimum distances, but also evenly at medium range.

In another field type, the medium range is served by a finger splaying the jet, and this is operated by a spinning wheel turned by a small jet, which also rotates the apparatus and the spinning wheel itself waters the near distance There are also special types of these field monitors, which will pass even dirty-water or liquid manure that would otherwise block a small jet, and on these models the wheel is operated by the main jet.

Another alternative type is the oscillator, which some market gardeners with beds of lettuce, cabbages and similar crops find more convenient than the revolving ones, because the area to be covered is rectangular rather than circular. For joining these pipes together, a form of "Express" coupling is used, while small nozzles are fitted at intervals along the tubes, and thus there are projected jets which fall like rain. As oscillation takes place, the rain falls first at a distance then nearer and nearer to the tubes, then over them, and so to the other side to the extreme limit and back again. By this cycle, uniform distribution is obtained even on lines 100 yards long or more. The tubes are mounted on simple supports of any height convenient to the crop.

The equipment, of course, includes full pumping facilities such as the "Sigmund" two-stage centrifugal pump which can deliver 50 to 80 gallons per minute with a 100 to 175 ft. lift and a portable multistage centrifugal pump with auxiliary hand primer. This latter pump is mounted on a four-wheeled undercarriage specially designed for irrigation purposes, with a delivery of 140 to 200 gallons per minute with a 130 to 180 ft. lift. Various forms of power can be used to operate these pumps, and in some cases, a light farm tractor finds the belt driving requirements well within its power when a plant of maximum size, such as one watering 1½ acres at a time, is being operated and the water drawn from a river or stream.

All the monitors, it should be added, are of non-ferrous construction, while the RR2 and the larger sizes have machine cut double reduction worm gear that is exceedingly well made. The worm first reduction is turned by the water jet driven wheel, and a bronzle crown wheel carries an eccentric disc to operate the jet splaying arm and the second worm wheel on the same spindle. The final bronze crown wheel is fixed to the frame, so that the monitor (including gearbox and everything else) rotates around it. The whole mechanism is well packed with grease, and in each case a special self-sealing rubber gland is fitted to the

monitor to retain the water under pressure. Steel lightweight tripod legs are provided and so permit the monitor to stand level, even on sloping ground. Later on, we hope to be able to give instructive figures obtained from independent tests recently carried out. (*The Implement Machinery Review* (65 : 770—772).

The importance of vegetative cover in Soil Erosion Control.

In an experiment conducted at the Agricultural Experiment Station of the University of Missouri, U. S. A., seven plots, each 1/80th of an acre in area and elongated in form, were laid out on a loamy slope of 3.68 ft. per 100 The plots were treated as follows:—

1. Uncultivated. Weeds pulled.
2. Cultivated 4 inches in spring, and after rains.
3. Cultivated 3 inches in spring, and after rains.
4. Dense pasture of blue grass.
5. Wheat annually.
6. Rotation—maize, wheat, clover.
7. Maize annually.

The average annual rainfall for the six years of the experiment was 35·87 inches. It was found that the average run-off of water varied from 48.92 per cent of the rainfall on the uncultivated plot to 11.55 per cent of the rainfall on the pasture plot. Pasture absorbed more water than cultivated land and lost ·68 per cent as much soil as bare soil cultivated 4 inches deep.

On this evidence it may be estimated that if farm land should erode as rapidly as the soil in these experiments, the time taken to erode 7 inches of soil would be:—

Uncultivated—29 years.
Ploughed 4 inches--24 years.
Ploughed 8 inches—28 years, or about 42 tons/ac. per annum.
Maize annually—56 years, or about 15 tons/ac. per annum.
Wheat annually—150 years, or about 9 tons/ac. per annum.
Rotation—maize, wheat, and clover—437 years, or about 3 tons/ac per annum.
Dense pasture—3,547 years, or about ¼ ton/ac. per annum.

From these experiments it is evident that farmers can do much towards reducing run-off and the disastrous effects of erosion by rotating crops in such a way that the land will be covered with a growing crop for a large proportion of the time. The type of vegetation will vary according to the slope and nature of the soil.

(*Journal of Agriculture, Victoria*, 38 : 174—175).

Gleanings.

Molasses for potash deficient soils. While recent reports received from representatives of the fertilizer trade regarding future supplies are more reassuring it is nevertheless desirable that efforts be made to utilize existing Australian resources to the best advantage.

In relationship to potash, all of which is at present imported, this would call for better supervision in the rationing and distribution of molasses which is extensively employed in several areas as a means of building up depleted soils. For obvious reasons this by-product is most effective when applied to soils, which are potash-deficient, and as far as practicable molasses utilization might be confined to areas of such lands.

In the Cane Growers' Handbook it is stated that difficulty would be experienced in spreading molasses evenly in amounts of less than 5 tons per acre. This would provide, of course, much more potash than the heaviest cane crops would need. In conversation recently, a northern cane grower pointed out that molasses applications of 2 or 3 tons per acre may be made satisfactory, with a little care and assistance on the part of the farmer. We would definitely recommend, then, that the by-product be applied in dressings of these dimensions, where molasses is regarded largely as a source of potash to the ensuing crop. On average composition, 2 tons will provide the equivalent of 2½ cwt. of muriate of potash per acre, or as much potash as is contained in 5 cwt. of sugar Bureau, No. 3 planting mixture—the richest mixture available for such soils. In addition, it will provide organic nitrogen equivalent to about 2 cwt. of sulphate of ammonia.

It is certainly more economical to apply 2 tons per acre to each of two successive ratoon crops of cane, than to apply 5 tons per acre to first ratoons only. This is particularly true in regions of high summer rainfall, where losses of potash due to leaching are of a high order.

We would also stress—although it should be obvious—that after applying molasses the farmer does not require any potash in the artificial manure subsequently employed. It might be advantageous to apply superphosphate or meatworks manure in moderate amounts and a top dressing of sulphate of ammonia will be of value, especially on older ratoons.

(*Queensland Agricultural Journal* Vol. 53 1940).

Citrus Diseases Dry root rot— In orchard experiments continued at Nelspruit during the past year in connexion with the above disease results obtained indicate that (1) in the case of trees planted in well drained, aerated soil over-irrigation will not increase the incidence of dry rot provided the fertilility of the soil is maintained (2) over-irrigation may cause chlorosis, severe defoliation and dieback if the fertility of the soil is not maintained (3) fertilized trees whether normally or over irrigated are of better quality than similarly treated trees without fertilizer and (4) over irrigated trees show retrogression in yield and general health in the absence of fertilizer. (*Farming in South Africa* 24:139).

Correspondence.

To

The Editor,
Madras Agricultural Journal.

Sir,

A Correction.

We are thankful to Dr. J. A. Muliyil for pointing out a slip which has occurred in our article entitled "*Perina nuda* Fabr, a pest of fig and its natural enemies". (*Madras Agricultural Journal* Vol. 27. Page 206, last line). The word *Braconid* should have appeared for *Ichneumonid*.

M. C. Cherian,
P. Israel.

Crop and Trade Reports.

Cotton Raw. in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February to 14th June 1940 amounted to 303,560 bales of 400 lb. lint as against an estimate of 3,66,800 bales of the total crop of 1939-40. The receipts in the corresponding period of the previous year were 291,312 bales. 267,974 bales mainly of pressed cotton were received at spinning mills and 57,188 bales were exported by sea while 67,776 bales were imported by sea mainly from Karachi.

(*From the Director of Agriculture*).

College and Estate News.

Season. An active south-westerly wind characteristic of the monsoon has set in during the latter half of the month, accompanied by drizzles.

Students' Corner. The college reopened on the 15th instant and students of the 2nd and 3rd year classes have assembled after the vacation.

The selection of the new batch of students for the B. Sc. Ag. degree course has been completed. 47 students in all have been selected of which 22 are from Telugu districts, 19 from Tamil districts, 3 from Malabar and 3 from South Kanara.

We regret that the results of the B. Sc. Ag. degree examination could not be published in the last issue of this journal due to unavoidable circumstances. They are now published elsewhere in this number.

Visitors. Mr. P. H. Rama Reddi, Director of Agriculture, Madras arrived here from the Nilgiris on the 3rd June and returned to Ootacamund on the 4th morning.

Mr. A. R. C. Westlake, I. C. S. the director-designate visited the Central Farm and Research Sections on the 7th instant, prior to his taking over charge as Director of Agriculture on the 10th instant.

The members of the Agricultural College selection committee consisting of the Director of Agriculture, Madras, the Principal, Agricultural College, Coimbatore; Sri K. P. Mallikarjunudu, M. L. C., Advocate, Masulipatam; Janab P. I. Kunhamad Kutty Hajee, M. L. A., Vice Chairman, Calicut Municipality and Sri T. Sivashanmugam Pillai, M. L. A., interviewed the candidates for admission into the Agricultural College on the 22nd instant.

The members of the Kamal Yar Jung Education Committee of which the Hon. Mr. M. Azzul Huque, C. I. E., Vice Chancellor of the Calcutta University is the chairman, visited the College and Research Institute on the 8th instant.

Officers' Club. In the Presidency Contract Bridge tournament conducted under the auspices of the Cosmopolitan Club, Coimbatore, the following members of the Officers' Club came out successful.

It is to the credit of the Officers Club that for two successive years its members have won this tournament.

Winners. C. S. Krishnaswami and M. A. Sankara Ayyar.

Runners up. G. K. Chidambaram and P. S. Narayanaswami.

Personal. Mr. C. S. Krishnaswami, B. A., B. Sc., Ag., Assistant to the Government Mycologist, has been deputed to go to Poona to study virus diseases for three months under Dr. Uppal, Plant Pathologist to the Government of Bombay.

We are glad to learn that Mr. N. Keshava Ayyangar, M. A., M. Sc. (London) has been selected for appointment as Cytological assistant for Cotton research work in Surat under the auspices of the Indian Central Cotton Committee.

Simla meeting of the I. C. A. R. Rao Bahadur G. N. Rangaswami Ayyangar, Millets Specialist and Geneticist and Mr. P. V. Ramiah, Government Agricultural Chemist were deputed to Simla to attend the fodder sub-committee and the Soils sub-committee of the Imperial Council of Agricultural Research.

Mofussil News and Notes.

Kuruvikarambai-vaikasi visagam festival. Kuruvikarambai is a big village, situated 4 miles to the east of Peravurani. In the village there is a Subramania Swami's Mutt belonging to Sri. A. V. Balasubramania Servikarar of Karambaikadu, a big landholder in the sub-circle, On the 6th, 9th and 10th of the Vaikasi Visahgam festival worshippers congregate in large numbers from the surrounding villages. An agricultural exhibition was held from the 19th to 21st May on the said important days. Exhibits included the chief varieties of Paddy and sugarcane, fodder crops, green manure crops, pine apple fruits, fruit plants from Panyam. Charts on agricultural subjects were posted prominently. Many people visited the stall and showed keen interest in the exhibits. A. G. N.

Namakkal (Salem District). A rural Industrial Exhibition was opened on 29—5—40 at 5 p. m. by the District Collector at the Board High School, Namakkal. The Agricultural, the Health, Co-operative, Education and Veterinary departments had opened stalls in the building. Besides Government departments, private people had exhibited their wares such as cabinets, Indian medicines, pottery products, footwear, mats and carpets. In the Agricultural stall, several improved varieties of paddy, cotton seeds, groundnuts, a few millets, lika cholam and tenai, two good clumps of Co. 419 sugarcane, charts and illustrations of entomological and mycological interest, green manure seeds, agricultural implements such as Buckscraper, chaffcutter, B. B. Mhotewheel, H. M. Guntaka Nos. 1 and 2, McCormick Deering cultivators, country drill set, Cooper ploughs No. 25,11 and 26, bund-former and ridgeplough were on show. Some ryots also exhibited excellent specimens of their produce the most important being fruit varieties from Kollimalais, Alanganatham and Belukurichi. Two bee-hives were also kept and their working was appreciated by visitors. During the eight days of exhibition, 3870 visitors visited the stalls and many testified to the excellence and educative value of the agricultural exhibits. On the closing day, prizes were awarded by the Assistant Collector to the producers of Co. 419 sugarcane (Mr. Kathapalli Nallappa Reddiar) and the best exhibits of Kollimalai produce. Certificates of merit were awarded to the exhibitors of fruits (two in number) and two bee hive owners. P. K. N.

Pendyala (Kistna district). The training classes in modern bee-keeping inaugurated at Kanchala, Nandigama Taluk, on 9—5—'40 by Rao Bahadur C. J. Paul, B.A., Collector of Kistna district, finished its sessions on 3—6—'40 after a period of three weeks. During the period, the students who were 13 in number, were given a thorough training in the theory and practice of Apiculture. Facilities for hiving wild colonies of bees from nature were also amply provided for. Successful students were awarded certificates of merit. The Secretary of the Training School in a short speech advised the students to do their best to popularise this industry among the rural folk in their respective areas. He further exhorted them not to get discouraged by initial failures but to redouble their efforts to attain success whenever they may fail. He emphasized the importance of Cottage Industries in the present day conditions of India and wanted every one of them to contribute their quota in the furtherance of this subsidiary industry by being themselves honest and helpful to the villagers. They were requested to become members of the All India Bee-keepers' Association which exists to serve the need of every novice and expert in the field, thereby subscribing to the *Indian Bee Journal*, the only one of its kind in India which would keep them in touch with many up-to-date topics on the subject of bee-keeping. With a vote of thanks to the chair by the students, the gathering dispersed. S. A. P.

Shiyali. An Agricultural Exhibition was held during Thrimmulaipal Festival from 12th April to 22nd April. Besides the usual display of paddy and rice samples of the different strains, improved ploughs and other implements recommended to the rice grower, live specimens of a large range of green manure and fodder plants, and *Korai* mat grasses raised in plots and the attractive display of locally grown fruits like sapotas, figs, pomeloes, Sathgudi oranges and mangoes formed a special feature of the exhibition. The other exhibits included different breeds of poultry, bee hives, smokers and honey extractors. Fairly large crowds were attracted to the exhibition daily and the importance of the different exhibits explained to the interested visitors. M. A.

Tiruvadi. (*Tanjore District.*) A large scale Agricultural Exhibition was held in the Central High School, premises, Tiruvadi between 23rd and 26th April 1940, during the Sapthasthanam festival. Tiruvadi is considered to be the South Benares and for this festival over a lakh of people assembled. The Tanjore District Board, Co-operative Milk Supply Union, Tanjore, South Indian Nursery, Kumbakonam were among others who co-operated. The perfect electric illumination of entrances and stalls coupled with the radio equipment provided by the District Board increased the attractiveness of the exhibition and over 10,000 persons visited the stall. Agricultural implements were worked in a separate area as demonstration to ryots who gathered. This year's exhibition was the best ever arranged here. A. G. N.

The International Yearbook of Agricultural Statistics.

We have been requested to give publicity to the following by the International Institute of Agriculture, Rome:— Ed. M. A. J.

Among the publications of the International Institute of Agriculture now in preparation is the International Yearbook of Agricultural Statistics, 1939—40, which owing to its scope and accuracy, is a basic reference book for those who study the problems of agricultural production, trade and prices. The Yearbook, which contains a thousand pages, has now reached its twentythird edition. It provides series of statistics on the area and population of all countries in the world, on the areas, yields per hectare and production of the various crops and on the numbers of livestock and poultry. Four hundred pages devoted to international trade show the course of movements between exporting and importing countries of the principal agricultural products during recent years. Another section gives the prices in various currencies of a wide range of products, Index numbers, monthly gold prices, freight rates and exchange quotations. A section of special interest in view of the progress in cultural technique, is that relating to the production, consumption and prices of fertilizers.

The 1939-40 edition contains, in addition to all the useful features of earlier issues, further improvements which make it an indispensable source of information on agriculture and on its importance in the various countries of the world.

Weather Review—MAY 1940.

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	13·7	+11·7	21·0	South	Negapatam	1·9	+0·3	2·6
	Calingapatam	11·6	+9 0	15·8		Aduthurai *	2·6	+0·6	6·1
	Vizagapatam	9·7	+7·7	11·5		Madura	4·3	+1·4	8·6
	Anakapalli*	9·8	+7·5	14·7		Pamban	1·8	+1·0	8·7
	Samalkota*					Koilpatti*			
	Maruteru*	4·6	+3·2	6·4		Palamkottah	1·9	+0·3	6·6
	Cocanada	5·7	+4·2	10·0					
	Masulipatam	0 9	−0·4	3·8					
	Guntur*	1·2	−0·9	5·7	West Coast	Trivandrum	7·3	−1·2	14·2
						Cochin	9·0	−2·7	15·0
Ceded Dists.	Kurnool	3·2	+2·1	4·7		Calicut	8·3	−0·2	8·9
	Nandyal*	0·0	0·0	0·0		Pattambi *	4·5	−3·6	7·8
	Hagari *	7·3	+5·6	9·5		Taliparamba *			
	Siruguppa*	3·3	+1·7	4·5		Kasargode *	3·9	−4·5	7·6
	Bellary	8·3	+6·3	9·2		Nileshwar*	7·8	−1·2	8·4
	Anantapur	3·9	+1·7	4·5		Mangalore	6·0	−0·2	6·7
	Rentachintala	5·9		6·2					
	Cuddapah	9·6	+8·0	10·2					
	Anantharaju-pet*	5·9	+4 9	7·0	Mysore and Coorg	Chitaldrug	3·7	+0·6	5·8
						Bangalore	7·6	+3·2	9·3
Carnatic	Nellore	6·9	+6·1	10·5		Mysore	6·4	+1·2	8·7
	Madras	5·4	+4·3	6·1		Mercara	5·3	−0·4	10·2
	Palur *	2·6	+0·7	3·5					
	Tindivanam *	3·7	+3·6	5·1					
	Cuddalore	2·7	+2·0	4·0	Hills	Kodaikanal	9·9	+3·9	18·5
						Coonoor			
Central	Vellore	3·4	+1·1	4·7		Ootacamund *	8·8	+3·3	14·5
	Salem	8·1	+3·4	12·4		Nanjanad *	6·2	+0·5	10·4
	Coimbatore	9·7	+7·3	13·0					
	Coimbatore A. C. & R. I.*	5·0	+2·4	8·6					
	Trichinopoly	4·6	+1·5	5·8					

*Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1937 published in the Fort St. George Gazette.

Weather Review for May 1940. During the 1st half of the month, due to secondary low pressures derived from the western disturbances traversing upper India, widespread thundershowers occurred in the Konkan, Bombay Deccan, Hyderabad, Malabar and South East Madras. On the 18th a depression appeared in the Bay of Bengal off the Coromandel Circars coast and caused a temporary advance of the South West Monsoon in the South Bay of Bengal and the South East Arabian sea off the Malabar and Ceylon coast. This developed into a severe cyclonic storm on the 20th and was centred near Nellore. It caused heavy rains in North Madras coast, Mysore and Madras Deccan. It weakened after crossing the coast on the 21st and lay over South Hyderabad and passed out into the Bay from the Orissa coast on the 23rd. A second depression appeared over the north of the Bay on the 27th but weakened and became unimportant by the 30th.

Rainfall in connection with the first depression was widespread and very heavy. It was in very large excess over most of the area except the west coast where it was in slight defect. Skies were heavily clouded in the Konkan, Bombay

Deccan, South Madras and Mysore and the relative humidity was in excess in most places. Day temperatures were below normal in the Bombay Deccan, Hyderabad, Mysore and South East Madras. Night temperatures were above normal in North Madras coast and Hyderabad. Rentichintala recorded the highest maximum of 114°F on the 14th.

Special falls of rain :

Gopalpore 5·0″
Vizagapatam and Calingapatam 4·9″
Madras 4·7″
Cuddapah 4·5″
} All on the 20th.

Bellary 6·7″ and Nellore 6·4″ on the 21st.

Gopalpore 3·5″ on the 22nd.

Weather Review for the Agricultural College & Research Institute Observatory:

Report No. 5/40.

Absolute Maximum in shade	...	92·5°F
Absolute Minimum in shade	...	68·0°F
Mean Maximum in shade ...	...	90·6°F
Departure from normal ...	...	−4·4°F
Mean Minimum in shade ...	...	73·7°F
Departure from normal ...	...	−0·3°F
Total rainfall for the month	...	5·0″
Departure from normal ...	...	+2·4″
Heaviest fall in 24 hours ...	...	1·3″ on the 5th.
Number of rainy days ...	...	8
Mean daily wind velocity ...	...	2 m. p. h.
Departure from normal ...	...	−1·7 m. p. h.
Mean Humidity at 8 hours	...	74%
Departure from normal ...	...	+3·8%

Summary. Local thunder showers and an advance of the South West Monsoon caused heavy rains during the month. The rainfall was 5·02″ which is nearly twice the normal amount for the month. Skies were moderately to heavily clouded and the humidity was in slight excess. The Mean Maximum temperature and the Mean Minimum temperature were both below normal. The Mean daily wind velocity was also below normal. P. V. R. & F. L. D.

Departmental Notifications.

Gazette Notifications.

Leave.

Name of officers.	Period of leave.
Sri. B. Ramiah, Dy. D. A. (on leave).	Extension of leave on m. c. on half average pay for 3 months from 1—6—'40.
„ K. Raghava Acharya, A. D. A. (on leave).	Extension of L. a. p. for 1 month from 21—6—'40.

Subordinate Service.

Appointment.

Sri. K. R. Nagarajan, B. Sc. (Ag.) Fieldman, Agricultural Research Station, Palur is appointed to Category 1, Class I, Madras Agricultural Subordinate service and to officiate as Upper Subordinate, Agricultural section, III grade on Rs. 75 in the new revised scale of Rs. 75-7½/2-105 with effect from 17th June 1940.

Promotions.

The following promotions of upper subordinates in the Agricultural section are ordered with effect from 1st April 1940:—

From IV grade Rs. 120—10—170 to III grade Rs. 200.

1. Sri. A. Ramaswami Ayyar, permanent upper subordinate, Agricultural section IV grade to III grade.
2. Sri. V. T. Subbiah Mudaliar, permanent upper subordinate, Agricultural section IV grade to III grade.

From V grade Rs. 85—5—120 to IV grade Rs. 120—10—170.

1. Sri. N. C. Tirumalai Acharya, permanent upper subordinate, Agricultural section V grade to IV grade.
2. Sri. P. A. Venkateswara Iyer, permanent upper subordinate, Agricultural section V grade to IV grade.
3. Sri. S. S. Katchapeswara Ayyar, permanent upper subordinate, Agricultural section V grade to IV grade.
4. Sri. N. S. Rajagopala Ayyar, permanent upper subordinate, Agricultural section V grade to IV grade.
5. Sri. V. Karunakaran Nayar, permanent upper subordinate, Agricultural section V grade to IV grade.
6. Sri. K. Varada Acharya, permanent upper subordinate, Agricultural section V grade to IV grade.
7. Sri. D. Bapayya, permanent upper subordinate, Agricultural section V grade to IV grade.
8. Sri. K. Sivasankara Menon, permanent upper subordinate, Agricultural section V grade to IV grade (provisional).
9. Sri. P. K. Parameswara Menon, permanent upper subordinate, Agricultural section V grade to IV grade.
10. Sri. A. Ram Mohan Rao, permanent upper subordinate, Agricultural section V grade to IV grade.
11. Sri S. V. Ramachandra Ayyar, permanent upper subordinate, Agricultural section, V grade to IV grade,
12. Sri P. S. Venkuswami Ayyar, permanent upper subordinate, Agricultural section, V grade to IV grade.
13. Sri P. Sudarsanam Nayudu, permanent upper subordinate, Agricultural section, V grade to IV grade.
14. Sri T. Gopalan Nayar, permanent upper subordinate, Agricultural section, V grade to IV grade.
15. Sri K. B. Vydiswara Ayyar, permanent upper subordinate, Agricultural section, V grade to IV grade.

The following provisionally substantive promotion of upper subordinate in the agricultural section is ordered with effect from 15th August 1939.

From III grade (new) on Rs. 75—7½/2—105 to II grade on Rs. 105—15/2—130
(Existing revised scale).

1. Sri T. K. Thangavelu, permanent upper subordinate, Agricultural section, III grade (new) to II grade (new) (provisional).

Transfers.

Name of officers.	From	To
Sri T. Venkatarama Reddy,	Offg. Asst. in Millets, Coimbatore,	Offg. Asst. in Botany, Coimbatore.
,, K. Venkataswami Nayudu,	Offg. F. M. A. R S., Nandyal,	Offg. Assistant in Millets, Coimbatore.

„ B. Madhava Rao.	Asst. A. D., Anakapalle,	Asst. A D., Narasanna.
„ Bhagirathy Padhy,	A. D., Narasannapeta,	A. D., Palakonda.
„ M. D. Narayana Reddy,	Asst. A. D., Palakonda,	Asst. A. D., Vizagapatam.
„ N. M. Bhukta,	Asst. A. D., Vizagapatam,	Asst. A. D, Tekkali.
„ M. Gopala Rao,	Asst. A. D., Tekkali,	Asst. A. D., Anakapalle.
„ K. Bhushanam,	Offg. F. M. A. R. S., Anakapalle,	To undergo Dt. work training (Cocanada).
„ K. Govinda Kurup,	A. D., Paramakudi,	Dairy Manager, Coimbatore.

Leave.

Name of officers.	Period of leave.
Sri S. P. Fernando, Asst. A. D., Harur.	L. a. p. for 1 month from 7—2—40.
„ P. K. Kannan Nambiar, F. M. A. R. S., Nileshwar II.	L. a. p. for 1 month and 13 days from 19—6—50.
„ D. Shanmugasundaram Pillai, A. D., Arupukottai.	L a. p. for 1 month from 12—6—40.
„ M. Somayya, A. D., under training, Tuni.	L. a. p. for 2 months from the date of availing.
„ D. Hanumantha Rao. A. D., Cocanada.	Extension of l. a. p. for 1 month from 12—6—40.
„ S. Ramachandra Ayyar, A. D., Tinnevelly.	Extension of l. a. p. for 1 month from 9—6—40.
„ Bhagirathy Padhy, A. D., Narasannapeta.	L. a. p. on m. c. from 1 month from 1—6—40.
„ K. M. Jacob, A. D. (on leave).	Extension of l. a. p. on m. c. for 2 months from 11—6—40.
„ G. J. Balaraj, Asst. A. D., (on leave)	Extension of l. a. p. on m. c. for 1 month from 29—5—40.
„ V. Karunakara Nayar, Dairy Manager, Coimbatore.	L. a. p. for 2 months from the date of relief.
„ M. K. Gopalan, A. D., Proddatur.	Extension of l. a. p. for 1 month.
„ A. R. Krishnamurthy Iyer, Asst. A. D., Karur.	L. a. p. for 2 months from 3—6—40,
„ G. L. Narasimha Rao, Asst. A. D., Vuyyur.	L. a. p. on m. c. for 2 months from 7—5—40.

UNIVERSITY OF MADRAS

B. Sc. Ag. Degree Examination—1940.

List of successful candidates.

First Examination.

Adivi Reddi, A.
Ananthakrishnan, N.
Ananthakrishna Rao, P. N.
Dharmakkan Isaiah.
Duraiswami, K. N.
Edward, L. J. D.
Gurubasappa, H.
Hanumanta Rao, K.
Jagannatha Rao, Y.
Krishnamoorthi Rao, S.
Krishnan, B. S.
Kutumba Rao, V. V.
Mahimaidas, V.
Mrutyunjaya Sastry, R.
Nageshwar Rao, J. P.
Picheswara Rao, M.
Radhakrishna Reddi, A.
Raja Rao, K.
Ramakanta Reddi, C.
Ramamohana Rao, K.
Ramanadham, S.
Ramaratnam, W. S.
Rami Reddi, T.
Ranga Rao, K.
Sankara Rao, C.
Sethuraman, M. S.
Sivasubramanyam, P. K.
Srinivasa Rao, B.
Subba Rao, K.
Subba Raju, A.
Subramanyam, J.
Subramanyam Reddi, C.
Subramanyam, A,
Sundararajan, C. L
Suryanarayana, K. S.
Suryaprakasa Rao, P. V.
Syed Muhamad, D. A.
Thandavarayan, K.
Theophilus Chellappa.
Venkatarama Reddi, C.
Vijayaraghavan, K. S.
Yegneswara Chintamani, P.

Second Examination.

Bhaskara Reddi, N.
Chinnappa Reddi, D.
Daniel Sundararaj, D.
Hanumantha Rao, B.
Jagannathan, N.
Minakshisundaram, M. N.
Muhammad Ibrahim, P. A.
Narasimham, B.
Narasimhamurthi, D.
Narayanamurti, R.
Narayana Nambiar, M.
Paramananda Panda
Radhakrishna Rao, D.
Rajagopalan, V. R.
Ramalingam, C.
Ramalingam, M.
Rama Rao, G.
Ramasubramaniam, S N.
Sambamurthi, K.
Sanyasi Rao, U.
Seshavataram, B.
Shaukat Ali, K A.
Sheenappa, K.
Srinivasan N. V.
Srinivasan, S. T.
Srinivasan, S. V.
Srinivasalu, N.
Tiruvengatachari, T. K.
Vasudeva Rao, B.
Venkataramanamurthi, C.
Venkateswara Rao, P.
Venkateswara Rao, T.
Krishnamurthi, C. S.
Padmanabha Row, K.
Sreshta, N

Final Examination.

Azariah, M. D.
Bhaskaram, K.
Bhaskara Rao, M. V.
Fazlullah Khan, K.
Cunha, E. V. J.
George Harris Maduram.
Jagannatha Rao, E.
Kailasa Rao, T.

Kesava Reddi, A. G.
Krishnamurti, C. S.
Muhammad Sulaiman, S. M.
Muthuperumal, V.
Muthuswami, T. D.
Narayana Rao, K.
Narayana Reddi, B.
Padmanabha Rao, K.
Peeraraju, A.
Rajasekhara Shetti, K.
Ramanathan, R.
Ramaswami, K. S.
Ramiah, M.
Sambandam, R.
Sivasubrahmanyam, T.
Sreshta, N.
Srinivasan, K.
Sumitra Rao, U.
*Vengala Rao, K. C.
Venkataratnam, L.
*Venkateswara Chayanulu.
Viraraghavan, R.
Aiyappa, K. M.
Chellappa, G. V.
*Gopalakrishna Gokhale.
Venkatta Subba Rao, R.
Md. Baig.
Anantaraman, R.
Francis Samuel.
Sivaraj, A.
Sreenivasam, P. S.

The following candidates have references in the subjects noted :—

Second Examination. *Animal Hygiene* Achutaramaraju, Narayana Kamath, K. M. Somanna, U. V. Tyagaram. *Engineering.* Monappa Hedge, H., P. V. Ramamurthi, C. M. George. *Agricultural Zoology.* D. V. Ramana Rao.

Final Examination. *Chemistry.* M. Mohan Punja, G. V. Raghavulu. *Agricultural Economics and Farm Management.* K. Murti Raju, B. Padmanabharaju, M. S. Kulandaiswami.

* Have to pass Engineering Examination.