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CONTENTS

NEW STRAINS OF PADDY FROM AGRICULTURAL RESEARCH STATION, MARUTERU

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The Maruteru Agricultural Research Station was opened in July 1925, as a breeding station for improving the local paddy varieties of both the Godavary and Kistna deltas. Selection of better yielding strains has been the main line of work, though agronomic investigation has been directed to improve the existing cultural and manurial practices of the tract.

The station is situated in the village of Neggipudi near Maruteru Lock along the Narsapur canal. Though it was originally intended to deal with the varieties of both the Kistna and Godavary districts, actual experience has however, proved that Maruteru was unsuitable for carrying on any intensive work on the Kistna varieties. Most of the strains that have been evolved belong primarily to the varieties now grown in the Godavary Districts. Luckily, however, with certain amount of preliminary work at Maruteru, it has been possible to

evolve two high yielding strains one in each of the two important varieties of Kistna and Guntur Districts. That this was possible was due to the willing co-operation of the Deputy Director of Agriculture, II Circle, and some of the enthusiastic land-lords who very willingly made their lands available for the actual testing of the selections made at the Maruteru Station.

The isolation of strains, and yield tests with them, both on the station and in ryots' fields, have been going on for the last seven years, with the result that there are now available for release from the station, eight strains. Short notes about each of these strains, the varieties they belong to, their special characteristics, and the tracts and conditions for which they are suitable are given separately.

These notes are expected to be helpful to the ryots in choosing the particular strain most suited to their conditions. The percentage increases of the strains mentioned in the notes indicate their values under average normal conditions of soil and season. It need not be emphasised that the maintaining or increasing the ascertained merits of the strains rests entirely with the cultivators who grow them. First, the worth of the strains can be maintained by adopting all necessary precautions against their getting mixed up with other varieties. Secondly, experiments with the strains on the station have proved that it is possible to enhance the indicated percentage of increases by over 50 per cent. if the fields grown with these strains are suitably fertilised, i. e., the ryot gets his maximum return for any outlay in manuring, by the growing of the strains in preference to local seed.

Bontha Akkullu. Maruteru No. 1 (Mtu. 1) This is a strain of *Akkullu*, a variety grown over forty to fifty per cent. of the area in the Godavary delta and portions of the Kistna delta as well, under a variety of conditions, from the precarious uplands to the saline and submergible coastal areas. The variety is also slowly making its way in the Guntur district. This strain has been under trial on the station for six years under a variety of conditions and has recorded an average increase of 20 per cent. over ryots' seed. Two year's trials at a number of centres in the district have established definitely its superiority and its cosmopolitan nature. The grain yield varied between 2800 to 3700 lb. per acre, depending upon the season, fertility of the land, manure applied and time of planting Its normal flowering time is the third week of October, irrespective of the time of sowing or planting, with broad limits. The rice is white.

Potti Akkullu. Maruteru No. 2 (Mtu. 2). This is another strain of *Akkullu* with rather slower initial growth found suitable to rich lands that usually suffer from rank growth and premature lodging. During six years' trial it has recorded an average increase of 16 per cent. over the local seed. It normally flowers during the third week of

October, slightly later than Mtu. 1.—(*Bontha Akkullu*). The grain yield obtained on the station ranged between 2800 to 3500 lb. per acre, according to the time of planting, and the fertility of the plot. The rice is white.

Potti Basangi Maruteru No. 3 (Mtu. 3), This is a bulk made up of five of the high yielding strains in *Basangi* which is also known as *Rasangi* in the East Godavary District. The cultivation of *Basangi* and *Rasangi* is confined to about ten per cent. of the area, particularly in the higher portions of the delta. *Basangi* though generally a higher yielder than the other medium and late varieties of the tract, its area is restricted, due to the fact that its harvest invariably synchronises with the north-east monsoon rains. The average increase of the strains making up the bulk was 12 per cent. over the ryots' seed during the four-year period of trial on the station. The acre yield of *Potti Basangi* varied between 3500 to 4500 lb. depending upon the time of planting and the fertility of the plot. It is also reported by ryots who have grown this during the two previous years, that it gave between 25—28 bags of paddy per acre in rich and early planted fields, against the maximum yield of 22 bags obtained previously. Apart from its potentiality for high yields, another redeeming feature of *Potti Basangi*, as the name would indicate, is its short slow-growing habit in the initial stages which helps the crop to get over the lodging trouble, invariably experienced with the *Basangi* crop in wet harvest seasons. It flowers generally during the fourth week of September. Its rice is white and the grain is short and plump compared to the local seed. *Potti Basangi* is particularly suitable to areas where planting can be done early, but not suitable to areas of poor fertility and where planting is done late.

Pedha Basangi, Maruteru No. 4 (Mtu. 4). This is another selected bulk composed of 2 strains. It is later in duration than *Potti Basangi* by a week. It has been found useful to areas of average fertility planted late. The bulk has recorded, an average increased yield of 9 per cent. over the local seed during 4 year's trials. The yield varied between 3200 to 3800 lb. per acre. The rice is white and the grain size is narrower than the local seed. Further *Pedha Basangi* has been noted to stand indifferent water supply during its vegetative growth and has recorded an acre yield of 3000 to 3300 lb. per acre under such conditions.

Bontha Krishnakatukkulu, Maruteru No. 5 (Mtu. 5). This is a selected bulk comprising two high yielding strains of *Krishnakatukullu*. This is a popular variety of the West Godavary district covering 30—40 per cent of the area in the Western delta, and due to the fineness of grain always fetches better prices. The two strains composing the bulk maintained an average increased yield of 10—12 per cent. over the ryots' bulk during the past six years of the trial. The flowering

time is towards the last week in October. It has the desirable growth habit to get over lodging under conditions where a crop from ryots, bulk invariably lodges. *Krishnakatukullu* as a variety is susceptible to unsetting if rainy weather synchronises with its flowering period. On that account the grain yield is liable to fluctuate from season to season. On the station under ordinary conditions of cultivation, it has produced acre yields of 2800—3400 lb.

Potti Atragada. Maruteru No. 6 (Mtu. 6). This is a strain in variety *Atragada* of the Godavary delta which is cultivated in about 5 per cent. of the area confined mostly to the lower reaches, where water does not drain off early for harvest. It has given an average increase of 16 per cent over the ryots, bulk tested over a period of four years. The crop grown in the district for observation has impressed the grower, of its superiorty. The grain yield varies between 2800 to 3000 lb. per acre. It flowers during the end of October and is quite different from both the *Pedha* and *Sanna Atragadas* of the Kistna district which flower between the 10th and 15th of November.

Gutti Kusuma. Maruteru No. 7 (Mtu 7). This is a selected bulk composed of a few promising strains in *Gutti Kusuma*, a variety grown over 40—50 per cent. of the area in Kistna and Guntur deltas. This selected bulk was tested for three seasons in the district itself in ryots' lands and has given a consistent average increase of 16 per cent. at a number of centres. The grain yield varied between 3400 to 3700 lb. per acre in two of the trial plots as compared to 2700 to 3200 lb. obtained from ryot's seed. It flowers during the second week in November, later than the local Kusuma by about a week and it is not subject to the lodging trouble. It gives bold, well-filled, good, white rice.

Vanki Sannam. Maruteru No. 8 (Mtu 8). This is a strain in *Vankisannam*, also known as Delhi *Boghum*. The variety is cultivated in about 15—20 per cent of the area in the Kistna and Guntur deltas, specially confined to the higher delta and well drained soils. The strain has been under test in the district for three consecutive seasons and has recorded an average increase of 10 per cent. over the local seed. An increase of over 18—20 per cent. has also been obtained in plots that escaped damage by rains during the flowering period. The maximum grain yield obtained in one of the trial plots at *Duggirala* was 3400 lb. per acre. It flowers during the end of first week in November, three to four days earlier than the ryots' seed. *Vankisannam*, as a variety, is defective in unsetting and shedding qualities, but this strain is noticed to be comparatively free from these defects. The crop raised from the strain has a characteristic dark green appearance during the early vegetative growth and an erect flag leaf during the flowering and ripening stages.

SOME PROPHYLACTIC MEASURES IN INSECT PEST CONTROL

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The well-known saying that "Prevention is better than cure" is a very old maxim and is specially appropriate, in many cases, where we have to deal with diseases and pests of various kinds; but, unfortunately the very sage advice contained in the pithy saying, is more honoured in its breach, than in its observance. It may be affirmed that in the case of many insect pests, prophylactic measures will be found far more practicable and economical, than those adopted to actually fight a disease or pest when it has made its appearance, and when it often becomes too late to employ preventive measures or, too difficult to resort to curative methods. In certain special cases, no other methods other than preventives will be found practicable. The more important preventive methods against crop pests, may be conveniently grouped under one of two kinds, viz., cultural and sanitary. The following is a brief summary of some of the more practicable and advantageous preventive methods which can be adopted against insect pests under South Indian conditions.

I. Field And Plant Sanitation. (1) *Keeping the fields clean by regular removal of all weeds* is important, since many crop insects feed on some weeds when their cultivated food plant is not available. Examples of such insects are—the Paddy mealy bug, the Rice bug, the Army worm, the Sunnhemp moth, the Fruit moth, etc., (2) *Pruning of dead branches, removal of loose bark, scraping of the unhealthy stems* and *patching up wounds with clay and tar* in fruit and other trees of economic importance; these measures will kill some insects which lurk or hibernate in these situations in one of their many stages, and which would otherwise attack the healthy parts of the plants in due course. Examples are shoot, bark and stem boring beetles, bark caterpillars, etc. The removal of the dead and splitting of crownless rotting palm trees and drying the stems will keep away the palm weevil and the rhinoceros beetle in coconut gardens. (3) *The removal of all remains of a crop* after harvest such as stubbles of cereals like paddy and cholam, old cotton, brinjal, sweet potato and cucurbitaceous plants. Failure to remove these, allows borers, etc., to breed unnoticed and appear on the crops during the following season, (4) *Proper disposal of litter*—in cattle sheds and stables. The trouble from domestic and cattle flies can be prevented by proper disposal of cattle yard and stable manure in which flies of all sorts breed, multiply and become not only a nuisance, but also play their part as disease-carriers in some cases. The oiling of stagnant pools and ponds to destroy mosquito larvae, is a similar measure. Under this heading may also be brought the periodical raking up of the manure heaps, to prevent

multiplication of the rhinoceros beetle grubs, and other cockchafer larvae that breed in them.

II. Cultural Methods. Some of these methods though partially curative, go a great way in checking the multiplication of some pests and effecting their control very easily and economically. (1) *Deep ploughing in general.* To destroy weeds, white grubs attacking garden crops like chillies, groundnut, etc., pupae of hairy and Sphingid caterpillars often attacking crops like groundnut, green gram, sweet potato and gingelly, this method will be found very helpful. (2) *Ploughing and raking up of field bunds* for destroying grasshopper eggs in paddy areas like Malabar, Ganjam, etc., forms another preventive measure in such areas. (3) *Crop rotation.* It is perhaps not widely realised that apart from its agricultural benefits, this method of growing crops in rotation on any area is also beneficial in checking the multiplication of some insect pests which would otherwise continue breeding in the same area right through the year. (4) *Digging out and destroying ants' nests in fields*—white ant attack on wheat, groundnut and cane and the occasional outbreaks of red ants on brinjal and other garden plants, can be prevented by this prophylactic measure. (5) *Raking up and hoeing of the soil* around melon plants and around mango and other fruit trees like Guava, Zizyphus, etc., which suffer from attacks of fruit flies, will destroy the underground pupae of these flies and prevent further breeding; this may be done for plants suffering from flea beetle and leaf beetle attacks also—such as the Pollu flea beetle in pepper areas, the pumpkin and other leaf beetles and the beetle pests of grape vine. (6) *Thorough drying before storage.* The thorough drying and chaff-free-storing of harvested crops like grains, pulses, oil seeds, ginger, turmeric, nuts of different kinds, pepper, cardamoms, chillies, etc., will prevent the infestation and multiplication of many insect pests like weevils, moths, mites, etc., which are partial to such stored products. It has also to be remembered that there is no good of storing such clean and healthy seeds in pest-infested and unclean cellars and vessels. Small quantities of valuable seeds may also be preserved in jars with a layer of sand on the top surface; this is found to prevent weevil-breeding in many cases. The use of naphthalene to keep away vermin from stored products, records, pictures, etc., is another closely allied method. A further precaution in this direction is to fumigate the commodities and store them in insect-proof vessels. Fumigation of ordinary seeds, etc., can be done by the use of carbon-bi-sulphide, which, of course, has to be done by trained hands. (7) *Flooding.* Whenever possible flooding may be resorted to, to check the multiplication of cut-worms, mole crickets, white grubs, and other underground pests often found in garden areas.

III. Other Preventive Measures. (1) *Treatment of cane setts before planting.* Before planting sugarcane and grape-wine, setts may be

treated with Copper sulphate, dilute Crude oil emulsion, or tar water to prevent white ant, mealy bugs and even borers. (2) *Light Traps*—Many insects including some well-known crop pests are attracted to lights; the setting up of light traps at the very beginning of a season when a phototropic insect pest is likely to appear, will nip the pest in the bud and very greatly check its multiplication and reduce its menace as a serious pest. Such are the paddy stem borer, the groundnut *surul*, the hairy caterpillar moths, the cockchafer beetles, one or two of the sorghum and cane borers, the ragi white borer, the spotted jassid of paddy, and many others. A study of the light trap catches in any area for a fairly long period, will give any one an idea of the incidence of the phototropic insects and the time of the year when they usually appear. Even bon-fires in field bunds at such seasons will serve the purpose. (3) *Covering ripening fruits to prevent insect attack.* Pomegranate fruits of good quality and size are kept free from the borer butterfly, by loose muslin or paper covers which prevent the butterfly from laying eggs on the fruit. Batavian and allied varieties of oranges, are often covered with cheap bamboo baskets in parts of the Northern Circars. Though the practice originated with a different purpose, it prevents the attack of the fruit-sucking moth which is a bad pest in the area. (4) *Banding cocoanut trees with smooth tin plates* will prevent rats going up the trees and causing damage to the nuts. A similar measure is the tarring of the stems of fruit and other trees to prevent white ant infestation. (5) *Use of healthy seeds, cuttings, tubers, etc., for propagation.* This is particularly the case with seed potatoes which often contain the borer larvae, cane setts often containing mealy bugs, borers and white ants, cuttings of grape-vine, crotons and other garden plants containing scales and mealy bugs. etc.

The above are some of the more suggestive and practical methods of actually preventing outbreaks of insect pests in many cases, and in some, to considerably minimise the damage even when the pest appears. The success of many such preventive measures depends a good deal, on the promptness with which they are adopted for different pests. It may also be added, that for an effective and economic application of one or more of the above prophylactic measures for different insect pests, it is essential that one should have correct ideas of the insect or insects, and the approximate seasons in the year when the different forms begin to appear in his tract. This is easily gained by intelligent preliminary observations, and records made through different seasons for a year or two, and then compiling a sort of pest calendar for the tract. There is no doubt that as the farmer gets to know his important pests and their vagaries, he will himself be able to devise such prophylactic measures which might suit specific pests and special localities.

DRY FARMING WITH SPECIAL REFERENCE TO PUDUKOTTAI STATE.

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Dry farming as at present understood is the system of farming extensive areas of land purely with the aid of rainfall received in a locality. It mainly consists in the attempt to save all the rainfall of one or more seasons, by different agricultural operations for the use of a crop during its period of growth. In foreign countries where rainfall in some places is not more than 12 inches annually, fair crops have thus been realised by cropping the land every other year.

Under this system great care is taken to keep the land stirred often, even when there is no crop in the field, the objects being, to maintain the soil in good tilth, to make it ever ready to absorb the rain, dew, etc. to the largest extent possible, and at the same time to prevent the evaporation of soil moisture due to atmospheric changes. This method of cultivation in western countries is termed cultivated fallow i. e., laying lands fallow but in a stirred state.

The production of one or more crops without irrigation, in places with 20 inches or less rain, and the cropping in places with an uneven distribution of rainfall, annually amounting to about 30 inches, are considered by some to come under dry farming. The cultivation of *Varagu*, (*Paspalum scrobiculatum*) groundnut, *Cumbu* (*Pennisetum typhoideum*) pure or mixed with red gram, *Ragi*, (*Eleusine corocana*) castor, lablab and sorghum as carried on in the major portion of the Pudukottai State, come under this category. Dry farming also embraces the apportionment of vast areas into suitable blocks, for pastures, or for raising fodder crops and the rearing of live-stock.

For successful dry farming, a clear knowledge of the local conditions i. e., the soil and rainfall, is necessary. A study of the rainfall statistics for Pudukottah, as given below will clearly show that there is no constancy in the amount of rainfall in any month, and the wide variations between years often disappoint the ryots in the pursuit of any definite cropping.

Rainfall at the Pudukottai station from 1921—22 to 1930.

Years.	Total.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.
1921—22	30·41	6·37	4·29	5·13	5·10	0·42	3·55	0·22	...	...	0·74	3·09	1·10
1922—23.	45·09	1·46	3·91	7·78	5·66	7·88	2·39	10·86	0·18	3·84	...	0·57	0·56
1923—24.	42·46	1·08	0·89	9·54	12·39	0.06	7·58	1·68	...	1·31	0·76	4·60	2·57
1924—25.	35·69	4·72	6·05	5·38	4·06	2·80	1·23	0·69	0·02	2·33	0·32	5·29	2·82
1925—26.	35·53	1·37	5·79	2·28	3·85	10·64	3·24	4·54	0·37	0·27	0·77	0·34	2·07
1926—27.	38·55	0·78	7·08	7·30	7·75	2·39	0·70	1·07	1·78	1·24	2·11	2·87	3·47
1927—28.	26·99	0·27	1·78	3·85	3·57	5·66	1·73	0·75	0·30	0·30	3·28	3·27	...
1928—29.	30·01	4·27	1·01	4·20	3·69	6·33	4·29	0·96	0·11	...	0·95	1·52	2·68
1929—30.	40·47	1·94	2·33	8·77	5·01	5·60	4·72	1·09	0·88	0·41	...	8·40	1·32
1930—31.	49·13	0·96	1·32	3·41	27·82	4·64	1·08	1·01	...	0·02	2·21	3·61	3·55

Total. 374·33 – Annual average 37·43.

It will be seen from the above table that the annual average has increased to 37·43 due to the unusually heavy and sudden precipitations in certain months during the last two years; but the State average works out to 34″ per annum for the same decade. Though the average rain-fall received is about 34″, due to the peculiar climate and the nature of the soil, 70% of the lands under plough, come under typical dry-farming areas. The major portion of the soil is gravelly ferruginous red loam, full of sand-stones and intercepted here and there with black clayey soil of saline character. The surface is more or less flat, interposed with a few hillocks and rocks. The sun between April and June is unbearably hot and many wells fail to supply water during this period. The climate is usually hot and dry, and the maximum temperature in the summer months rises above 102°F for several days.

"The vagaries of the monsoon" are rather a rule than an exception to this State. Practically an extent of three lakhs of acres out of five lakhs of arable area comes under dry cultivation. The insufficient rainfall during the season (April—June) and the subsequent drought or heavy rains, adversely affect the yield of the dry crops. This freak of the monsoons during the sowing season and afterwards, compels the dry land farmer to be prompt and efficient in his farm operations to ensure a successful harvest.

Principles of dry farming. The principles which underlie dry cultivation are (1) conservation of soil moisture and regulation of its movement in the soil, (2) maintenance of soil fertility, (3) raising of crops suitable to local conditions i. e. with reference to the quantity of moisture available in the soil and the requirements of the crop.

Control of soil moisture. Water is the most important factor in crop production in dry-farming areas. Without moisture in the soil, no crop can be grown anywhere and much less in dry-farming areas. This compels a dry land ryot to pay particular attention to ploughing and preparing the soil to such a tilth as to secure the required amount of moisture. He should therefore see that the maximum amount of water during the rains is absorbed and is preserved in the soil. It is also necessary that the surface soil, thus reduced to a fit condition, is not also washed out by heavy rains or surface drainage. To achieve the objects mentioned above, we should be quite conversant with the several farm operations and their influence on soil water and soil fertility.

Preparation of land and utilisation of soil water. Tillage of the soil is of great importance as a means of absorbing and retaining moisture as much as possible, from the natural sources, for use during the months when the crop-demands are great. The deeper the soil is ploughed and the finer the soil particles rendered, the greater is the depth of loose soil available for retaining large quantity of water for the use of a crop, the surplus also gradually sinking into the layers

below. The shallow depth to which the wooden country plough penetrates, tends to make rain water get into that portion quickly, but the hard layer below does not as quickly absorb it, so that the top ploughed layer becomes slushy and when more rain is received the fertile portion in the surface is sometimes washed off exposing an unfertile layer. Thus a deep and thorough ploughing is essential to prevent surface wash. It should be repeated at least once in three years for successful farming.

Again, the water holding capacity of the soil is increased by raising the quantity of humus in the soil. This decayed organic matter really gives life to the soil and is greatly needed by the soils in this State. It fills up vacant spaces between particles of sandy soil and helps it to hold more moisture. Again, when applied to clayey soils it absorbs rain water quicker and holds it longer in dry weather. It regulates soil aeration, favours root development and hastens the activities of the microorganisms in the soil. Frequent inter-cultivation between crops especially after every rain tends to arrest the growth of weeds and also minimises the loss of moisture and ultimately helps in reaping a better harvest. Even long periods of drought can be tided over, if the cultivators frequently keep the surface soil loose and open, to absorb the available moisture readily. Ryots here, are yet lacking in realising the value of inter-cultivation and of the timely removal of weeds, which as a result of neglect rob the crop of the moisture and the plant food which would otherwise be available for it. These methods are best carried out if the crops are drilled i. e., sown in lines. While big implements and machinery are largely used in farming by the peasants of other countries, our farmers have not reached even a stage when they could use the inter-cultivating implements which need only bullock power. Drill-sowing reduces the seed rate and facilitates the deposition of seeds at required depths to aid uniform growth. Besides, it tends to complete the cultural operations, before the surface soil loses its moisture. The constant stirring of the soil with the bullock hoes between the rows of the crop, enables the farmer to regulate the moisture needs, and thereby get a better crop than under broad cast sowing, when it is not so easy to weed frequently and stir the soil loose with manual labour as often as weather conditions require. It is therefore, necessary that our ryots should change their present methods of sowing and take to drills, bullock hoes, etc. so that they may reduce the cost of production and farm a greater area with less labour. If some careful and enthusiastic ryots are encouraged to follow new methods by awards of prizes or other inducements, such improvement will be quickly taken up by other ryots also and become established in the tract.

The next point to be considered is the maintenance of soil fertility. The continuous renewal of crops year after year from the soil and the

constant tillage operations go to exhaust the plant food in the soil and largely the humus (organic matter). The loss of soil fertility (crop producing power) occurring in nature is so gradual that the depletion of fertility is not realised until the soil begins to give very poor returns. In this State, the *Odayars* are as a rule better cultivators than other classes, and they have realised the value of maintaining the fertility of the soil by manuring. Sheep or cattle may be penned. Judicious quantities of cattle manure or sweepings may be applied. These methods surely increase the organic matter in the soil. Lost fertility can be made good by giving the land temporary rest for some time, when natural agencies bring about decay of organic matter and 'cook' the soil, for later crop production.

By adopting rotation in cropping, the natural productive power of the soil can be also maintained. Rotation means the growing of a given number of crops of different nature, in a regular order, in the same area, to regulate and control the soil fertility. This is done by a balanced removal of plant foods from the different layers in the soil either by cultivating deep rooted crops and shallow rooted ones alternately, in the same field, or exhaustive crops to follow restorative ones. This system often helps the farmer in protecting the crop from pests and diseases and keeping the soil free from weeds. In addition, it also helps even distribution of labour throughout the year. Rotation is a necessity here, since certain crops refuse to yield well after a few seasons.

Selection of suitable crops for dry lands. A crop generally suitable to the place, the cropping season and the local markets is preferred for cultivation; a note on the principal dry land crop in the State will not be out of place here. *Varagu* :—This being the main food crop for the dry land ryot of this State it is extensely cultivated, either pure or mixed with *Cumbu* and groundnut. This crop is at present subject to the attacks of a root parasite locally known as *Kudivirattipoondu*, or *Palli poondu*, (*Striga lutea*) which considerably reduces the outturn. Removing this parasite before it flowers and abandoning for some years the cultivation of cereals like *Varagu* and *Cholam* that are susceptible to the attack, are being advised to arrest the spread of this parasite. It will be a boon to ryots of the State if they could get some strains of *Varagu*, resistant to parasites. *Ground nut*:—This is now being cultivated in all classes of lands dry, wet, and garden, and it extends to 17350 acres. Mauritius nut is the popular variety but it is said to have degenerated in quality and out-turn, perhaps, due to its continued cultivation without rotation and proper manuring. More hollow pods are found in the harvest and the ryots are advised to change the seed and apply a basal dressing of lime to remedy this defect. For late seasons they are recommended to grow bunch varieties which are short-duration ones. The ryots are also

being enlightened on the benefits of using the *H. M. Guntakka* (a modified blade harrow) for harvest, to reduce the cost of cultivation. *Red Gram*:—This is the next important crop and it is usually mixed with *Cumbu* or *Varagu*, and no change in its cultivation is necessary. If the season happens to be late for this crop, other pulses like black and horse gram are recommended.

There are at present 34,000 acres of cultivable waste lands in this State, of which a major portion is suitable for raising plantations like *Senna*, silkcotton, cashew-nut, casuarina etc. As these crops require attention only in their initial stages, and as they are afterwards adapted to dry conditions, efforts are being made to popularise their cultivation here. When the farmer becomes sufficiently conversant with the soil and the seasonal changes in the locality, he may attempt to raise a better crop and try the change. If he finds the change beneficial he can gradually extend the area under a new crop and even tap fresh markets. To be brief, conservation of rain water, prevention of the loss of soil moisture and fertility, go hand in hand in the development of dry farming.

Conditions requisite for their initiation. Though a greater portion of dry fields in this State is not level, but undulating, our ryots carry on cultivation without effecting improvements. While the plants in the elevated portions may suffer for want of moisture those in the lower levels are water-logged and the entire crop consequently results in a poor return. Such defects can be rectified during the slack seasons and fields rendered as level as possible consistent with the drainage. The steep and sloping lands may be divided into small plots under terrace system and the plots suitably bunded and provided with turf vents to prevent erosion. In this State the number of actual cultivators is small in many villages, and of these many have emigrated to obtain a living elsewhere. Those who still cling to their homes, are heavily indebted. Many owners of lands do not live in villages and do not care to consolidate these holdings to the desired extent or adopt improvements. If some enterprising capitalists would reside in villages and demonstrate dry land farming on scientific lines our peasants will follow them. Where extensive areas are available, cultivators and colonists from outside may be attracted to such lands by offering inducements.

THE POULTRY INDUSTRY OF INDIA

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Part I.

India is supposed to be the original home of poultry and it is presumed that the genus *Gallus* originally migrated from India to other parts of the world, although it is difficult at the present time to trace

this migration in all its stages, through the passing of time. In Indian literature, ancient, medieval and modern, references also abound, mentioning the superior qualities of poultry-flesh and its aphrodisiac, health-promoting and disease-eradicating properties Proverbs and pithy sayings about what human beings might learn from the life of poultry, as among other animals and birds, are to be found in the writings of Chanakya a great Hindu politician and naturalist who lived about 400 B. C.

While these references unmistakably point out to the flourishing condition of the poultry industry in the ancient days, we have it on record historically, how, during the Mohamadan period, the industry got a fillip on account of the great interest taken by the court, where cock fighting happened to be one of the chief amusements. The interest evinced by the rulers of the land is reflected even in the writings of the Urdu authors of the times, wherefrom it is clear that there was a popular belief, that the cock and its flesh were even supposed to posses mysterious powers. How far this superstitious belief was rooted in the popular mind could be gauged from the fact, that an idea was prevalent, that once in its life time, the cock laid a very small egg called in Arabic " Bayzat-i-vgr ".

But the industry could not reach a high standard of development on account of religious considerations in the case of Hindus and the decline in power in the case of Mohamadans.

Present condition of the industry. At present the industry is in the hands of ignorant men. There is no system of breeding, feeding, housing etc. Fowls inbreed as they please and are bred just to supply eggs and table birds without any attention to size. These birds have to look for food themselves. If the master is kind a handful of grain is all they can expect from him but in the majority of cases that too is missing. Under these conditions their vitality has detriorated and the birds have become susceptible to many diseases. Often, whole flocks are wiped out on account of plague, cholera, ticks, fever, etc. Still, taking into consideration the circumstances under which it has to live, the indigenous fowl is a hardy bird and is capable of enduring very adverse circumstances, but, on account of the treatment meted out to it, the size and the laying have deteriorated considerably.

Species of Fowls found in India. The red jungle fowl is found in abundance in the jungles of Northern India, with different kinds of pheasants, while the grey jungle fowl, *Gallus Sonnaratti*, is found in the Southern India jungles. Domestic fowls that are prevalent in India at present can be put under the following heads :—

(1) Those that resemble the jungle fowl; they seldom exceed 3 to 3½ lb. in weight and are very poor egg producers both in size and number. (2) *Aseels*, the pure-bred game-fowl ; this breed is getting

very rare and is found in the hands of a few breeders. (a) *Ghages*—resembling *Aseels* are slow maturing good table birds, but very poor layers. (b) *Chittagongs*—so called after the name of that district of Bengal. This is a valuable breed both as regards laying as well as table qualities. (c) *Karaknath*—The eyes, skin and blood of this breed are all black. This breed is getting extinct. (3) Modern Breeds :—(a) In this class will be the modern breeds of Europe and America such as *Rhode Island Reds, Leghorns, Minorcas etc.* (b) The crosses between (a) above and the country fowls. They are bigger in size and are better layers. (c) In addition to the classes enumerated above there are a number of geese, ducks, turkeys, guinea fowls and various kinds of pheasants.

Among the modern breeds, White Leghorns, Black Minorcas, Rhode Island Reds, Orpingtons are very popular and seem to stand the climate well.

Organisation. Unfortunately the Central Government has till now done nothing to promote the industry of poultry farming but of late some of the Provincial Governments have been taking some interest in the industry.

The chief agencies for the promotion of this industry in India at present are as under;— 1. *The U. P. Poultry Association, Lucknow.* This is the most important and the pioneer organisation in the whole of India. 2. *Poultry Sections of the Agricultural Department of the Punjab, Bengal, Bombay and Madras.* These sections have been started very recently on a small scale. 3. *Indian Poultry Clubs.* (i) South Indian Poultry Club. (ii) Bombay Presidency Poultry Club. (iii) Burma Poultry Club. 4. *Christian Missions.* American Mission in Etah. U. P., Katpadi and Ramanathapuram in Madras Presidency and Hubli in Bombay Presidency. 5. There is a small poultry section connected with Dr. Rabindranath Tagore's (the world famous poet) rural reconstruction work in Bengal. Among the Indian States, Kashmir, Baroda, Hyderabad and some smaller states have started small poultry sections which are connected with their Agricultural Departments.

As no records have ever been kept of the number of head of poultry in India, it is impossible to give any accurate data on the point, but it is roughly calculated that out of 350 millions of people about 1/6th of the population participate in this cottage industry, each family keeping about 6 to 7 birds.

Methods of Marketing. The marketing of eggs and fowls is in the hands of the professional dealers, who make house to house collection and transport the produce to market towns. The eggs are sold by number and not by weight. Generally eggs are packed in a sort of earthern jar and an egg-shell is tied on the top of it, which denotes the delicacy of the contents and warns the people to handle them carefully.

The Railways charge half the usual parcel-rates for egg-parcels, but their charges for empties and live poultry are very high and these do not encourge the industry. The average weight of an egg is about 1½ oz. and that of a table-bird generally about 3 to 4 lb. The average production of the country hen is about 40 to 60 eggs. The price for poultry production in the different parts of the country varies from 6 to 12 annas which is equivalant to 6 to 12 pence. There is no standard for eggs or poultry. Larger eggs command slightly higher price. Table birds are sold by piece prices ranging from 8 to 10 d. according to demands and size. The industry is carried on between the peasant-producer on the one hand and the consumer on the other through the agency of the middle man who makes the most of the deal. There is no trade in bye-products of poultry. They are all wasted.

Obstacles for the Industry. There are several difficulties that come in the way of the development of this useful industry, some of which are noted below:— 1. Most of the people of the country are vegetarians and have got religious scruples, which are up against poultry-farming. 2. The ignorance and poverty of the peasants and their lack of knowledge as to how to handle these living beings are formidable obstacles. 3. The susceptibility of poultry to diseases and different climatic conditions. There are no scientific research institutions where any thought is given to problems relating to poultry. 4. Lack of proper breeding stock in the country. Except the United Provinces Poultry Association, Demonstration Farm at Lucknow, I do not know of any other farm through out the length and breadth of India and Burma, where any pedigree breeding is conducted. 5. There is no organised system of marketing the produce. There is no State Law to govern this factor, there is no check to bringing sick fowls to the markets and there is no restriction to selling stale eggs in the open market. Even the purchasers do not take proper measures to ensure that they are getting proper quality commodity for the money spent.

Part II

POULTRY BREEDING IN THE UNITED PROVINCES

For the past 22 years some small efforts have been made to effect some improvement in Indian poultry. In 1910 an unofficial body styling themselves as the Indian Poultry Club was formed. The body has been instrumental in interesting the public in modern pure-bred fowls by holding exhibitions in different parts of the country. They also publish a monthly journal "The Indian Poultry Gazette."

As an outcome of this club Sir Hercourt Butler, the late Governor of these Provinces, in 1919 asked his Government to finance a small scheme, which would have as its objects (1) the improvement of poultry in the United Provinces. (2) to popularise the breeding of

fowls and (3) to educate the public on the importance of the industry.

Mrs. Fawkes was appointed as Poultry Expert to the United Provinces Government—with her headquarters at Lucknow, which is one of the big cities of India and a very central place in the Province, with a small staff consisting of (1) a Farm Manager. (2) an Assistant Secretary and Demonstrator. and (3) one Office clerk with a small menial staff.

Keeping these points in view, two farms were established, in 1920—21 one in the Horticultural Gardens, Lucknow and the other at the Government Bovine Depot at Patwa Dangar, near Naini Tal. The purpose of these farms was:— (1) to demonstrate how poultry farming should be conducted. (2) to breed such breeds of fowls as would be suitable to the conditions of the country. (3) to provide stock birds and eggs of the improved breeds throughout the whole Province. (4) to study the suitability of poultry foods grown in the country. (5) to study poultry diseases as far as possible, and (6) to evolve a suitable breed of fowl that will combine greater production and immunity from poultry diseases etc.

As regards the popularisation of good breeds of fowls and the educational work, the following methods were adopted:-(1) Instructive and interesting articles were contributed to the important newspapers on the importance of the industry. (2) Lectures were delivered, illustrated by magic lantern slides and later on also by screening a Cinema film, on poultry industry in India, (3) Poultry shows and Demonstrations were organised at all the important Agricultural fairs and other exhibitions that take place every year in these Provinces as well as separately, in which the successful exhibitors were given prizes in cash or stock birds as an encouragement. (4) Pamphlets and bulletins were issued on poultry keeping free of cost. (5) Training of students in poultrying on up-to-date and scientific lines was conducted as far as possible. (6) Local Associations and poultry societies in connection with the Co-operative Department were organised. (7) Practical demonstrations were given by running a Railway Poultry Car, or Miniature Farm on wheels, which is fully equipped with up-to-date appliances etc, and which runs all over the province whenever possible. (8) Recently, a monthly Poultry Journal in Urdu is started in which instructive articles are published on different points of poultry farming such as diseases, housing, feeding etc. (9) People interested in poultry are enlisted as members all over the Province. (10) Mutual business transactions are arranged between the different farmers. In addition to this thousands of advisory letters have been issued and are being issued every day.

The main object of the Association was to improve the conditions of poor professional poultry keepers and to carry out this policy some

small farms were started under the Courts of Wards, District Boards, Criminal Tribes Settlements, and in Etah District through Mr. Slater, an American Missionary, who also has been engaged in teaching the poor villagers the benefit of this industry; and, quite a lot of stock birds and eggs were distributed to the deserving people. Under the supervision of Mr. Slater a large number of cockerels was given to be distributed among villagers. The results were really very encouraging where there was technical and reliable supervision, and in other places though the success was not as much as expected still it did help in improving the country breeds by coming in contact with the improved varieties.

Now year by year the farm grew in popularity and the interest aroused in poultry farming spread all over India, and there was a big demand for our stock.

Success Achieved. Before this Association started, there were practically few people who knew the importance of this industry. To-day we find nearly all the Provincial Governments and most of the Indian States have started Poultry breeding operations, and others are contemplating to do so soon under the Development Departments on a permanent basis. All these schemes are being manned by our students on our lines.

The Kashmir Government started four farms last year and all these farms are being managed by our students and every thing is being done on our suggestions.

The Government of the Punjab which started the work under our directions some five years ago. have started four more breeding centres each under a Deputy Director of Agriculture from the very beginning.

We have trained two men of high education for the Government of Baroda State who are now engaged in poultry work of the State.

Since January 1931 the Government of His Exalted Highness the Nizam have started this work on a grand scale and the work is being carried out earnestly and on our lines and directions.

Experimental work. (1) Pure bred stock imported has been kept successfully through the tropical conditions of the plains, and the progeny deteriorated in no way. (2) The production of pedigree stock has been determined and it is proved that they yield 3 times more than country fowls. (3) The crossing of pure-bred poultry with indigenous ones in villages has resulted in producing a progeny much bigger in size with better laying capacity both in quantity and quality than the country fowl, as described elsewhere. In one year a brown Leghorn-desi cross pullet was put in the Egg-laying Test conducted by us, and laid 61 eggs in 64 days. (4) Controlling of poultry diseases by sanitary measures. For example in 1928—29, the best year of the farm, the disease known as "Ranikhet Disease" broke all over India and the cities and towns were simply cleared of

poultry and quite a lot of farms were ruined. Crows were dying in thousands. Every day there used to be dozens of crows which were the carriers of this disease dying on the farm. The disease broke out on the farm, which within its limited space and with its proximity to the municipal rubbish dumping grounds stocked a flock of 1300 birds. But prompt measures were taken and only 10 birds died which were at once destroyed. The saliva of these destroyed birds was sent to Muktesar for examination and there it was tested and proved to contain the infective principle of the same disease. (5) Suitability of food stuff for poultry that grow in this country were tested and people were advised accordingly. (6) A suitable breed of fowls was evolved. The breed combines increased egg production both in number and size, and greater immunity from diseases. The peculiarity of this breed is that while in other breeds the birds lay a fewer eggs and the vitality is reduced and they become useless soon, this has a very good longevity ; some of them are 5 years old and still they lay quite well and the size of eggs is remarkably good. Both in 1929-30 and 1930 -31 the eggs from this breed won first prizes in large white egg class of the All India Poultry Exhibition.

The brief report on one of the shows held in these Provinces in January, 1932, will throw a good light on the success of poultry work in the Provinces.

The Etah Poultry show. "The fifteenth annual Etah poultry show has just been concluded, and marks the high point in poultry-raising in the Etah District. There are two outstanding features, about the show ; (1) that it is a villagers' show ; and *(2)* that pure-bred fowls of the White Leghorn and Black Minorca breeds make up 95 per cent. of the show.

A total of 2,341 exhibits by 329 exhibitors from 174 villages was represented. These village men spread out over 8 districts.

At no classic show in either England or America are such large classes in Minorcas and White Leghorns to be found as have characterised the Etah Show.

An outstanding feature of the Etah Show was the visit of His Excellency the Governor, Sir Malcolm Hailey. In a brief speech, before the distribution of prizes, His Excellency voiced his appreciation of the show, and the splendid efforts being made through poultry-raising to improve the economic status of the villager, and particularly the low-caste people.

Mr. Pandey of the U. P. Poultry Association, in making the Judge's remarks, drew attention to the need for developing the poultry industry in each and every district of the Provinces, and finding suitable markets for surplus poultry products."

PROBLEMS OF NUTRITION IN INDIA

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Throughout the whole of India the staple article of diet of the masses is a cereal grain of one kind or another—wheat, barley, millet, maize, rice—sometimes a mixture of two or more of them. Most of these grains are eaten whole; these are not subjected to any milling or refining process before use. The outer layers of the grain and embryo, containing valuable dietary constituents, are thus consumed with endosperm. Rice is the single exception to this rule; though within recent years the use of white flour and white bread is spreading in the larger towns and cities. Rice is always subjected to some form of refining process. In country districts, distant from rice mills it is pounded by the villagers in large mortars; a process which removes some, but not all of the external layers. In towns it is milled and polished in the raw state or after par-boiling or curing. As is well known these processes reduce its nutritive value to a greater or a lesser degree. Biological tests in this laboratory have shown that these cereals differ in nutritive value; whole wheat being the most, and whole rice the least, nutritious. The other cereals occupy an intermediate position between these two extremes. All are deficient in certain food essentials—suitable proteins, calcium, sodium, iron, phosphorus and certain vitamins These deficiencies are greatest in whole rice; and as rice is always subjected to refining processes, always washed before cooking, and always consumed after prolonged boiling, this cereal is, generally speaking, of much lower nutritive value than any of the others.

The nutritive value of some of these cereals may, and often does, vary in different localities; amongst rices grown in different parts of India, this variation may be considerable; the same is true of millets. Thus certain millets grown in the south of India have been found to be surprisingly low in vitamin B, an observation which has a bearing on the not infrequent occurrence of beri-beri in millet-eaters resident in endemic areas of this disease. It has been found, too, that groundnuts and split peas (*dhal*) grown in certain localities in South India, are unexpectedly low in this factor. Observations of this kind have led to the suspicion that the nutritive value of certain cereal grains, legumes and nuts, in common use in India, may depend to some extent on conditions of soil, manure and irrigation under which they are grown. A considerable amount of evidence in support of this supposition has been obtained in this laboratory. Thus, it seems certain that rice grown under conditions of natural rainfall, or of watering designed to stimulate natural rainfall contains more vitamin B than the same rice when grown in standing water. The former practice is generally followed in the south-west of India where beri-beri is not endemic; the latter in the south-east where it is. Biological tests appear also to indicate that manurial conditions influence the nutritive value of cereal grains; and it seems likely that the almost universal practice of utilising cow-dung for fuel purposes instead of returning it as manure, to the soil, is one that has a bearing on the nutritive value of Indian food crops. Thus agricultural practice appears to have a definite relation to problems of nutrition in this country.

The varied conditions of climate, rainfall, irrigation, and soil prevailing throughout the Indian Peninsula makes some part of it more suited to the cultivation of one cereal than of another. The cereal or cereals grown in any particular locality are those that enter into the dietaries of the inhabitants of that locality. In the north of India—North-west Frontier Provinces, Punjab, Beluchistan and United Provinces—wheat is the principal cereal grown; though some rice, barley, maize or millet are also grown. Generally speaking, the races resident

in these areas—Pathans, (Afridis, Waziris, Bajauris), Punjabis, Sikhs, Baluchis, Rajputs and Paharis—are wheat eaters. Wheat is the staple article of their dietaries; the other cereals mentioned being merely adjuncts to it. A large amount of wheat is also grown in parts of Central India, Bombay and the Deccan; but in general the races resident in these localities such as the Mahrattas, use a diet of mixed cereals—usually wheat and rice. Towards the East, through Bihar to the Coast of Bengal all down the east and west coasts and throughout the Madras Presidency rice is the principal cereal grown; though in parts of these regions millet is also a considerable crop. But, for the most part, the races resident in these areas are rice-eaters. Throughout the rest of India millet is the chief crop, that forms the staple article of diet of races—such as, the Kanarese—resident therein, who commonly use rice as a supplement to it. In parts of Travancore the staple article of diet is the tapioca root supplemented with rice.

As we pass from the north to the east, south-east, south west and south of India there is thus a gradual fall in the nutritive value of food grains forming the staples of the national diets, this fall reaching its lowest limit among the rice eaters of the east and south. There is also a gradual fall in the amount of animal protein, animal fats and vitamins entering into these diets. The races of the north are either milk users or meat eaters or both; while those of the south and east use both meat and milk sparingly and sometimes not at all. Thus the Pathans are meat eaters; the flesh and fat of goats and sheep forming a principal constituent of their dietaries. They also use milk freely, chiefly in the form of butter-milk, curds and butter and ghee. The Sikhs are large users of milk and the products of milk; milk being only an occasional addition to their diet. The Mahrattas also make free use of milk and milk-products, an additional source of animal protein being eggs and fish. The Bengalis, Kanarese and Madrasis, on the other hand, are for the most part vegetarians; and although some of them do eat mutton or fish, millions do not, while milk and milk products are, in general, less extensively used by them than by northern races. It so happens therefore, that as the nutritive values of cereal grains diminish there is also a dimunition in the amount of animal protein ingested and in the level of protein metabolism attained by the races concerned. There is, too, a precipitate fall in the amounts of vitamins A and B ingested by the races of the south as compared with those of the north. Legumes (*dhal*), vegetables and fruit enter into all the national dietaries of India; but it is only among the better classes that a sufficiency of these is eaten. Accompanying the gradual fall in the nutritive values of the national diets there is a gradual decline in the stature, body weight, stamina and efficiency of the people. McCay was the first to draw pointed attention to this association, which my own observations have confirmed. In his book—"The Protein Element in Nutrition" (1912)—he emphasizes the "all important influence exerted by food, and particularly protein in determining the degree of muscular development, the general physical endowment, the power of endurance and resistance to disease, and the most important of all the place a tribe or race has won for itself in manliness, courage and soldierly instincts." Indeed, nothing could be more striking than the contrast between the manly, stalwart and resolute races of the north—the Pathans, Baluchis, Sikhs, Punjabis, Rajputs and Maharattas—and the poorly developed toneless and supine peoples of the east and south; Bengalis, Madrasis, Kanarese and Travancorians. McCay's work was done before the days of vitamins; and while he rightly emphasized the important part played by the protein element of food in bringing about this result, we now know that other factors—vitamin and mineral elements—are concerned in it also. Inherited factors, climate, customs, caste, religion and endemic diseases no doubt contribute their share to the production of this result; but food is the paramount factor concerned. This is shown to be so by an experiment carried out some

years ago (1926) in this laboratory. Groups of young rats—20 in each—were fed on certain national diets of India; care being taken to stimulate in every detail the culinary practices of the races concerned. The animals were obtained from the same stock, an unusually healthy one. The experiment was so conducted that factors such as climate, atmospheric temperature, rainfall, age, body weight, sex distribution, caging, housing and hygiene were the same in all groups. It was found that the nutritive values of these diets—as determined by the average body weight of each group at the conclusion of the experiment—ranged themselves in the following order:—

Diet.		Average Body-weight of group.
Sikh.	...	235 grams.
Pathan,	...	230 ,,
Maharatta.	...	225 ,,
Kanarese.	...	185 ,,
Bengali	...	180 ,,
Madrassi	...	155 ,,

The "Sikh Diet"—the most nutritious of those examined—was made up of freshly ground whole wheat made into cakes of unleavened bread (*Chapatis*), milk, and the products of milk—butter, ghee, curds, butter milk—*dhal* (legume), vegetables (fresh carrots and cabbage) tomatoes, root vegetables, fresh meat with bone and fat once a week and water. The "Madrassi diet"—the least nutritious of those examined—was made up of washed polished rice, *dhal*, (legume) fresh vegetables, condiments, vegetable oil, coffee with sugar and a little milk, a little butter milk, ghee (sparingly), coconut, betel nut and water. The respects in which these two diets differ are obvious.

Further evidence of the health-giving properties of the Sikh diet is afforded by the following experience; my stock rats are fed on this diet. The average daily strength of these is round about 1000; sometimes more, sometimes less. The animals live under conditions of perfect hygiene and are exposed daily to sun's rays. During the past three years there has been no case of illness amongst them, no death from natural causes (the older animals are killed off when no longer of use for breeding purposes) and no infantile mortality other than an occasional accidental death. Large numbers of them (1189) at all ages upto 2 years, have been killed and subjected to post-mortem examination without revealing any microscopical evidence of disease except an occasional cyst (tapeworm) in the liver Disease has been almost completely excluded by attention to three things; cleanliness, comfort and food. These experiences illustrate the great importance of food in relation to the physical efficiency and well being of animals and man; the importance also of a proper balance of the national diets of India with respect to animal protein, animal fat, vitamins and mineral elements; and the great value, as a health promoting agency, of the lacto-vegetarian diet used by the people of North India amongst whom are some of the finest physical specimens of mankind.

Our first problem of nutrition in India—"What diet is most likely to maintain physical efficiency and health?" has thus been solved. It is a diet composed of any whole cereal grain or a mixture of cereal grains, milk, the products of milk—butter, curds and butter milk—legumes, green leafy vegetables, root vegetables fruit and water with meat occasionally. I notice that "Oslo Breakfast"*

* A breakfast served free to School Children and consisting of half a litre of milk, wholemeal bread with butter, wholemeal rusks, a raw carrot, an apple or orange and whey cheese.—Ed.

which is reputed to be having such remarkable beneficial effects in Norwegian children is of this order. To the tribes of our Indian frontier this is "an old accustomed feast".

One further fact in regard to the national diet of India is here deserving of note—it introduces another element into the complexities surrounding problems of nutrition in this country—that of high atmospheric temperature and drought. It was observed in this laboratory, about 10 years ago, that the milk of cows subsisting on the parched pasture available during the hot months of the year contained less vitamin A than that of cows feeding on the green pasture that spring up after the rains. Generally speaking it is safe to say that the vitamin A content of the milk of the ill fed and of ten semi-starved Indian cow is relatively low; a circumstance which is not withoutits effect on the well being of the people into whose dietaries milk and milk products enter.

It is not to be supposed that the national diets of India are invariably used in their completest form by every member of the races concerned. It is only those in better class circumstances who can afford to do so. The poorer classes, according to the degree of their poverty, drop out, in part or in whole, the more expensive or less easily obtainable items; meat, milk, milk-products, animal fats legumes, fruit and vegetables. So that as the people are poorer and poorer their dietaries are more and more cereal in character, more and more unbalanced, more and more depleted of animal protein, animal fats. vitamins and essential mineral elements. Lower down the social scale a stage may be reached when the diet consists mainly of cereals, and lower still it may not provide even enough of these; under nutrition is then added to faulty nutrition—a state in which millions of Indian people exist for the greater part of every year of their lives. "Throughout his daily work the powerful influence of this condition of chronic semi-starvation, not only in the poor Indian himself, but throughout his whole race and generation, is constantly obtruding itself upon the physician, who says, 'This man's constitutional malady is mal-nutrition anaemia, asthenia, complicated with fever, dysentry or what not'. Consequently, the first indication for treatment is a proper and nourishing diet". (Norman Chevers, 1886).

Our next problem of nutrition in India has, therefore, been this "What are the effects, on the people using them. of diets composed of cereals?" This problem may be approached in two ways, and for its proper solution it should be approached in both ways; by an epidemiological survey of diseases with special reference to dietary conditions (an undertaking so great as to be outside the resources of this laboratory) and by animal experimentation. The latter is the way I have followed.

In India we have to deal with combination of food-faults rather than with single food-faults. There is, for instance, no diet in common use in India which while lacking in any single element or complex necessary for normal nutrition, is not at the same time faulty in other regards. It may indeed be doubted whether any deficiency is ever complete; deficiency of vitamin C is the most likely one to be complete. It is with "insufficiency" rather than with complete want of certain food factors that we have to deal; and with a combination of such insufficiencies Associated with them, there is, as a rule an imbalance of the diet with respect to proximate principles such imbalance usually takes the form of excessive richness of the food in carbohydrates. It is true that one insufficiency or another may be dominant; as for example, an insufficiency of vitamin B in rice eaters. But upon the effects of the dominant insufficiency there are often super-imposed those of other associated insufficiencies, of the imbalance of the food in other regards, or of actual under-nutrition. Our problem in India is not so much of the effects of this or that faulty diet. What then

are the effects on the animal organism of a diet composed wholly or almost wholly of rice? What are those of a diet composed wholly or almost wholly of wheat? And to what extent do these effects, as observed in animals, enable us to account for ill-health in man?

To begin with rice. This cereal has many deficiencies prominent among them being that of vitamin B. In India rice is the poorest of all cereals in this complex. The effects of rice on the animal organism, either alone or in combination with other food materials in common use by rice eaters, were studied in the pigeons and monkeys. It was found that the more highly the rice was polished and the more it was washed, the more rapid was the onset of symptoms; and these symptoms were usually of the same kind polyneuritic. But no man lives on rice alone. No matter how great his poverty may be he makes some addition to his rice—a little dhal (legume) a little vegetable or a little of both. These additions raise the nutritive and vitamin B value of the diet to some extent; and it is when animals are kept on a diet of this kind—a diet in which vitamin B is not wholly lacking though insufficient for normal metabolism—that we begin to see signs and symptoms of ill health which are of the greatest importance in relation to the origin of maladies prevailing amongst rice eaters. These signs and symptoms are poor appetite, loss of appetite or (in monkeys) depraved appetite, failure to increase in body weight or actual loss of body weight, vomiting (in monkeys) diarrhoea, dysentery (specific and non-specific), colitis, slowing of the respiratory rate lowering of body temperature, cardio-vascular depression, progressive asthenia, anaemia, disorders of the skin, oedema, nervous irritability, symptoms referable to mal-nutrition of the nervous systems, and intercurrent infections. The last may lend wide variety to the symptomatology; and it is here that chance comes into play in determining the kind of infection from which the animals suffer. Thus one batch of pigeons, imported for experimental use into this laboratory, had amongst them carriers of the invisible virus of *Epithelioma contagiosum*. The birds fed on rice diet suffered much from this condition, while well fed controls did not. Another batch happened to have amongst them carriers of B. suipestifer; the birds fed on the rice diets suffered much from this infection—itself capable of causing neuritis—the well fed controls did not. A batch of monkeys happened to have amongst them carriers of Entamoeba histolytica; dysentery appeared amongst the ill fed animals, while the well fed—amongst whom were also carriers—remained free from it. Thus did faulty nutrition favour infection by invisible virus, bacillus and amoeba.

It was found also that a number of other factors—age, sex, warmth, cold damp, chill, balance of the food, previous food conditions and above all, individual idiosyncrasy—influenced the onset of symptoms either in the direction of precipitating or of retarding them. Those that precipitated symptoms were such as placed additional burdens on the metabolic resources of the body; those that retarded them were such as conserved these resources. Thus, an addition of an excess of fats to the rice diet hastened the death of both birds and monkeys, while exposure to cold and damp precipitated the onset of oedema—an observation of significance in regard to malnutritional oedema and beri-beri. Associated with these symptoms of ill-health profound changes were found throughout the organs and tissues of the body; these were observable even by the naked eye and the relatively crude method of histological examination. Of these changes the most conspicuous were those in the gasto-intestinal tract, the circulatory system, the endocrine organs and the nervous system. They are now-a-days so well known that little further reference need be made to them; by analytical methods of experimentation many of them have since been traced to particular deficiencies in the diet.

In these observations a parallel is to be found in the poor stamina, muscular development and physical endowment of rice-eating races, and in low powers of endurance and resistance to infection of the poorer classes amongst the rice eaters. A parallel is also presented in the frequent occurrence amongst them of respiratory diseases, gastro-intestinal diseases (diarrhoea, dysentery, cholera, colitis) malnutritional oedema, anaemia, skin diseases and beri-beri Interest in the last named has, because of its occurrence amongst rice eaters, over-shadowed the vastly more important and more general effects of the rice-eater's diet. For, considering the millions whose staple article of diet is rice, beri-beri is relatively an uncommon disease in India. Its distribution is very limited; it is confined, as an endemic, to certain coastal areas of the north-east of Madras and Bengal. In Madras it is rarely seen at a distance of more than 50 miles inland. It is practically unknown on the West Coast of Madras and Bombay where as much rice per capita is eaten as in localities where it is endemic. Occasional small outbreaks (epidemics) occur in other parts of India, but, for the most part, these are in persons who have emigrated from endemic areas. In India endemic beri-beri is very definitely a "place disease". I do not here speak of "epidemic dropsy" which some in India, consider to be a form of beri-beri. Much of the confusion in regard to the causation of beri-beri has arisen from the fact that par-boiled rice and rice which is not highly milled and polished are supposed to contain "plenty of vitam B". They do not. In this laboratory true beri-beri has been produced in pigeons fed exclusively on diets of undermilled or home-pounded rice or of washed par-boiled rice. A second source of confusion has been the assumption that *polyneuritis columbarum* is the same condition as beri-beri. It is an analagous condition certainly, but not the same condition; though it may arise under precisely the same dietary conditions as true beri-beri does. Thus if pigeons be fed on a diet simulating that in use by human beri-beries—washed polished rice plus 0·8 gram of dhal per bird daily, the latter administered artificially—some will develop no signs either of polyneuritis or of beri-beri, though they may suffer from other maladies within a period of 100 days; others will develop polyneuritis, columbarum others beri-beri columbarum; others again, a condition intermediate between these two states The individual indiosyncrasy of the bird is the final factor determining which condition it will suffer from or whether it will suffer from either.

These two conditions differ from each other as follows:— the former is a state of polyneuritis and cardiac atrophy with or without oedema; it is most readily and most regularly produced when the rice diet is very deficient in vitamin B. The latter is a state of polyneuritis, cardiac, hypertrophy and degeneration with (usually) or without (rarely) oedema; it arises when the diet contains an insufficiency of, but is not wholly lacking in, vitamin B. It is to this latter condition that the term "true beri-beri" can alone be accurately applied. Statistical examination of my experimental data has shown that it is due to an unknown positive factor acting in association with insufficiency of vitamin B. This positive factor is produced in the bodies of birds themselves, and is either a metabolic or a microbic poison. True beri-beri is an intoxication. It is still thought by some that the beri-beri poison can be produced in deteriorated rice outside the body. No evidence in support of this view has so far been forthcoming in the course of work in this laboratory.

There are, thus, a number of polyneuritis states which can arise in pigeons fed on rice-diets; infective polyneuritis due to a microbe such as the B. suipestifer; nutritional polyneuritis due solely to avitaminosis; true beri-beri, due to avitaminosis plus an unknown positive agent arising in the bodies of the birds in consequence of the avitaminosis; and intermediate states between nutritional polyneuritis on the one hand and true beri-beri on the other. If there be this

diversiiy of "beri-beri-like" maladies in birds fed on rice diets it is reasonable to suppose that a similar diversity of these maladies will be found in human beings who subsist mainly on rice. All these forms of neuritis are preventable in birds by the same means; the addition to the rice—whether it be from deteriorated stock in use by human beri-beries or not—of a sufficiency of food materials (wheat, tomatoes, legumes, etc.) rich in vitamin B. Human beri-beri as it occurs in India, is also preventable by the same means and has been so prevented in jails where it is endemic for years. The prescription of ancient Indian Hakims—"stop eating rice and take a diet of wheat and milk", can hardly be bettered.

So much then for the rice-eater's diet. What of the wheat-eaters? If animals (rats) be fed on an exclusive diet of whole wheat the mortality amongst them is very high. Pulmonary infection is the chief cause of death. If to the diet of whole wheat some good olive or sesame oil—which are poor but not wholly lacking in vitamin A—be added, together with a salt mixture to make up for certain mineral defects in the wheat, the animals live longer and afford greater opportunity for the study of the effects of diets comparable in composition to that used by the poorer class of wheat-eaters. The main deficiency of this diet is one of fat soluble vitamins. Its effects are exhibited as metaplasia of epithelia, throughout the body—a change now recognised as characteristic of vitamin A insufficiency. Infections of the eye, the nasal sinuses the lungs, are common; urinary calculus is frequent; the goitre is occasionally met with.

In the course of experimental work in this laboratory many variations of deficient diets, having one or other cereal grain or cereal product or a mixture of such as their basis have been used with results which manifest themselves, for the most part, as "it is's" of various kinds and locations. These need not be enumerated but some reference may be made to three conditions—"Stone", goitre, and peptic ulcer", which in India are problems of moment.

The distribution of "Stone" is peculiar; it occurs, for the most part, in the north of India and is relatively rare in the south. It is a disease of wheat eaters rather than of rice eaters. Experimental work in this laboratory has shown that the cereal grains in common use in India vary in their stone-producing potency, wheat having the highest, the rice the lowest potency, in this regard, while the other cereals occupy an intermediate position between these two extremes. The distribution of stone is therefore related to the distribution of cereal crops. The stone-producing potency of white flour is relatively low; and as white flour contains no more vitamin A than whole wheat flour it is obvious that in the process of milling some substance favourable to stone production is removed from the whole grain. There are two classes of factors (apart from infection and foreign bodies in the urinary tract) concerned in the causation of stone; negative ones—vitamin A deficiency and phosphate deficiency; and positive ones—an unknown substance existing in different amounts in different cereals, and excess of lime in the diet. Cattle stones are, in India, almost invariably composed of calcium carbonate. The dietary conditions under which they arise in nature or are produced under experimental conditions in the laboratory are the same: deficiency of vitamin A and deficiency of phosphates relative to the amount of lime in the diet. Work in this laboratory has convinced that, in India, urinary calculus is usually a disease of faulty nutrition.

The distribution of "goitre" is also peculiar: it occurs chiefly in Himalayan regions. In these the iodine content of the soil is low and no doubt also that of the food materials grown upon it. But the iodine content of the urine is not significantly higher in non-goitrous than in goitrous persons in these regions; and while admitting that iodine deficiency may favour the development of certain kinds of goitre, such deficiency is not regarded as the essential cause of the disease. With the possible exception of the adrenal glands and thymus, no organ

or tissue of the body is more sensitive to food conditions than the thyroid. The iodine content, the fat content, the lime content the phosphate content, the vitamin content of the food—all these influence its size; as do certain unknown substances in food materials such as cabbage, and groundnuts. Its size also is influenced in certain circumstances by insanitary conditions of life. Iodine is by no means the be-all and the end-all of goitre. Four etiologically distinct types of goitre have been produced in this laboratory—the hyperplastic, the hypertrophic, the colloid and the lymph adenoid—but all have this in common: they are preventable by the same reasons. This means the provision of a perfectly balanced diet such as the lacto-vegetarian one previously described. Thus, *insanitary condition—a positive goitrogenic agency—will not cause goitre* when the animals are properly fed; it will cause goitre when they are not. Goitre is, in the main, a disease of faulty nutrition; but, like beri-beri and like urinary calculus, both negative and positive factors are concerned in its causation.

"Peptic ulcer" has also a peculiar distribution. It is very common in the south of India—particularly in Travancore. It has been shown in this laboratory that the tapioca diet of the poorer class Travancorian will cause this condition in 27 per cent. of albino rats fed upon it: that of the poorer class Madrassi, 11 per cent.; while the lacto-vegetarian diet of the Sikhs affords the animals complete protection against it. Some 10 years ago it was observed, in this laboratory, that deficiency of vitamin C was capable of causing duodenal ulcer in guinea-pigs.

A pernicious type of anaemia may occur in albino rats when they are fed on a diet of oatmeal, linseed meal and patent flour. It is due to rat-house-borne organism: Bartonella muris. As is well-known this organism gives rise in these animals to a profound anaemia on removal of the spleen It is of significance, in regard to such maladies as malaria, typhus, relapsing fever and Kala-azar—all widely prevalent in India and favoured in their course and development by famine conditions—that the protective resources of the spleen can be injured by faulty nutrition in a way comparable to that brought about by splenectomy.

Other diseases of faulty nutrition—keratomalacia, night-blindness, rickets, osteomalacia, tetany, dental caries, scurvy, pellagra, anaemia of pregnancy, lathyrism—all concern us, to a greater or lesser extent in India; and many other conditions, such, for instance, as cataract and sprue, may have a malnutritional basis of the nature of which we as yet know but little Keratomolacia is common, and is the chief cause of preventable blindness (Wright 1931). It occurs in undernourished, poverty stricken persons, whose diets are not only deficient in vitamin A but in other vitamins as well. "In all probability it requires an initial multiple vitamin deficiency, with a secondary multiple disfunction of glandular structures to account for the whole picture of degeneration, loss of function, wasting, necrosis, secondary infection and death which we see in kerotomalacia." (Wright 1931). Night blindness is also common—well known to ancient Hakims in India who treated by the administration of liver. It is frequently associated with lathyrism in localities where the latter condition prevails (McCombie Young, 1927). "In Northern India and Kashmir rickets in its various forms, osteomalacia, late rickets and infantile rickets, tend to occur in any race or caste wherever there is deficiency of sun light or diet, or more frequently where there is a relative deficiency in both these factors." (Wilson, 1930, 1931). It is of a greater severity amongst those who observe purdha couditions of life. Osteomalacia accounts for much maternal mortality in child birth (Vaughn). Tetany is frequently associated with rickets; it is endemic in certain valleys of the Himalayas (McCarrison 1910). Dental caries and hypo-plasia are widespread amongst Indians whose diets are composed mainly of cereals and are deficient in fat soluble vitamins and vitamin C. If deficiency of vitamin D be the chief

cause of dental caries it is obvious that tropical sunlight does not provide enough for its prevention. Scurvy, usually in minor form, is wide spread throughout the whole of India; and pyorrhea alveolaris is frequently to be found in persons whose diets contain far too little fresh vegetable foods. Pellagra appears to be relatively rare. The anaemias of pregnancy are common; they are malnutritional in nature, occurring in women whose diets are both quantitatively and qualitatively deficient (Wills. 1928-31). Epidemiological investigations carried out by McCombie Young (1927) from this laboratory, have shown that lathyrism is associated not only with the predominance of lathyrus sativus in the diet but with undernutrition and deficiency of fat soluble A.

The problem in connection with all these diseases is no longer one of lack of knowledge of their nature, nor of their means of prevention; but one of the improvements of conditions of living and of food supply of the people. Indeed, the greatest of all problems in India at the present time is the adjustment of the population to its food supply. It is one that is capable of solution only by the people themselves; by the exercise of self-help; by the jettisoning of old habits and customs unsuited to modern economic conditions; by improvements in methods of agriculture, animal husbandry and industry; and above all by restraint in re-production.

Recently (1931) I had occasion to contrast the incidence of disease in 2243 improperly fed albino rats with that in the well fed stock rats in this laboratory. It was shown that while the former exhibited a large proportion of the maladies included in the calendar of human ailments, the latter were remarkably free from disease of any kind. The only significant difference in their conditions of life was the improper feeding of the one "Universe" and the proper feeding of the other. It seems to me that, however deeply we may delve into the minutiae of the relationship of faulty nutrition to disease, the essence of the whole matter will be found to lie in this; the use of a properly constituted diet is a sure means to the attainment of physical efficiency and health. Such a diet is the lacto-vegetarian one in use by certain vigorous and resolute races of Northern India. (*From "Nutrition Abstracts & Reviews", Vol. II, No. 2. July 1932*).

Notes and Comments.

Potato Breeding. The appointment, with the help of a grant from the Imperial Council of Agricultural Research, of an officer of the Department, to carry on breeding work on potatoes at the Nanjanad Agricultural Research Station, Ootacamund, marks yet another step forward in the march of agricultural science in the Presidency. The breeding work done in the earlier years, on major crops like sugarcane, paddy, cotton and the millets, has resulted in valuable strains being evolved and distributed over the country; the appointment of the Oil Seeds Specialist two years ago has similarly satisfied the growing need for improving the several oilseed crops, and the appointment of an officer to breed superior varieties of potatoes, will therefore be hailed with satisfaction by all those interested in agriculture, especially as in modern days the tendency has been to depend not merely on any one crop, but on as many suitable ones as possible to make agriculture more paying.

A New Agricultural Farm at Pattukottai. It is very gratifying to understand that the Irrigation Development Board have resolved to recommend to Government for acceptance, the proposal of the Director of Agriculture to have a Demonstration Farm in the Cauvery-Mettur area preferably in the Pattukottai taluq. Research work on agriculture and allied sciences, to be of benefit to the masses, must go along with more propaganda and demonstration, so that ryots might come to know and take advantage of the improvements suggested by the Department. The Agricultural Research Station at Aduthurai, which is the only one in the V circle comprising the Trichinopoly and Tanjore Districts, is more an experimental station with a definite aim, but the proposed Pattukottai Farm will remove a long felt want for demonstration in improved methods of agriculture, in a district, which is second to none in agricultural importance. We hope that Government will give effect to the recommendations of the Irrigation Development Board.

The World Poultry Congress. The Fifth World Poultry Congress with a grand exhibition is to be held in Rome from the 6th to the 15th of September 1933 under the high patronage of His Majesty the King of Italy. These international Poultry Congresses are being held at the initiative of the World's Poultry Science Association and their main aims appear to be the establishment of friendly relations between the various categories of persons interested in the development of the poultry industry, the pooling of the most recent knowledge regarding the raising of courtyard animals, the development of scientific research work and instructions in connection with poultry-raising, to make known the most rational devices used in that connection, to encourage, through appropriate measures the trade in poultry products, and, by means of international exhibitions, to spread the knowledge on the subject. The Congress is held every third year. The first was held in Holland in 1921, the second in Spain in 1924, the third in Canada in 1927, and the fourth in England in 1930. We hope some of the Poultry Associations in India may be able to depute their representatives to this show, so that they may return with knowledge of up-to-date methods in the Science of Poultry. We are also publishing a brief paper on this subject in this issue.

The Sugar Industry in India. It is very encouraging to find that with the protection now offered by Government, there are signs all over the country for an active revival of this important industry not only in proposals to grow sugar cane in larger areas in different parts of the country, but also in starting investigations on the manufacture of both white sugar and superior jaggery. A number of sugar companies have been floated in Northern India recently and even in Madras there has been sufficient enterprise shown. While Mysore was the first in launching a scheme to open a sugar factory in the Irwin Canal

area, we are glad to hear of another similar enterprise in Bellary. The company which has just been advertised inviting shares, proposes to start work in Hospet which has always been considered the most suitable place in Madras for a sugar factory, and it is very encouraging to find among the directorate of this new company, the present Chief Minister of Madras and an Ex-Development Minister. We also understand that the Director of Industries is investigating into the possibilities of establishing a factory at a suitable place in the Ramachandrapur Taluk of the Godavary District, where sugarcane cultivation is being carried on, on an extensive scale. The idea appears to be to start this factory on a co-operative basis under the supervision of Government Whether the manufacture of white sugar could be introduced as a cottage industry under south Indian conditions was being investigated by the Industries Department who were trying at one or two centres "The open pan system of white sugar manufacture" described by Mr. B. C. Srivatsava, Sugar Technologist to the Imperial Council of Agricultural Research. While the manufacture of white sugar on a factory scale is expected to replace a portion of the foreign white sugar imported into the country, it can never replace the manufacture of jaggery completely. Due to the poor quality of the jaggery offered on the market, people have to go in for white sugar in spite of its higher price. If a simple process could be evolved to make the jaggery manufactured by individual ryots better in quality and appearance, it would be generally welcomed, as it should mean a better price and hence a greater return to the cane grower and a cheaper product for the middle class consumer who now goes in for white sugar. We are glad to note that investigations on this point have already been initiated at the Research Institute, Coimbatore. The Agricultural Chemist has been conducting experiments and has succeeded on a laboratory scale in producing jaggery almost as white as sugar using activated charcoal prepared from paddy husk and has also held a demonstration at Anakapalle. We understand that during the coming cane crushing season more demonstrations of the improved method will be arranged all over the Presidency.

Marketing of Tanjore Rice. We made a reference to this subject in our March issue drawing attention to the hard position in which the Tanjore rice growers were placed. As a result of the strong representation made to the Railway authorities about the reduction in freight, the South Indian Railway and the Ceylon Railway have agreed to reduce the present rates by 16%. This in the opinion of the Tanjore people, is not enough as they feel that for them to be able to successfully compete with Burma in the Ceylon market the present rates must be reduced by at least 30%. Meanwhile at a public meeting held recently in Tanjore it has been decided to form a syndicate consisting of Mirasdars and mill-owners of the district for developing and

maintaining markets for Tanjore rice. The meeting has also formed a strong committee of men including the Deputy Director of Agriculture, V circle, and the Deputy Registrar of Co-operative Societies, Tanjore, to frame rules for the formation of the syndicate. The idea appears to be that the mirasdars should entrust this surplus paddy to the association which will arrange for its milling, the mill-owners being paid their hulling charges and a fair rate of interest for their capital. The milled rice would then be sold in inland and foreign parts and the profits left over would be distributed to the mirasdars in proportion to the paddy supplied by them. The Association is to be registered either under the Co-operative Societies Act or under the Joint-stock Companies Act. We wish the syndicate all success in their endeavour to alleviate the suffering of the delta cultivators. We are also glad to hear that efforts are being taken to open up the port of Tranquebar and afford facilities for the export of rice through the port.

ABSTRACTS

Geographical Aspects of Cane-Sugar Production. *C. J. Robertson,* (*Geography*, 1932, vol. 27, part 3). In the present paper, the author has reviewed the factors which have influenced the localisation of sugar cane production and manufacture in certain parts of the world like the West Indies, Java etc. Climatic and soil factors, like moisture, temperature, incidence of rainfall, nature of the soil etc., have a great determining influence in delimiting the cane area of the world; thus, sufficiency of moisture at the critical period of maximum vegetative growth is an important factor in securing good yields. In Java, where the cane is mostly planted from June to September, the critical period as regards moisture is found to be October-November (when the crop is 2½-3½ months) and Tengwall and Van der Zyl have worked out the following formula relating precipitation with yield:—

$x_1 = 79{\cdot}75 + 0{\cdot}0504\ x_2 + 0{\cdot}506\ x_3 + 0{\cdot}3132\ x_4$, where x_1 is the production of standard muscovado (raw sugar) in pikuls (about 140 lbs.) per bouw (1·7537 acres), x_2 is the precipitation in October, x_3 is the precipitation in November and x_4 is the percentage of total crop planted before 1st August. In the eleven years 1912—23, the difference between the yield calculated by this formula and that actually obtained averaged only 2·9 %. It has been demonstrated both at Java and at Mauritius that the months statisticalty found to be critical for moisture are those when the young cane is growing most rapidly at the beginning of the wet season. A period of drought at this stage of vegetative activity stunts the internodes, kills the leaves, increases the fibre and acidity of juice. The period of vegetative growth should be followed by a well marked dry and cool season when the crop matures and sucrose accumulates. Irrigation facilities whereby the moisture supply can be controlled give higher yields than dependance on rainfall even though this may be sufficient and they have the advantage that the cane may be grown independently of the season and the factories can be operated for a much longer period—as in Hawaii for ten months in the year and in Peru all the year round—thus greatly reducing overhead costs. As regards the effect of temperature in limiting cane growth, observations at Peshawar have shown that the buds are practically killed when the mean minimum temperature (of December—January) falls to 52° F; there is very little growth below 68°F; the growth

increases thereafter up to 88°F. Coimbatore observations showed maximum growth at 105° F. There was poor germination when temperature was above 117° F at planting and the buds were killed by temperatures of from 122° F to 131° F. The harmful effects of frost and severe wind are well known; frost adversely affects the quality of the juice as it causes inversion of the sucrose and increases the viscosity of the juice.

In regard to the influence of soils on the distribution of the cane crop, the author notes that the plant thrives best on loams and well drained clays and prefers a slightly alkaline soil. The chief cane soils of Cuba are the Matanzas clays which can be cultivated even within a few hours after rain. In other areas, red soils have been very popular for cane growing, on account of their ease of working and good drainage (Hawaii, parts of Cuba, Mauritius, Natal, Deccan, Queensland etc), but owing to the leaching effect of tropical rains these soils are getting poorer in lime and phosphoric acid and they are also poor in humus and nitrogen. Alluvial lands in Natal and Queensland have maintained their yields for a long period. But from the historical stand point, the determining influences which have localised the cane tract in a few islands like Cuba, Java etc, have not been so much the above factors, but rather political considerations like the backing of an organised group of capitalists and the security of a contiguous market. American capital and tariff concessions have made Cuba the leading world producer of cane sugar (4·7 million metric tons in 1929—30 out of a total world production for cane and beet sugar of 26·0 million tons). Dutch capital and enterprise have similarly controlled the Java industry. Insufficiency of labour and local sparsity of population have not proved limiting factors to the development of cane production in the above areas. (C. N.)

A Sensitive pot test for Phosphate Deficiency in soils *J. A. McDonald* (*Tropical Agriculture*, (Trinidad). 1933, vol 10. pp 108–111). The author utilises the tomato plant as a sensitive indicator of the phosphorus requirement of soils. Tomato plants grown in phosphate deficient soils (below about 40 parts per million of available phosphorus) showed the following abnormal symptoms;—(1) A violet red colour developed on the lower sides of the leaves and stems (most marked after 10 to 20 days growth), (2) The stems and foliage had a darker green colour than normal. (3) The plants showed great response, in respect of dry matter produced, to additions of soluble phosphorus to the soil. (4) Some times, in extreme cases of phosphate deficiency, the first pair of true leaves remain unparted at the tips, and there is an upward inclination of seed-leaves forming an acute angle. For determining qualitatively the phosphate deficiency of a soil, the author suggests a pot experimental method, where-in 4 pots are used, in two of which the sample of soil is used as such without any addition, and in the other two the soil is mixed with soluble phosphate. From the difference in growth of tomato plants in the two sets of pots and by observation of the foliage symptoms, the degree of phosphate deficiency is inferred. The method is claimed to have advantages over chemical methods like Truog's colorimetric method, especially for alkaline and calcareous soils, where a sufficiency of phoshate may be shown by chemical methods but the phosphate may be in an "unavailable" condition as revealed by the tomato test. (C. N).

The influence of different levels of fat intake upon milk secretion.— *L. A. Maynard* and *C. M. McCay*, (*Bulletin No. 543 of the Cornell University Agricultural Experimental Station*, Ithaca, New York, 1932). The experiments reported in the present paper throw interesting light on a question of practical importance to the dairy farmer, viz., whether the fat ingested in the food has any influence beyond its energy value on total milk secretion and the fat content of milk. The experiments covered a period of three years from 1928—1931 and involved nineteen cows in all. The influence of different fat levels on milk secretion was

studied, by partial or nearly complete removal of the fat from the grain mixture by benzine extraction and its replacement by an isodynamic amount of starch. The data obtained show that the fat content of a dairy ration has a special value in addition to that represented by its energy content. The replacement of one half or more of the fat in a 6 or 7% fat grain mixture by an isodynamic amount of starch, uniformly resulted in a lowering of the yield of milk and of fat. When the fat ingested was reduced to 1%, the fall in milk yield was most marked. The primary effect of ingested fat was on the total milk secretion and not on the fat percentage which latter sometimes tended to go up in inverse relation to total milk yield. The present studies suggest that maximum milk secretion is favoured by a fat intake which would be sufficient to provide at least a major part of the fat secreted in the milk. In the present experiments wherein the succulent used viz. beet pulp, was abnormally low in fat, a level of 3% fat in the grain mixture proved insufficient for maximum milk production. It is interesting to note that at each of the fat levels 1%, 3% and 7% in the food supplied, the total fat secreted in milk was greater than that ingested in the food, the difference being greater in the case of low fat supply; the difference in fat was synthesised from the carbohydrate supplied. Such substitution of carbohydrate for fat in the metabolism was immediately reflected in the quality of the secreted fat as shown by its higher iodine number. The lowering of the fat intake, with its resultant decrease in milk secretion, was accompanied by a gradual lowering of the total fatty acids, the phospholipid fatty acids, and the cholesterol of the blood plasma. The changes in these lipids exhibited a high degree of parallelism. (C. N.)

The Effect of Different planes of Protein intake upon milk production. *E. S. Harrison* and *E. S. Savage* (*Bulletin No. 540 of the Cornell University Agricultural Experimental Station*—Ithaca. New York.—May 1932). The pamphlet makes an interesting contribution to the important question of the protein requirements of dairy cows, about which so few data are available under Indian conditions. In order to examine the scientific soundness of the general tendency of American Dairy farmers to feed too much of protein to milch cattle, the authors carried out experiments over two years on three batches of 12 Holstein cows each, which were fed on three different protein levels, viz., 16%, 20 %, and 24 % of protein. The protein supply was secured by means of concentrated bran, linseed meal, cotton seed meal and corn gluten feed, which were mixed in such proportions as to make three mixtures containing the same percentages of fat, fibre and total digestible nutrients per ton, but one carrying 16 %, the second 20 % and the third 24 % total protein. Roughages like hay and corn silage were fed to all the groups. A statistical analysis of the data showed that there was no significant difference between the total yields of milk in the three groups, which averaged from 9500 to 10,000 lbs. during the first 40 weeks after lactation. There was also no significant difference between the groups in the efficiency with which the three groups utilised their rations. Generally, about thirty lbs. of concentrate, 37 lb. of hay and 110 lbs. of silage were required in each case for the production of 100 lb. of milk, representing about 0·27 to 0·28 lb. of total digestible nutrients in addition to maintenance requirements per lb. of milk produced. When 0·7 lb. of digestible protein per 1000 lbs. of live weight is deducted for maintenance, the ratio of the digestible crude protein consumed to the protein produced in the milk was in the 16% group 127·8%, in the 20% group 149·8%, in the 24% group 180·6%. The 16% concentrate mixture furnishing 127·8% of the protein in the milk was just as effective in maintenance of milk production as either the 149·8% or 180·6%. There was no evidence of a stimulating effect of the higher protein feed on total milk production. (C. N.)

The Marketing of Fruits and Vegetables in Bombay. *G. S. Cheema* (*Government Central Press, Bombay*, 1932). In this interesting pamphlet Dr. Cheema, who

has recently been on a visit to the fruit-markets of Europe, points out the disorganised state of the production and marketing of fruits and vegetables in India, and discusses measures necessary of adoption, if India is to improve her trade in these primary commodities. Public interest in the fruit export trade of India has recently been roused by the attempts made by the Bombay Department of Agriculture under the auspices of the Empire Marketing Board, during the last and current season to send consignments of the best Indian mangoes for the English market. The present pamphlet limits itself to Bombay city only and Dr. Cheema points out that the per capita consumption of fruits and vegetables in Bombay is only half an ounce per day as compared with 1 lb. per day in New York, 4½ oz. in London and higher still in Paris. The reason for this low consumption, especially in a predominantly vegetarian country like India, is attributed to two principal factors namely (1) high prices and (2) the faulty distributing organisation, especially as regards meeting the requirements of the poor man. The high prices have, in fact encouraged the import of fruits into Bombay from foreign countries, eg. dates from Iraq, oranges from Palestine, Rhodesia and Italy, grapes from Spain, potatoes from Italy etc. the total value of the imports being nearly a crore of rupees per year. An analysis of costs of local production showed that 71% of the retail price of fruit is taken by the middleman, 18% is absorbed in freight and only 11% goes into the pockets of the grower. In order to avoid the high middle-man and transport charges, Dr. Cheema recommends the formation of a Marketing Board for fruits and vegetables, similar to the Market Committee provided in the Bombay Cotton Markets Act of 1927, which shall have entire control in the grading and packing of the produce, issuing licenses for registered auction agents, fixing prices to prevent unjust price fixing, issuing certificates regarding the spoiled condition of consignments, maintaining an information bureau to publish wholesale and retail prices etc Besides the formation of the Marketing Board, the author recommends the immediate separation of the wholesale market from the retail market, the substitution of free auctioning in place of secret sales in the wholesale markets and sufficient publicity for the wholesale prices. Transport facilities should be increased by a lowering of freight, speeding up of transport by means of through-scheduled trains and provision of special vans with good ventilation for the carrying of fruits and vegetables and the provision of special refrigeration cars. (C. N.)

Production of Industrial Alcohol from grain by the Amylo Process. *W. L. Owen (Industrial and Engineering Chemistry*, 1933, vol. 25, pp. 87-89). This article describes some of the recent improved methods for the manufacture of alcohol from maize, which may prove of interest in this country, as suggesting a possible outlet for the large quantity of cereal grains like cholam and maize grown in India. The Amylo process, developed by Calmette and Voidin at Antwerp, is a scientific improvement on the age old Chinese process, wherein the white mould *Amyloces Rouxis*, growing on rice doughs, was used. Saccharification and alcoholic fementation are hastened by the use of powerful ferments like purified cultures of *Mucor B, Mucor G, Rhizopus Delemar etc.*, besides *Amyloces Rouxii*. The Amylo process is complete in about three days, but in a still later improvement called the Boulard process, the reaction is finished in 48 hours, being hastened by the simultaneous carrying out of the saccharifying and alcoholising fermentations side by side and the use of still more powerful ferments like Mucor Boulard No. 5. The Amylo and Boulard processes possess several advantages over the older malt-method of bringing about saccharification since there is a saving in respect of barely malt used, which in the older methods went up to 10 to 15% on the total grain mash, and moreover higher yields of purer quality alcohol were obtained. The saving in malt alone caused a difference as between 1 sh. 6½ d. per gallon of 95 per cent. alcohol by the malt method and 11¼ d by the Amylo process. The

yield is about 37–39 liters by the Amylo method as against 34 liters by the malting process. Moreover the higher temperature (about 40°C) at which the Amylo process can be carried out, due to the use of special yeasts like *Saccharomyces anamensis*, and Boulard No. 21–30, destroyed other infecting ferments and yielded a finer quality of alcohol. (C. N.)

Gleanings.

Leather Waste as Chicken Feed—The leather industry has for many years furnished the glue manufactures with millions of pounds of raw material each year, and from this certain technical gelatins and animal glue have been processed. With conditions as they are at present due to the economic situation, the glue manufactures are affected like all other industries. The glue industry has further met with reduced demands during the past year or so, due to the trend in furniture, steel or other metal furniture supplementing wood furniture to an appreciable degree. With all these conditions there was no demand for the raw material from which to manufacture animal glue. When it became apparent that huge quantities of this raw material were accumulating all over the United States, the Department of Leather Research of the University of Cincinnati undertook the problem of finding ways and means of utilising this material. Many research problems were started and the one which to date has given most promise is the processing of this raw stock into a protein concentrate food-material. The process involved is simple. By the fine subdivision of the material and an intimate heating, the moisture is reduced to a low percentage Meat scrap and tankage are usually sold on a 50% protein basis. The new food should compete with these materials, for its protein content has been found to be from 60—67%. (*Scientific American*, February, 1933).

Silver Purifies Water. Metallic silver in an ionic condition appears to exercise a very effective bactericidal action on the germs which are usually present in drinking water. Various means of introducing silver ions into water are described in a recent issue of *Chemical Age*. An electrical method recently proposed involves the passage of the water between silver electrodes through which a very small current is continuously passing. By this method an effective number of silver ions are introduced into the water with the aid of a three to five milliampere current. One of the earlier methods of purification was based upon the ability of water to take up silver by merely allowing it to trickle over glass beads coated with a thin layer of the metal. A suitable small-scale plant consists of a 25 quart stone-ware jar filled with a quantity of silver coated glass beads which reduces the capacity to 18 quarts. The water is passed into the jar via a tube filled with silver-coated quartz fibres, and a velocity of flow of half to one quart per minute suffices for thorough disinfection. A curious feature of this catodyne process is that water sterilised in this manner can itself be used as a sterilising agent for mineral water bottles and the like. It appears that on allowing such silver-charged water to stand in a glass bottle for several hours, a proportion of the ionic silver becomes transferred to the walls of the bottle and serves to sterilise any liquid subsequently poured into it. (A. E. B. in Scientific American, March 1933).

Mosquito Horde Kills Live-Stock. A furious attack by a mosquito horde near Miame, Floride, resulted in the death of at least 173 head of live-stock and poultry, F. C. Bishopp of the Department of Agriculture reported to a recent issue of *Science*. While blood loss was an important factor, Mr. Bishopp is of

the opinion that the death may have been due to the injection of a toxin by the mosquitoes as well as the loss of blood. He points out that few of the current reports of fatal attacks on man and animals by mosquitoes have been verified. The check of the losses in this instance was made by T. E. McNeel of the United States Bureau of Entomology *Science service.*

New Fertilizer from Peat. Ammoniated peat, a new fertiliser material has been developed in the laboratories of the United States Department of the Agriculture. It seems to combine many of the good features of the two familiar types of nitrogen carrying fertilisers. It has not been developed commercially yet, but chemists of the department say that the manufacturing process is simple and relatively inexpensive and that the commercial production of ammoniated peat offers opportunity for material saving in freight on fertilisers. Small scale experiments with plants have given promising results. By heating ammonia and peat under pressure, about two thirds of the reacting ammonia is changed to chemical combinations that are not soluble in water. These forms are generally similar to the nitrogenous fertiliser materials in cotton seed meal and animal tankage. Roughly a third of the ammonia remains in water-soluble forms. Depending on temperature, the peat may be ammoniated so that it will consist of as much as 20% of nitrogen. A 20% product would thus contain in each 100 pounds the equivalent of 200 pounds of cotton seed meal plus 50 pounds of sodium nitrate. Raw peat is of relatively little value as a nutritive ingredient in fertilizer, but is recognised as a highly desirable element in mixed fertilisers because of its value as a conditioner, preventing the caking of the product and because it applies to the soil, a desirable form of organic matter. (*A. E. B. in Scientific American*, April 1933.)

Heterosis: Specific not General in Nature. In studies of hybrid vigour in F_1 oat plants, variable results were obtained from different crosses. In the F_1 of some crosses nearly all the measurable parts are greater in the F_1 hybrid than in the larger parent. In other crosses possibly only one or two characters are noticeably increased. The difficulty of obtaining oat crosses in large numbers is a serious obstacle to studies of heterosis in oats, but it is believed that an increase of 10% over the larger parent may safely be considered a significant increase where small numbers are involved. Examples of these results are found in the cross *Fulghum Richland* × *Markton.* In the first cross the F_1 plants averaged 13·2 per cent taller, bore 17·5 per cent. more culms per plant, weighed 48·5 per cent more, and yielded 35·2 per cent. more grain and 51·3 per cent. more straw on the average than the larger parent. In all other characters the hybrids were intermediate between the parents. In the second cross the F_1 plants yielded 18·9 per cent. more grain, and the grain-straw ratio was increased 33·8 per cent. over that of the larger parent. In all other characters the F_1 plants of this cross were intermediate in size between the parents. In other crosses other characters manifested the influence of heterosis.

Heterosis is commonly accepted as having a genetic basis and as such this increase in plant size is satisfactorily explained as being due to the bringing together in the F_1 of the growth factors present in both parents. The impression seems quite generally held that when heterosis occurs in an F_1 hybrid individual the increased size is of a more or less general nature, extending to all or almost all the measurable parts of the hybrid organism. In the light of available knowledge it appears that this widely held conception may need some revision. Barring actual linkage, heterosis is a condition which more often has a rather high degree of specificity. In some crosses a number of the parts of the F_1 hybrid plant may show influence of heterosis, yet it does not necessarily follow that the parts are closely linked genetically. The fact that in some F_1

crosses only a single plant part shows the influence of heterosis, while in others there may be several showing increased size, definitely indicates lack of genetical linkage. (F. A. Coffman, *Science*, January 27, 1933. Vol. 77 No. 1987).

Correspondence.

I

Potatoes in Nilgiris.

The Secretary of the Association of Economic Biologists writes:—

In the report of a meeting of the above Association published in the March issue of 1933, I regret that certain inaccuracies occured which have since been brought to my notice and I request that you may publish the following alterations in that report.

(1) Para 4. (3) Second crop September—December 33,000 acres should read as 3,300 acres.

(2) Para 5. A bag is 200 lb., and not 80 lb.

(3) Para 6. Second line, in place of kidney read Royal kidney.

II

An Appreciation.

Mr. R. C. Wood, Professor of Agriculture, Imperial College of Tropical Agriculture, Trinidad, and formerly Principal of the Coimbatore Agricultural College writes:— May I take this opportunity of tendering my congratulations to the Union and those responsible for the Journal, on its twenty first birthday. I remember, and I suppose was partly responsible for, itsappearance under the title of the Journal of the "Madras Agricultural Students' Union".

It is interesting to compare its age with other similar Journals. "The Tropical Agriculturist" (Ceylon) is the oldest, now in its 79th half year; "The Agricultural Journal of India" had reached its 25th year, but is now discontinued. "The Malayan Agricultural Journal" and the "Philippine Agriculturist" are contemporaries.

You have a record to be proud of, and I wish you all success for the future.

Crop & Trade Reports

Groundnut Crop, Madras 1933, First Report. (1) The area sown with the summer or irrigated crop of groundnut during the three months of January to March 1933 is estimated at 49,200 acres as against 40,600 acres for the corresponding period of last year, an increase of 21 per cent. (2) The wholesale price of groundnut per imperial maund of 82 lb as reported from important market centres towards the close of March, ranged from Rs. 3—3—0 to Rs. 3—4—0. (*From the Board of Revenue, Madras*).

All India Memorandum on the Sesamum Crop, 1932—'33. The total estimated acreage and yield of sesamum in India in 1932—33 is 5,982,000 acres and 545,000 tons, against 5.639,000 acres and 476,000 tons, for 1931—32 and 5,373,000 acres and 486,000 tons for the average of the five years ending 1930—31. The shares of the different Provinces are: Burma, 1,534,000 acres, 64,000 tons; United Provinces 1,221,000 acres, 132,000 tons; Madras 806,000 acres and 106,000 tons; Bombay

602,000 acres and 73,000 tons; Central Provinces and Berar, 591,000 acres and 51,000 tons; Bihar and Orissa, 200,000 acres and 29,000 tons; Bengal 161,000 acres and 36,000 tons; Punjab 135,000 acres and 11,000 tons; Hyderabad 601,000 acres and 35,000 tons; Increase of area and yield over the average of the preceding 5 years is greatest in Burma (32·4% in area and 33·3% in yield) and the United Provinces (39·4% in area and 64·0% in yield). The yield per acre is highest in Bengal (501 lbs. per acre) followed by Bihar and Orissa (325 lbs. per acre), Madras (295 lbs. per acre) and Bombay (272 lbs. per acre). The quantity exported by sea from British India to foreign countries during the last five years ending 31st March was as follows:—1928—29, 30·483 tons; 1929—30,10·789 tons; 1930—31, 1116 tons; 1931—32, 12,322 tons; and in 1932—33, 10,322 tons.

Condition of Important Industries in the Madras Presidency. The trade and industrial depression reduced the international trade of the world in the last quarter of the year under review to less than half of what it was in the corresponding quarter of 1929—30. Unsettled political conditions also adversely affected trade. The Madras Presidency being a province dependent mainly on its primary products, felt the effects of the depression acutely. The cotton and jute industries in this Presidency had a comparatively favourable year. Production and employment in hosiery mills also increased above the figures for the previous year. However, the tanning industry suffered severely and exports declined by 10% in weight and 17% in value owing largely to the increase in tariffs in several countries. Employment in the oil milling industry and in rice mills declined. The engineering industry also employed fewer people than before. The timber industry fared no better, political conditions in Bombay being the cause of reduced demand. The tile industry on the West Coast and the cigar industry have also been depressed. However, the production of soap in the Madras Presidency has increased and several new factories have been started, mostly by students who have passed out of the Kerala Soap Institute. In the tea planting industry prices have been on the downward grade for about two years but the unfavourable prospect is likely to be relieved to a partial extent by the British preference granted to Empire grown tea. The Indian Tea Cess Committee has been active throughout India in propaganda for the increased consumption of tea. Good crops of coffee were yielded during the season but there was a heavy fall in exports. On the other hand the demand for local consumption appears to be steadily increasing and thereby rendering the Indian producer less dependent on outside markets. There has been an improvement in prices. The rubber planting industry has been extremely affected. Most Estates ceased tapping during the year, but some continued production in anticipation of an agreement between England and Holland in regard to the restriction of output. As no such agreement was reached, tapping had by the close of the year in many cases ceased. The Industries department in co-operation with the department of Agriculture launched a campaign for increasing sugarcane cultivation and the manufacture of sugar, with a view to making the Madras Presidency self-support-in this respect. It is hoped to introduce hand or power driven centrifugals for economic manufacture of sugar in small factories.

Kerala Soap Institute. During the year the institute was appointed as Soap-makers to His Excellency the Earl of Willingdon, Viceroy and Governor-General of India. In spite of the general trade depression there was improvement over the previous year's figures both as regards production and sale of toilet soaps. Sales increased from Rs. 2,23,553 in 1930—31 to Rs. 2,41,698. The result of the year's working was a net profit of Rs. 12,436, after paying the interest of Rs. 19,885 on the capital invested by Government and meeting the cost of the educational side of the institution. This compares with a loss in the two previous years. During the year 16 students were trained in soap making. Some of

the students have started soap factories of their own. In the laboratory of the Institute 630 analyses of oils, soaps and other products were conducted during the year. Some original research work was also done.

Government Industrial Institute, Madras. The experiments during the year consisted principally in finding cheaper substitutes for raw materials, their treatment and the effect of their use on the quality of finished products in the manufacture of printer's inks. A series of experiments were made for investigating the cause of corrosion in copper stills used for distilling *mahua* flowers. Enquiries regarding the manufacture of fluid inks, fruit preservation, extraction of various oils etc., were dealt with and replies furnished. Printer's ink was manufactured and 5,000 lbs. were supplied for the use of the Government Press.

Sandal-Wood Industry in the Madras Presidency. The administration report of the Forest Department of the Madras Presidency for the year ending 31st March 1932, states :—672 tons of sandalwood were sold for Rs. 6,12,802 as against 564 tons for Rs. 4,40,755 in the previous year. The average price realised was Rs. 912 per ton as against Rs. 782 in the previous year; Rs. 1395 in 1929—30 and Rs 1485 in 1928—29. That it was possible to dispose of the whole of the stocks and at better prices was satisfactory; but this market remains very uncertain, only small quantities at a time being in real demand. Efforts have been made in conjunction with the High Commissioner to establish direct touch with users and samples are being sent for analytical trial to European oil distillers. It is of interest to recall that in 1913—14 the average price realised was Rs. 558 and in 1924—25, Rs. 1596, the highest on record. In the last ten years 6452 tons have realised Rs. 77,21,818, the direct costs of production being only a little in excess of Rs. 5,00,000. It is thus evident how important a source of revenue this is and also that it is worth while to spend on research and cultural work far more than is devoted to the purpose at present. Rao Bahadur K. R. Venkatramana Iyer was deputed to study market conditions in the year and has submitted a valuable report. There is a considerable import of sandal substitute from Australia, Africa and other countries, which are sold to an unsuspecting public at genuine sandalwood prices. It is proposed presently to address Government with a view to an increase in the import duties. Efforts to effect retail sales of small quantities at a time for ceremonial and other personal use have not so far met with much success.

Quinine Manufacture in the Madras Presidency. The work of the Government Quinine factory at Naduvattam was hampered by the meagre supply of cinchona bark available for quinine extraction, and production was again maintained at a low level. Bark was not easily available as cinchona has been all but ousted in the locality by tea plantations. A quantity of 517.564 lbs. of bark was worked, of which 392,986 lbs. were locally purchased and the remainder obtained from the Government plantations at Naduvattam and Dodabetta and in the Anamalais. The output of quinine sulphate was 22,307 lbs. and cinchona febrifuge 9084 lbs. The factory cost of production of quinine sulphate was Rs. 13—8—4 per lb. A trial consignment of "totaquina" a purified form of cinchona febrifuge, which has been sponsored by the Malarial committee of the League of Nations was made and distributed to various hospitals for trial. The selling of 'treatments" in Post Offices which was inaugurated in June 1930, made satisfactory progress and 2167 lbs. were thus disposed of as against 1290 lbs. in the previous year. An extent of 1958 acres was under cincona plantation in the three Government plantations at the end of the year. The plants in the Anamalais estate were affected by water logging owing to heavy rains. The Naduvattam plantation had favourable weather conditions and success was obtained there in the grafting and high grade ledger plants on the stout roots of *Cinchona robusta*. New

nurseries were opened at Dodabetta and a number of cinchona seedlings were transplanted. The financial accounts disclosed a profit on the year's working of Rs. 22,790, a satisfactory increase of Rs. 13,103 over the previous year's results (*Report on the Administration of the Madras Presidency, for the year 1931—32.*)

Review.

Sugar Reference Book and Directory, 1932—33. (Published by Palmer Publishing Corporation, New York, U. S. A., price 5 dollars). This handy book giving facts and figures regarding the production of cane and beet sugar in the different countries of the world, opens with a world map showing the distribution of the chief beet and cane areas. The tendency during the last few years has been towards a greater development of cane and beet sugar locally in the different countries with a view to render each country self contained as far as possible in regard to sugar, the prominent exception being the United States, which mainly depends for its supplies on Cuba. Till a few years ago, the ambition of several favourably situated countries was to follow the lead of Cuba and Java, in producing a great deal more sugar than what was required for internal consumption and dumping the excess on the world sugar market. Cuba and Java were successful in such international sugar trade on account of favourable circumstances like the contiguity of assured markets like the U. S. A. for Cuba and India for Java, but latterly when a number of other competitors like the European beet countries and the South American cane growing countries entered the field, it was found that the supply was greater than the demand and there was a heavy slump in the market. In order to save the international trade, some of the chief sugar exporters like Cuba, Java, Czechoslovakia, Germany, Poland, etc. formed at Brussels in 1931 an international sugar council and arrived at an International Agreement at Paris in 1932, whereby definite quotas were assigned to each country for export, and production was decreased with a view to clearing off the heavy stocks on hand and maintaining world prices. Despite unfavourable trade conditions, the Agreement has been successful in as much as an appreciable portion of the stock on hand has been already cleared and the Council hopes to clear off all excess stock by 1935. But it is doubtful whether in view of the strong protectionist policy adopted by each country, international trade in sugar would again resume the prominent place it attained in the post-war days. The graphs given in the Directory showing the variation in annual prices of raw and refined sugar at New York from 1903—1932, show that the high peak was reached in 1920, when price reached 15·5 cents per lb. for refined sugar and 12·5 cents per lb., for raw sugar, but after 1923 prices have been falling rapidly, so that in 1932 they reached the low water-mark of 3·7 cents for refined sugar and 2·6 cents for raw sugar. The efforts made by Java and Cuba to counteract this by a limitation of production is shown by the fact that production in Java has been brought down from 3,115,080 tons in 1929—30 to 1,350,000 tons in 1933, and in Cuba from 4,746,000 tons to 2,050,000 tons in the same period. The total world production has shown a decrease from 28,427,000 tons in 1929—30 to 26,063,000 tons in 1932—33, while consumption has shown an increase from 26,920,000 tons to 27,451,000 tons in the same period. The production of India has increased from 3,079,000 tons in 1929—30 to about 4,400,000 tons in 1932—33; her consumption has also shown an increase from 4,051,000 tons to 4,950,000 tons in the same period. She imported about a million tons of refined sugar from Java in 1930—31, but with the increased import duties now imposed (18 rupees 2 annas per bag of 224 pounds) and the active policy of increasing local production at present being adopted by the Government of India, imports from foreign countries are likely to cease in a few years. The Directory besides giving a review of the present position of the sugar industry

in each country with details regarding the number and addresses of sugar factories with their maximum annual production capacity, contains several interesting articles on topics like the economics of sugar by products, the molasses supply situation, improvements in sugar technology, the tariff rates of different countries etc., and would prove a useful reference book to all those interested in the sugar trade, (C. N.)

Weather Review (MARCH—1933)

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	...	−0·6	0·5	South	Negapatam	4·3	+4·0	4·3
	Berhampore *	...	−0·7	0·6		Aduthurai *	1·8	+0·5	2·6
	Calingapatam	...	−0·4	...		Madura	0·1	−0·6	0·1
	Vizagapatam	0·5	+0·2	0·6		Pamban	1·2	−0·7	3·3
	Anakapalli *	0·3	+0·2	0·3		Palamkottah	0·2	−1·1	1·3
	Samalkota *	0·4	−0·1	0·4		Koilpatti *	0·3	−0.4	0·3
	Cocanada	...	−0·5	0·4					
	Maruteru *	0·1	+0·1	0·1					
	Masulipatam	...	−0·4	...					
	Guntur *	0·1	−0·2	0·1	West Coast	Trivandrum	0·4	−1·1	0·4
Ceded Dists.	Kurnool	1·6	+1·3	1·9		Cochin	1·4	−0·5	2·4
	Nandyal *	0·4	+0·1	0·4		Pattambi *	0·2	−0·2	0·2
	Anantapur	...	−0·1	0·1		Calicut	0·9	+0·3	0·9
	Hagari *	0·1	...	0·3		Taliparamba *	0·4	...	0·4
	Bellary	0·3	+0·1	0·3		Nileshwar *	...	−0·4	...
	Cuddapah	...	−0·2	...		Kasargode *	0·2	−0·3	0·2
						Mangalore	...	−0·1	...
Carnatic	Nellore	...	−0·2	...					
	Madras.	3·4	+3·0	3·4					
	Pallakuppam *	6·9	+5·8	7·1	Mysore and Coorg	Chitaldrug	0·5	+0·2	0·8
	Palur *	12·4	...	12·4		Bangalore	...	−0·6	0·3
	Cuddalore	11·9	+11·7	11·9		Mysore	0·4	+0·1	0·8
						Mercara	1·4	+0·8	1·4
Central	Vellore	1.0	+0·8	1·0					
	Salem	0·8	+0·3	0·8					
	Hosur Cattle Farm *	1·1	+0·7	1·1	Hills.	Kodaikanal	1·7	−1·3	3·1
	Coimbatore	0·1	−0·4	0·1		Coonoor	2·8	+0·3	5·5
	Coimbatore Res. Inst. *	0·2	−0·9	0·2		Kallar *	2·7	+0·6	6·2
						Ootacamund *	1·6	+0·9	1·9
	Trichinopoly	0·6	+0·3	0·6		Nanjanad *	1·9	+1·1	2·1

Stations marked * are stations of the Agricultural Dept.

Summary of general weather conditions: The weather over the whole of the area was generally fine till the 12th, when an area of low pressure extended westwards over the Bay and gave rise to general rain over the south of the peninsula and very heavy falls in the neighbourhood of Cuddalore on the 12th and 13th. Thereafter weather was normal with scattered thunderstorms in the Deccan, Central districts and West Coast. Rainfall was in excess along the south Coromandel coast, and locally in Coorg and the Deccan. The chief falls of rain were: Cuddalore 4·6" and Negapatam 3·4" (12th); and Cuddalore 7·2" (13th) Temperature was generally normal, Cuddapah reported the highest temperature of 105° on the 25th.

Weather Report for the Research Institute Observatory :

Report No. 3/33.

Absolute Maximum in shade	...	99·0°
Absolute Minimum in shade	...	60·5°
Mean Maximum in shade	...	95·2°
Departure from normal	...	+ 0·7°
Mean Minimum in shade	...	69·0°
Departure from normal	...	- 0·7°
Total rainfall	...	0·17″
Departure from normal	...	- 0·90″
No. of rainy days	...	1
Mean daily wind velocity	...	1·7 M. P. H.
Departure from normal	...	- 1·6 M. P. H.
Mean humidity at 8 hrs.	...	68·7%
Departure from normal	...	- 1·0%
Total hours of bright sunshine	...	295·2
Mean daily hours of bright sunshine		9·5

Summary of weather conditions : Weather was fine and dry during the greater part of the month except during the 12th and 13th when the unsettled conditions of the Coromandel coast induced a temporary revival of North-east monsoon conditions, accompanied with cool weather and cloudy skies. Temperature was below normal during the first half of the month and above normal in the latter half when the maximum rose to 99·0°. Rainfall was below normal and one fall of 0·17 inch was recorded.

Weather Review (APRIL—1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	1·4	+0·6	1·9	South	Negapatam	0·3	−0·3	6·3
	Berhampore *	1·7	+0·4	2·3		Aduthurai *	0·3	−0·7	2·8
	Calingapatam	0·4	−0·5	0·5		Madura	3·3	+1·3	3·3
	Vizagapatam	0·1	−0·7	0·6		Pamban	0·1	−1·5	3·4
	Anakapalli *	3·5	+2·2	3·8		Koilpatti *	2·5	+0·5	2·8
	Samalkota *	0·4	−0·2	0·8		Palamkottah	5·3	+2.8	6·6
	Cocanada	0·2	−0·4	0 6					
	Maruteru *	...	...	...(a)					
	Masulipatam	0·1	−0·5	0·1					
	Guntur *	...	...	...(a)	West Coast	Trivandrum	5·7	+1·2	6·2
Ceded Dists.	Kurnool	1·0	+0·5	3·6		Cochin	3·1	+3·4	10·5
	Nandyal *	0·1	−0·2	0·5		Pattambi *	4·3	+0·9	4·5
	Bellary	1·5	+0·7	1·7		Calicut	10·0	+6·7	10·9
	Hagari *	0·4	+0·2	0·7		Taliparamba *	3·7	+1 0	4·1
	Cuddapah	0·1	−0·3	0·1		Nileshwar *	2·3	+0·9	2·3
	Anantapur	0·9	...	1·1		Kasargode *	6·2	+3·8	6·4
						Mangalore	2·7	+1·7	3·4
Carnatic	Nellore	...	−0·4	...					
	Madras	...	−0·5	3 5	Mysore and Coorg	Chitaldrug	2·6	+1·4	3·4
	Pallakuppam *	...	−1·4	7·1		Bangalore	0 9	−0·4	1·3
	Palur *	...	?	12·4		Mysore	2·5	+0·1	3·2
	Cuddalore	0·1	−0·5	12·0		Mercara	1·7	−1·0	3·1
Central	Vellore	0.3	−0·3	1·3					
	Salem	1·3	−0·5	2·1					
	Hosur Cattle Farm *	...	...	...(a)	Hills.	Kodaikanal	6·6	+2·3	9·6
	Coimbatore	2·6	+1·2	2·7		Coonoor	4·4	+0·1	10·0
	Coimbatore Res. Inst. *	3·7	+1·6	3·9		Kallar *	3·8	+1·1	10·4
	Trichinopoly	1 9	+0·2	2·6		Nanjanad *	2·6	−0·7	4·8
						Ootacamund *	1·9	−1·2	3·8

* Stations of the Agricultural Dept.

(a) Reports not received.

Summary of general weather conditions: The weather at the beginning of the month was fine with a few scattered thunderstorms in the west of the peninsula, and high temperatures in the Deccan. On the 9th thunderstorms became general over the south of the peninsula and continued till the 13th, and some heavy falls were reported from the west coast, and a few scattered falls also occured on the North Madras Coast. A low pressure area appeared over Mysore and Deccan on the 17th but became unimportant on the next day after giving a few scattered hundershowers in the area. On the 24th conditions became unsettled over the central regions of the Bay but moving eastwards did not influence the weather to any great extent. Scattered thunderstorms continued till the end of the month.

Rainfall was general over the whole area with the exception of the Carnatic, and was in excess generally over Malabar, and Mysore, and locally in the Central districts, Circars extreme south and Deccan. The chief falls recorded were: Calicut 4·4″ and Cochin 3·2″ on the 11th.

Temperature fluctuations were irregular and connected with the distribution of the rainfall, and day temperatures were generally below normal. Cuddapah reported a maximum of 107° on the 8th and 29th.

Weather Report for the Research Institute Observatory :

Report No. 4/33.

Absolute Maximum in shade	...	99·5°
Absolute Minimum in shade	...	67·5°
Mean Maximum in shade	...	95·5°
Departure from normal	...	− 0·1°
Mean Minimum in shade		73·2°
Departure from normal	...	+ 0·2°
Total rainfall for month	...	3·65″
Departure from normal	...	+ 1·61″
Heaviest fall in 24 hrs.	...	1·32″
No. of rainy days	...	4
Mean daily wind velocity	...	1·9 M. P. H.
Departure from normal	...	− 1·5 M. P. H.
Mean humidity at 8 hrs.	...	73·0%
Departure from normal	...	+ 3·0%
Total hours of bright sunshine	...	268·8
Mean daily hours of bright sunshine		9·0

General weather conditions : The weather was fine during the first week of the month with high day temperatures. Thunderstorms appeared on the 8th and lightning or thunder was recorded almost daily thereafter till the end of the month. The observatory recorded two very severe thunderstorms on the nights of the 24th—25th and 26th—27th, accompanied by severe squalls and continuous lightning and thunder. The second storm was of exceptional intensity, though the rainfall which accompanied it was local in character, decreasing rapidly to the south-east, it was 1·32″ at the Observatory, 1·59″ at a gauge 4 furlongs to the N. W., and 0·7″ at Coimbatore Town about 3 miles to the S. E.

Rainfall was in large excess, and wind velocity below normal. Other climatic elements were nearly normal.

P. V. R and T. S. L.

College News & Notes.

Results of the B. Sc. Ag. Degree Examination 1933 : The following is the list of successful candidates in the recent B. Sc. examination :—

First Examination : (New Regulations) : S. Arunachalam; M. Balakrishnan Nair; C. Bhujanga Rao; J. Gopala Rao; P. Govinda Rao; P. Kameswara Rao; S. Kanakaraj David; M. Kasiviswanadhan; C. P. Kesavan Nair; N. Krishna Marar; S. Kutti Mudali; K. Lakshmanan; N. Mariakulandai; Money Joseph; G. Murugesan; G. Narasimha Murti; U. Narasinga Rao; V. Narayana Pillai; N. Raghava Rao; T. S. Ramakrishnan; B. V. S. Ramalingaswami; V. Sadasiva Ayyar; Samuel Joshua; D. Satyanarayana; M. Satyanarayana Rao; S. Satyanarayanamurthi; R. Soundararajan; P. Srinivasan; R. Sriraman; B. Suryanarayanamurti; M. Venkataramayya; N. Venkata Rao.

Part I. (Old Regulations) : S. Adinarayanamurti; R. Alagiamanavalan; U. Ananda; P. S. Anantanarayanan; C. Balasubramanian; Bennet P. Masilamani;

K. V. Chelapathi Rao ; M. R. Devarajan ; M. Edwin Amritharaj ; K. V. Caurangamurthi ; C. K. Gopalakrishnan ; V. Jayaraman ; M. Kandaswami ; C. Krishnamurti ; K Krishnamurti ; M. Lakshmikanthan ; K. Minakshisundaram ; S. Muthuswami ; C. Parthasarathi ; S. V. Parthasarathi ; G. Radhakantam ; P. Rama Rao ; B. Ramakrishna Reddi ; K. V. Reddi Naidu ; P. C. Sahadevan ; G. Satyanarayana Rao ; P. Seetaramiah ; V. Srinivasan ; M. Srinivasa Rao ; R. Subbiah ; A. Subrahmanyam ; Tayi Ramanujulu ; Y. Veeriah ; G. Venkataratnam ; G. Venkatasastry ; K. Viswanadham ; P. S. Viswanathan.

The following have passed part I with reference in subjects noted against each :— G. Doraiswami (Chemistry); P. K. Kunhi Anujan Raja (Engineering); G. Satyanarayana (Engineering); C. Vadamalai (Chemistry); P. Hanumantha Reddi (Chemistry).

Part II. (Old Regulations): K. Adhinarayana Rao ; M. Bhavani Sankar Rao ; T. S. Dakshinamurthi ; F. L. Daniel; T. Devasikhamani ; D. T. Dhanapandian ; C. Ekambaram ; S. Gideon Ayyadurai ; P. Gopalakrishnan; D. C. Hanumantha Rao; C. Konda Reddi ; K. M. Krishna Menon ; N. S. H. V. Krishnamurthi; T. E. Krishnaswami ; S Lakshmanan; G. Mahadevan ; Muhammad Abdul Jaleel ; Muhammad Obedullah Shah ; K. R. Nagarajan ; K. M. Narayanan ; Y. V. Narayanayya; B. W. X. Ponnayya ; K. Raghunatha Reddi ; R. Rajeswara Gupta ; M. Rama Reddi ; J. P. V. Ranga Rao ; K. V. S. Satyanarayana ; T. V. Seshadri Ayyangar ; M. Sitaramaraju ; D. Srinivasa Rao ; V. S. Rangacharlu ; N. Srirama Reddi ; M. Subba Reddi ; K. Sundararajan ; W. Thirumala Rao ; S. Varadarajan; K. Venkataswami; Y. Venkataswami ; C. Venkatamuniappa Chetti ; T. Venkatarama Reddi Anantaram Panda ; A V. Purushothamarcharyulu ; C. Lakshmanacharya ; U. Seshagiri Rao ; T. S. Jagannathan ; P. Parthasarathi ; R. Guruswami ; Kerala Varma.

Scientific Honours for Departmental Officers: Mr. K. Cherian Jacob of the Botany Section and a member of the Union has been admitted as a Fellow of the Linnean Society of London. We also understand that Mr. T. D. Iswara Ayyar of the Simms' Park, Coonoor, has been made a Fellow of the Royal Horticultural Society, and that Mr. P. Satyanarayana of the Chemistry Section has been awarded the M. Sc. Degree of the Madras University for a thesis on "The Chemistry of Bordeaux Mixture."

Indian Officers' Association: Mr. C. V. Seshachari, Manager of the Central Farm, was given a hearty 'send off' by the members of the Agricultural Section of the Association on the eve of his departure on promotion as Assistant Director of Agriculture, Madura.

The Fieldmen Association: The Annual General Body Meeting of the Association came off on 11—5—33 when the Annual Report showing the steady progress of the Association was presented at the meeting. The following office bearers were elected for the coming year:—*President :* Dr. J. S. Patel; *Secretary :* Mr. S. Kalayanasubrahmanyam ; (Mycology) ; *Asst. Secretary*: Mr. K. Raghavan (I. C. C.); *Managing Committee Members*:—Messrs. B. Rangiah Pillai (Entomology); P. N. Kader Batcha Sahib (Cotton) ; S. Srinivasan (Millet) and J. Manuel (Paddy)

The Coimbatore Collector's Durbar: The Collector of Coimbatore held a Durbar on 11—5—33 to present the Sanads and Insignia to the recipients of the New Year Honours in Coimbatore, among whom M. R. Ry. Rao Bahadur C. Tadulinga Mudaliar was one. A large gathering of officials and non-officials from the town and from our estate attended the function to witness our Principal being presented with the Sanad and the Insignia.

Scout Activities: The Scouts of the Estate Troop spent a two days' delightful camp at Kuniamuthur, where comfortable arrangements were made for them,

through the kind exertions of Mr. Marudachalam, Fieldman to the Government Mycologist.

Visitors: Mr. T. K. Chidambaranatha Mudaliar, who as Commissioner of the Religious Endowment Board stayed at Coimbatore during the month, paid a visit to the College.

The College Band: The following is the full text of the song: "The College Band," sung by the students, on the occasion of the Students' Club Day, in March last.

OUR COLLEGE BAND

A College Band — From far and near
We meet to learn — Our lessons here
To read her word — Whose every line
Is filled with hope — And joy sublime.

Chorus:—

May our Endeavour Band
Now gathered in her name
United heart and hand
Go forth to spread her fame.
Then firmly let us stand
For God and Native land
And pray that He may bless
And keep our College Band.

The Agricol—With fields and all
Splendid labs—And superb staff
Coaches all—In useful science
And makes us all—A man to be.

Our object is—To help the poor
To help the ryot—Our Indian ryot
Whose work it is—To till the land
And grow the crops—To feed us all.

Oh may our Lord—Do help us all
To do His work—To hear his call
In private work—Or Government jobs
To follow him—In every way

Departmental Notifications.

I Circle. U. Vittal Rao, F. M. Smalkota, l. a. p. for two months from 1—5—'33 **II Circle.** R. Krishnamurty, Cotton Assistant, l. a. p. for 2 days on 20th and 21st April. V. Ratnaji Rao, A. D. Nayudupet, l. a. p. for 25 days from 7—5—'33. **III Circle.** P. Subrahmaniam, A. D. Siruguppa, extension of l. a. p. for 2 weeks on m. c. in continuation of leave from 15—2—'33. P. V. Subba Rao transferred to Nandyal. K. Jaganatha Rao, A. D. Anantapur, l. a. p. for one month and 11 days from 20—4—'33 with permission to avail Easter Holidays. **IV Circle.** A. Ramaswami Iyer A. D. Villupuram, extension of l. a. p. on m. c. for 2 months in con.-

tinuation from 3—5—'33. R. Narasimhachary A. A. D. extension of l. a. p. for 18 days from 13—4—'33. N. Krishna Pillai A. D. Tiruvettipuram l. a. p. for one month from 20—4—33. **Transfers.** S. Ramachandran on relief by Muhamad Abbas to Villupuram. M. Eggiyaswami as A. D. to Tindivanam. P. S. Venkatasubramaniam as F. M. to Palakuppam. K. P. Sankunni Menon F. M. posted to be Assistant to F. M. Palur. K. V. Natesa Iyer A. D. Cuddalore to Tiruvellore as additional Demonstrator to take part in the rural reconstruction work. **V Circle.** N. Subrahmania Iyer A. D. Trichy, l. a. p. for 2 months from 24—4—33. **VI Circle. Transfers.** P. K. Natesan F. M., A. R. S. Koilpatty, as A. D. Srivilliputhore. V. G. Dhanakoti Raju A. D. to Satur. S. Bhima Raju A. A. D. to Tinnevelly. L. Sankarkumar Pillai A. D, to Melur. G. Venkatakrishnan A. D. to Madura. G. J. Balraj F. M. Koilpatty l. a. p. for one month on m. c. from 6—4—'33. K. Krishnan A. D. Tinnevelly to Koilpatty as F. M. temporarily. V. Chidambaram Pillai A. D. Srivaikuntam will be in additional charge of Tinnevelly circle. **VII Circle.** A. Gopalan Nair. F. M. Talipparamba extension of l. a. p. for 2 months from 3—5—'33 on m. c. K. Achuta Nambiar A. A. D., l. a. p. for 15 days in continuation of the Easter holidays. **VIII Circle. Transfers.** M. Gopala Chetty A. D. Trichengode to be A. D. Hosur. T. S. Sundaram A. D. Hosur to be A. D. Salem. G. K. Subrahmania Iyer A. A. D. Salem to Krishnagiri. K. M. Venkatachalam Pillai A. A. D. Krishnagiri to Tiruchengode. K. H. Subrahmania Iyer A. D. Palladam l. a. p. for one month and 15 days from 27—3—'33 on m. c. On return from leave he is posted to Annur. A. K. Ramasubba Iyer A. D. Annur to Udamalpet. T. K. Thangavelu to Gobichettipalayam. K. Kuppamuthu is posted to work under A. D. Erode. **D. D. I. S.** H. Narahari Rao F. M. l. a. p. for one month and 13 days from 8—5—'33. **Cotton Section.** R. Sankura Iyer Assistant l. a. p. for 28 days from 26—4—'33. **Curator's Section.** P. Govindakutty Kurup F. M. Kallar and Barliar Gardens, l. a. p. for 3 weeks from 24—4—'33. **Paddy Section.** M. K. Padmanabhan Assistant, l. a. p. for 15 days from 1—5—'33. V. M. Ramunni Kidavu F. M. Pattambi, l. a. p. for 15 days from 24—4—33. **O. S. S's. Section.** C. M. John, Senior Assistant, Palakuppam, l. a. p. for one month and 18 days from 22—5—'33. **Principal's Office.** Francis Joseph l. a. p. for one month and three days from 12—5—33. K. K. Raghavan F. M., l. a. p. for one month and 12 days from 20—4—'33. **D. A's. Office orders. Transfers.** G. J. Balraj A. F. M. Koilpatty to be A. A. D. Mannargudi. S. P. Fernando, A. A. D. Mannargudi to be A. F. M. Koilpatty. K. P. Sankunni Menon F. M. Oil Seeds Specialist's Section to iv circle. K. V. Natesa Iyer A. D. Cuddalore to Tiruvellore to work in the rural reconstruction scheme. P. S. Venkatasubrahmaniam to Palakuppam. M. Eggiaswami Iyer F. M. to Palur. S. Ramaswami Iyer A. D Udamalpet to A. R. S. Anakapalle to be Botany Assistant Temporarily. R. Vasudeva Rao Naidu F M. Maruteru to be F. M Anakapalle. K. Kuppamuthu appointed to officiate as upper subordinate Agricultural Section in the iii grade on Rs. 75/- and to report for duty to D. D. viii circle. R. Govindaramayya A. D. Musiri, to iii circle Bellary. P. S. Athmarama Iyer A. D. Kumbakonam to iii circle to report for duty to D. D. iii circle Bellary. V K. Appaji offg F. M. Kalahasti to v circle. Dr. C. J. George. Entomology Assistant extension of leave without allowances for 4 days from 18—4—'33. P. S. Narayanaswami whose officiating appointment as Assistant in the Entomology section terminated on 21st April 1933, will be considered to have been officiating as Assistant in the Entomology section from 22nd April 1933 up to 19th June 1933. K. Veerabhadra Rao Offg. Assistant, Chemistry Section Coimbatore to the A. R. S. Anakapalle. T. Varahalu, Chemistry Assistant. Anakapalle to Coimbatore.

UNIVERSITY OF MADRAS

B. Sc. Ag. Degree Examination Question Papers 1933.

(New Regulations)

FIRST EXAMINATION

1. AGRICULTURE

(Monday, 3rd April 7 A. M. to 10 A. M.)

Only six questions are to be answered. Questions 5 and 7 are compulsory.

1. Discuss the necessity for deep cultivation on heavy black soils.

2. (*a*) Illustrate the type of tine you would expect to find on (i) a grubber, (ii) a cultivator, (iii) a harrow.

(*b*) What shape of plough mouldboard would you use in (i) a sticky clay soil, (ii) a sandy soil ?

3. Sketch a section through (*a*) a threshing machine, and (*b*) a winnowing machine, and name the essential parts. Briefly indicate the use of each part.

4. State how air movements arise. What are the effects of the NE. monsoon on dry and garden-land farming in the Coimbatore district ?

5. Describe how you would effectively incorporate the following in a garden-land soil :—

(*a*) Five tons of farmyard manure per acre.

(*b*) A four-foot high green manure crop of 20,000 lb. per acre.

(*c*) A two-inch layer of tangled sugar-cane trash.

6. Describe the formation and the distinguishing features of a laterite soil.

7. What is the effect of 'aspect' on soil conditions ? Is the effect of 'aspect' greater in the plains or the hills ? Give reasons.

8. Enumerate the agencies which are responsible for the formation of (*a*) sedentary soils, and (*b*) alluvial soils, and briefly describe their action.

2. BOTANY

(Monday, 3rd April 1 P. M. to 4 P. M.)

Only six questions are to be answered. Questions 3 and 8 are compulsory.

1. What are the food substances commonly stored in seeds ? In what form do these occur and by what tests would you recognize them ?

2. Mention some of the modifications met with in the stems and roots of flowering plants, giving examples.

3. What is meant by 'secondary growth' and what is its significance ? Describe the process as it is seen in the dicotyledonous stem and root with illustrative sketches.

4. What is transpiration ? What parts of the plants are chiefly concerned in the process ?

5. Describe an experiment you have seen to show that light is necessary for the formation of starch.

6. What are the contrivances in flowers for cross fertilization ? Give examples.

7. Give a short account of the adaptations met with for dispersal of fruits and seeds in flowering plants, mentioning suitable examples.

8. What are the distinguishing characters of Amarantaceae and Euphorbiaceae ? Mention *two* plants of economic importance in each.

3. CHEMISTRY

(Tuesday, 4th April. 7 A. M. to 10 A. M.)

Only six questions are to be answered.

1. Give a brief account of the paraffins, their occurrence, chief properties, and commercial uses.

2. Describe how you would determine the molecular weight of a substance which can be vaporized without decomposition. Give experimental details.

3. State how you would prepare sulphuric ether, giving experimental details. What are the reactions involved when methyl-ethyl-ether is formed ?

4. How is ethyl alcohol prepared on a commercial scale ? What are its uses in science and industry ? What are its chief properties ?

5. State briefly arguments in favour of the constitutional formula for benzene.

6. How would you test for the following :—(*a*) nitrogen, (*b*) alcohols, (*c*) aldehydes, and (*d*) carbohydrates ?

7. What are the fatty acids ? Why are they so called ? What are their chief properties ?

8. How are the amino-acids derived ? What is their biochemical importance ?

4. ZOOLOGY

(Tuesday 4th April. 1 P. M. to 4 P. M.)

Only six questions are to be answered.

1. Describe the phenomenon of 'Alternation of Generations' in the animal kingdom.

2. Explain how a bird is adapted for aerial life, a fish for aquatic life, and a frog for amphibious life.

3. Describe the method of locomotion in (*a*) Amoeba, (*b*) Paramoecium, (*c*) Snail, (*d*) Earthworm, (*e*) Snake.

4. Describe the life-history of any *one* of the parasitic worms.

5. Describe the typical formation of the Gastrula. What is the biological significance of the Gastrula ?

6. What are the characteristics of mammals ? Name the chief mammals of economic importance.

7. Classify Insecta, stating the chief characteristics on which the classification is based.

8. Write notes on :—retrogressive metamorphosis, convergence, metameric segmentation, gene, nephridia.

Old Regulations.)

PART I.

1. AGRICULTURAL ENGINEERING

(Monday, 3rd April. 7 A. M. to 10 A. M.)

Only six questions are to be answered. Question 1 is compulsory.

1. (*a*) It is intended to put up a verandah 8 ft. wide (calicut tiled) and having a rise of 3 ft, close to the wall of a main building, and have it supported at the outer end on teak posts 8 ft high and 8 ft. apart (centre to centre) carrying T. W. bressummer, and at the other end on corbel stones carrying a wall piece. The rafters are 2 ft. centre to centre and project 2 ft. beyond the posts. Determine suitable sections for rafters, bressummer, and posts. Assume wind-pressure 20 lb.

(b) Make a neat freehand sketch of the cross section of the above verandah, bringing out all the dimensions for the roof, floor, retaining wall, etc.

2 Give specifications for the following :—(*a*) plastering (new wall), (b) whitewashing (old wall), (*c*) painting (exterior doors and windows), (*d*) flooring of a granary.

3. (*a*) Describe, with sketches, the methods of scarfing ordinarily employed in a village smithy for making hoops out of flat-iron.

(*b*) How would you make and fit the hoop for a cart-wheel, 3 ft. 9 in. diameter, out of a long flat-iron bar $2\frac{1}{4}$ in. $\times \frac{5}{16}$ in. ?

4. (*a*) Give the proportions of C. I. wheel teeth commonly adopted, for instance, in a bullock-driven sugar-cane crusher, clearly explaining backlash and clearance.

(*b*) Describe with sketches *either* the cutting arrangements provided in a mower, *or* the nozzle of a sprayer.

5. (*a*) Explain how a screw is only an adaptation of an inclined plane.

(*b*) A tractor weighing 3 tons is capable of pulling a wagon weighing 12 tons on a level road. Assuming the coefficient of traction to be 150 lb. per ton, what is the tractive force on the level road? What load can it draw up an incline of 1 in 10?

6. (*a*) Show by means of a sketch how you would construct a Spanish module for obtaining a constant discharge of water from a canal having variable heads.

(*b*) Design a suitable plug for an orifice 16 inches in a Spanish module capable of discharging 5 cub. ft. per sec. the head varies from 5 ft. to 2 ft.

7. (*a*) State the laws of fluid friction.

(*b*) An irrigation canal in earth with side-slopes 1½ to 1 conveys 600 cub. ft. per sec. at a velocity of 2½ ft. per sec. Design a suitable canal section with a depth of 3 ft.

8. (*a*) Explain the term 'hydraulic gradient'.

(*b*) It is found that x gallons of water are discharged per minute through a certain pipe which is 1000 ft. long. What would be the discharge if the last 500 ft. were provided with a second pipe, of the same diameter as the first and laid side by side with it, and the water is divided equally between the two pipes?

Make a sketch to show the hydraulic gradient for both arrangements of the pipe line.

2. AGRICULTURAL BOTANY

(Monday, 3rd April. 1 P. M. to 4 P. M.)

Only six questions are to be answered. Question 8 is compulsory.

1. Write a brief account of the vascular bundle system of a dicotyledonous plant embracing (*a*) bundle structure, (*b*) distribution in the organs of the plant, and (*c*) functions.

2. What purposes are served by the intercellular spaces in plant tissues? Illustrate your answer by reference to tissues in leaf, stem, and root

3. Give an account of the characteristics of Malvaceae and Solanaceae, and mention some plants of these families that are of economic importance.

4. What are the special botanical characteristics by which you distinguish the following families:— Myrtaceae, Rubiaceae, Rutaceae, and Gramineae?

5. Draw floral diagrams of the following:— rice, tomato, daincha, plantain, coffee, and sunflower. Give their botanical names, and mention the families to which they belong.

6. Explain the following:—Pneumatophore, Perisperm, Nucellus, Synconium, Velamen, Caryopsis, Periblem, and Verticillaster.

7. Contrast the characters and methods of nutrition of parasitic and saprophytic plants, using members of these groups found in agriculture and horticulture to illustrate your answer.

8 What is considered to be the significance of the process of respiration to a plant? Illustrate your answer by reference to (*a*) the germination of seeds, (*b*) the cambium layer of a woody plant, and (*c*) stored fruit.

3. AGRICULTURAL CHEMISTRY

(Tuesday, 4th April. 7 A. M. to 10 A. M.)

Only six questions are to be answered. Question 7 is compulsory.

1. Explain what you understand by 'alcoholic fermentation'. Give the important properties and reactions of ethyl alcohol.

2. What do you understand by (*a*) constitutional formulae, (*b*) polymerism, (*c*) unsaturated fatty acids, (*d*) essential oils, and (*e*) glucosides ? Give *one* example of each.

3. Compare and contrast the properties of the aromatic and fatty acids, taking benzoic and acetic acids as the representatives of their classes.

4. How is potassium ferrocyanide prepared commercially ? How would you prepare from it a pure specimen of (*a*) potassium ferricyanide, and (*b*) urea ?

5. Explain what you understand by ' wilting coefficient of soil '. In what respects does it differ from the ' hygroscopic coefficient ' ? How are these coefficients determined ?

6. What is ' humus ' ? How is it determined ? Give its properties and explain its importance in soils.

7. What are colloids ? What colloids are present in soils ? From the agricultural point of view how far are they advantageous in soils ? When do they prove to be disadvantageous and why ?

8. Presence of certain salts in soils is considered to be injurious to crops. Name these salts in the order of their harmful character. Discuss the conditions under which salt lands develop.

4. AGRICULTURAL ZOOLOGY

(Tuesday, 4th April. 1 P. M. to 4 P. M.)

Only six questions are to be answered. Question 4 is compulsory.

1. Describe the embryonic development of any insect you have studied.

2. Describe in detail the anatomical changes undergone by a Dipterous larva during metamorphosis.

3. How do you distinguish (*a*) a Trichopterous adult from a moth, (*b*) a tadpole from a fish, (*c*) a round worm from a tapeworm, (*d*) an earthworm from a snake, (*e*) an Anopheles larva from a Culex ?

4. What are the important insect pests of pulses in the Madras Presidency ? Give an account of the methods adopted for their control.

5. Explain the action of the following insecticides :— (*a*) crude oil emulsion, (*b*) Shell tox, (*c*) tobacco decoction, (*d*) pyrethrum powder, (*e*) potassium cyanide.

6. State the nature of the measures now in existence to prevent the introduction of notorious insect pests into India from elsewhere. Discuss the adequacy of these measures.

7. Briefly describe the methods you would employ to eradicate Termites from a garden.

8. Describe the life-history of the pink boll worm, and indicate how the life-history differs from what is obtainable in other parts of the world. What reasons would you adduce for the difference ?

5. AGRICULTURE. I

(Wednesday, 5th April 7 A. M. to 10 A. M.)

Only six questions are to be answered. Question 3 is compulsory.

1. What are the agricultural characteristics of a sandy soil ? How will you rectify its defects ? Explain why certain crops are not grown in them.

2. Enumerate the points that would help you to decide whether a Kangayam calf is fit for stud purposes. How would you feed it during the first year of its growth ? What fees will you charge per service if the cost of its rearing and maintenance is to be covered by the service fees ?

3. A farmer who has no experience of mhote working asks you to help him in the erection of a single mhote. Describe to him, giving suitable sketches wherever necessary, the method of erection, the nature of material used, the points he should be careful about, and the probable cost of each item of work.

4. Compare and contrast the work done by a country plough, a drill without the sowing arrangement, a Junior hoe, and an H. M. Guntaka. State under what conditions you will use them on black cotton soils.

5. Arrange the following crops in a rotation for garden lands, stating the months when they will be on the field:—chinnamanjal cholam, panivaragu, Cambodia cotton, tobacco, ragi, periamanjal cholam for fodder.

State under what conditions a farmer will be forced to deviate from the normal rotation practised in a tract.

6. Describe the methods which a farmer should adopt if he is to secure the maximum benefit of the rainfall of the tract.

7. Classify agriculturally the important weeds growing on the Central Farm. Describe the means you would adopt to control their spread, taking a good example from each class of weed.

8 A field is found to take an unusually long time to get to a ploughable condition after the rains. When it dries, it becomes very hard. What measures would you take to bring it to good heart? Estimate the cost of such measures per acre of this land.

6. AGRICULTRE. II

Including Animal Hygiene

(Wednesday, 5th April. 1 P. M. to 4 P. M.)

Only six *questions are to be answered. Questions 1 and 2 are compulsory.*

1. Describe with the aid of a diagram the anatomy of the heart of the ox.

2. Describe foot-and-mouth disease as regards aetiology, mode of infection, animals susceptible, and symptoms. What measures would you adopt in dealing with an outbreak of the disease in a farm?

3. Describe the methods of immunization adopted in respect of any *two* of the following:—(*a*) rinderpest, (*b*) black-quarter, (*c*) haemorrhagic septicaemia. Explain the principles underlying the methods.

4. Detail with reasons the principles you would observe in the construction of a cattle shed to accommodate twenty cows.

5. Give the actions, uses, and doses of the following drugs in cattle:—(*a*) magnesium sulphate, (*b*) carbolic acid, (*c*) copper sulphate.

6. Describe how you would treat the following:—(*a*) red water, (*b*) sheep-pox, (*c*) dysentery.

7. Name any *two* common internal parasites affecting cattle. Describe them and state the symptoms they produce in cattle and the treatment you would adopt.

8. What are the signs of pregnancy in a cow? Explain how you would take care of her before and after parturition.

PART II.

1. AGRICULTURAL BOTANY. I.

(Friday, 7th April. 7 A.M. to 10 A.M.)

Only Five questions are to be answered.

1. Give an account of *two* of the Phanerogamous parasites you know, indicating the adaptations to their parasitic mode of life. Briefly describe how these parasites can be kept under control.

2. Describe the morphological and structural adaptations seen in plants growing under aquatic and xerophytic conditions, giving suitable examples

3. In what respect does a 'moss plant' differ from a fern in its life-history? Illustrate your answer with suitable sketches.

4 How do fungus diseases of crop plants get spread from one country to another? Describe the methods adopted to prevent such spread.

5. Give an account of the life-history of any *one* of the important fungus diseases of the palms of economic importance in South India. How is it kept under check?

6. Describe the symptoms of the Blast disease of Paddy (*Piricularia oryzae*). What measures can be taken to minimize the loss due to this disease?

7. Discuss the methods you would adopt with your knowledge of Agricultural Botany in improving the sugar-cane crop of this Presidency.

2. AGRICULTURAL BOTANY, II.

(Friday, 7th April. 1 P.M. to 4 P.M.)

Only Five questions are to be answered. Question 4 is compulsory.

1. Draw up a key for the identification by means of stem and foliage characters only of the various leguminosae grown as green manure crops in the Madras Presidency.

2. Give a botanical account of samai (*Panicum miliare*) with special reference to its habit, root system, structure of inflorescence and flower, and state how it differs from the other panicums of agricultural importance.

3. Describe the structure of the flower and fruit, with an account of the pollination methods, of cotton, sunnhemp, panivaragu, and castor.

4. Explain the theoretical results which would be obtained from a cross between two pure line parents involving two pairs of characters both of which exhibit simple dominance. What would be the value to the plant breeder of a cross between any of the resulting forms and the 'pure recessive'

5. (*a*) Explain the following terms:—pure line, mutation, linkage, and homozygous.

(*b*) Give a short account of reduction division of the nucleus and its bearing on heredity.

6. Describe the morphological and physiological changes which take place in (*a*) beans, and (*b*) castor seed during the process of germination. Describe tests or experiments which you would perform in support of your statements.

7. What do you understand by vegetative propagation? Give examples of farm crops reproduced in this way and discuss the methods of crop improvement adopted in these cases.

3. AGRICULTURAL CHEMISTRY, I

(Saturday, 8th April. 7. A. M. to 10 A. M.)

Only five *questions are to be answered.*

1. Define the term 'digestive coefficient'. What is the exact significance of the term in animal nutrition? How is it determined for a given food?

2. Two samples of groundnut cake are available on the market; their analysis and prices are given below. Which of them would you select as a concentrate for your cattle, and why?

	Sample A.	*Sample B.*
Protein	51·7%	12·5%
Oil	5·3%	9·2%
Acid value of oil as milligrams KOH	71·0	126·0
Price per ton	Rs. 100/-	Rs. 87/-

3. Give experimental details and rationale of the method for the estimation of crude fibre in a food stuff. How is crude fibre important to a farm animal?

4. Give a brief account of the changes food protein undergoes in the animal system.

5. What are 'feeding standards'? What are the approximate requirements according to well-known standards for (*a*) dairy cows giving 20 lb milk, (*b*) working bullocks, (*c*) one year old calves?

6. What are the chief bacteria which occur in milk, and which make it a source of infection?

7. What are the functions of (*a*) protein, (*b*) fat, and (*c*) mineral matter in the nutrition of farm animals?

4. AGRICULTURAL CHEMISTRY, II.

(Saturday, 8th April. 1 P.M. to 4 P.M.)

Only Five questions are to be answered.

1 What is activated sludge? Explain the process by which it is prepared. How does activated sludge compare with (*a*) farm-yard manure, (*b*) oil-cakes as manure.

2. Compare sulphate of ammonia and nitrate of soda as fertilizers. What is their effect on soils?

3. How is superphosphate prepared? For what crops and for what soils is it useful? What is double superphosphate? Give the approximate percentage of soluble phosphoric acid in superphosphate and double superphosphate.

4. (*a*) State the chemical changes which take place during the assimilation of carbon by plants.

(*b*) How do non-chlorophyll plants obtain their supply of energy?

5. (*a*) What important differences are there in the composition of cereal grains and pulse grains?

(*b*) How is starch prepared from rice on a large scale? Give the important commercial uses of starch.

6. (*a*) What is the percentage of sucrose and glucose in the juice of well-ripened sugar-cane? What is the effect of lodging on the composition of the cane?

(*b*) Give the tests by which you would judge whether the sugar-cane is ready for harvest.

7. What are enzymes? What are their functions? How are they extracted and preserved? How are they named? Mention any *two* enzymes from plant bodies and any *two* from animal bodies, stating their function.

5. AGRICULTURE, I.

)nday, 10th April., 7 A.M. to 10 A.M.)

(*Only Five questions are to be answered*).

1. Give the composition of good farm-yard manure. Out of the list of fertilizers given below select the cheapest and make up a mixture to give the N, P_2O_5, and K_2O equivalent of 10,000 lb. farm-yard manure.

Sulphate of ammonia	20·5 % N	Rs. 120 per ton.
Calcium cyanamide	19·5 % N	Rs 150 ,,
Superphosphate	18·0 % P_2O_5	Rs. 110 ,,
Concentrated superphosphate	42·0 % P_2O_5	Rs. 150 ,,
Muriate of potash	50·0 % K_2O	Rs. 115 ,,
Sulphate of potash	48·0 % K_2O	Rs. 145 ,,

2. Describe the usual method of raising and curing a crop of chewing tobacco in Coimbatore. Detail the production expenditure per acre and show the probable profit.

3. What methods would you follow and what practices would you observe in the production of clean milk (cows') of high fat content?

4. Discuss the advantages and disadvantages to the landowner and tenant of a produce rent system as against a cash rent system.

5. Describe the most suitable type of silo for South Indian conditions. How would you fill it with a crop of fodder cholam and what precautions would you take?

6. State the method you would adopt to renovate a ten-year-old pasture of *kolukattai* grass and detail the cost.

7. Explain the following terms and briefly indicate their importance in agriculture :—

(*a*) Law of diminishing returns. (*b*) Satiability. (*c*) Insurance. (*d*) Maintenance farming. (*e*) Dual-purpose cattle.

6. AGRICULTURE, II

(Monday, 10th April. 1 P. M. to 4 P. M.)

(Only five questions are to be answered.)

1. Comment on the variations in the following agricultural practices :—

(*a*) A black-soil ryot of Bellary cleans his field of hariyali with a guddali, while his Coimbatore brother digs it out with a crowbar.

(*b*) Cotton is drilled in the Ceded districts, but it is broadcasted in Tinnevelly.

(*c*) The sizes of paddy fields and bunds in Coimbatore district are different from those observed in the Tanjore district.

(*d*) Cholam sowing preceeds cotton in Tinnevelly, while it follows cotton in Bellary district.

(*e*) A South-Arcot farmer lifts his water with a circular mhote, while in Coimbatore it is done with a single mhote and in Bellary with a double mhote.

2. What do you understand by the term 'standard deviation'? The following are the recorded yields of three strains under comparative trials :—

A	B	C
10·5	9·0	12·4
8·6	10·2	11·5
10·2	8·7	11·8
10·4	10·8	10·7
9·8	11·3	10·2
11·2	10·6	9·9

Determine the highest yielder, and state if it is significantly superior to the other two.

3. The two important features in the agricultural situation of to-day are comparatively high wages of labour and low prices of agricultural produce. Discuss briefly how you will make the cultivation on wet, garden, and dry lands pay in these circumstances.

4. Discuss the factors that determine the spacing given to crops. Illustrate each of them with a practice obtaining in this presidency.

5. There are 150 buffaloes and 60 cows in the village of Vellaikinar Of these two-thirds are always in milk, and 120 persons are engaged daily in vending dairy products of this village at Coimbatore. State how you will organize and equip them so as to get more profit. Prepare a balance sheet for the first half-year.

6. Outline the steps you would take to obtain the maximum yield in a crop of Cambodia cotton. Make out an estimate for producing one pothi of kapas.

7. Under what conditions will you include market gardening in arable farming? State how this inclusion will affect your general farming.

7. AGRICULTURAL ESSAY

(Tuesday, 11th April. 7 A.M. to 10 A.M.)

Either. Discuss the organization of the production and marketing of grain grown on half a million acres of new grain-producing land recently settled by good farmers lacking in working capital. No rotation crops should be introduced.

Or. Discuss the effects of adulteration and mixing up of agricultural produce on the income derived by the farmer, and suggest measures by which the situation may be improved.

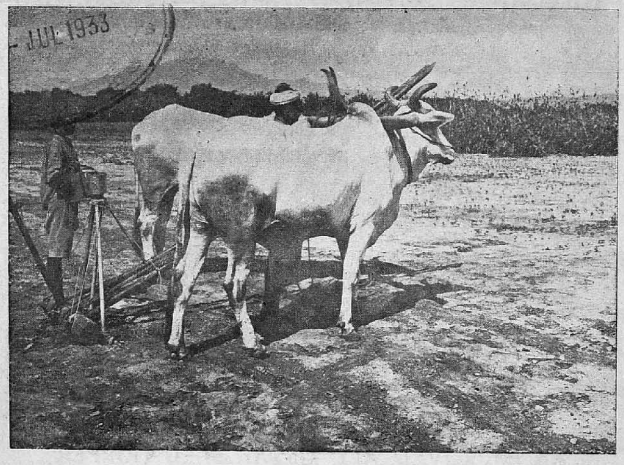

PLATE I. The drill with the hopper at work.

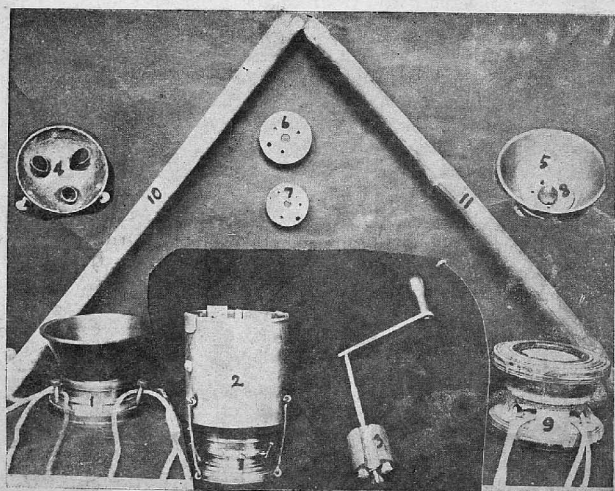

PLATE II. PARTS OF THE ALL METAL SEED-HOPPER

1. Brass hopper; 2. Seed box; 3. The stirrer; 4. Bottom half of the hopper showing the 3 projections; 5. Top half of the hopper showing how the disc (8) is screwed on; 6, 7. Discs 9. Wooden hopper showing the side holes for the ropes; 10. Tin tube; 11. Bamboo tube.