The Madras Agricultural Journal.

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

Vol. XXVI.] OCTOBER 1938 [No. 10.

EDITORIAL

Agricultural Education. A drive for the agricultural education of the masses is long overdue; and it is time to tackle this question seriously. Agricultural education and propaganda must go hand in hand. At present the work of the propaganda staff is seriously handicapped for want of agricultural education in the masses.

In most of the agricultural countries agricultural education is imparted in both general and vocational schools; in the former, agriculture forms one of the many courses of instruction, and in the latter, it is the major subject of study.

In U. S. A., twenty-eight states have prescribed by legislation, the instruction of simple agriculture in rural elementary schools. Children six to eight years old, are taught to observe wild and cultivated plants, trees, insects and animals in their natural environment at home and near the school; they grow some of the common vegetables and flowers in the school garden. Nine to eleven year old children are instructed to record weather, and observe soils, plants, insects and animals in the environment of the school district and its vicinity; they compare habits of plants and animals in order to become familiar with their different modes of living, their struggle for existence and their uses to man; in the school and home gardens they grow typical economic plants of the region and give some attention to different varieties and the relation of crops to different conditions of soil, weather and treatment. Real agricultural instruction is, however, intended for 12 to 14 year old children who are required to develop powers of observation, comparison and judgment. They grow different crops in home gardens and are encouraged to rear poultry and farm animals at home and to maintain accounts of labour, fertilizers, feeds, gross and net returns etc. They also experiment on different methods of planting, cultivation, harvest and preparation for the market. The instruction is supplemented with the aid of text books on elementary education and visits to typical farms.

In Mexico, the agricultural school represents the primary school in the rural districts. In these schools particular attention is given to agricultural activities which are of an every day local character. The primary and agricultural schools,—15,000 in number—impart elementary instruction in agriculture. The courses which last for four years include agriculture, animal husbandry and agricultural industries.

In Germany the primary rural schools are required to keep in contact with farmers and to be adapted to the particular character of the district in which the school is situated. In Hungary, teaching of elementary agriculture is compulsory in primary schools. This instruction requires two hours per week; and the pupils are 9 to 12 years old. Simple agricultural instruction in rural elementary schools is compulsory in Belgium, Greece, Turkey, Germany, Hungary, Mexico and parts of U. S. A. In Italy gardening practice is compulsory. In many of the elementary schools in Japan, agriculture is taught. Instruction in Agriculture is given in some of the elementary schools in Scotland and Albania.

To extend and intensify the knowledge acquired in ordinary primary schools, complementary schools exist in Germany, Hungary and Bulgaria. In these schools much emphasis is laid on agriculture. In a majority of the Provinces in Germany, the attendance at these schools is compulsory for all young persons between 14 to 18 years of age. Secondary agricultural instruction is available in many of the secondary schools in western countries. In U. S. A., in 4,260 secondary schools, agricultural instruction is given to over 153,000 students. In Hungary teaching of agriculture in lower secondary schools is compulsory.

Apart from the agricultural courses in general schools, there are special vocational schools for agriculture in most of the European and American countries. In Germany there were 657 elementary agricultural schools in 1928, giving two year courses in agriculture to boys about thirteen and preferably having farm experience of at least a year. Such elementary schools are found in Greece, Belgium, Latavia and Mexico.

In most of the countries there are secondary schools of agriculture, but their number is always restricted on account of high cost. In these schools 14 to 16 year old boys are taken and in some countries pupils are required to undergo two years farm work before they join the school. The course generally extends to two to three years.

The organization for education of adults consists of (a) regular adult schools, and (b) itinerant schools. In Italy there are 1,500 rural adult schools which teach agriculture to men over 14 years of age. Such schools are also met with in Bulgaria, Belgium and France. The adult schools are held in the off-season or off-time, i.e., in winter during holidays or in the evenings. In Belgium 500 evening schools impart agricultural education, two or three times a week amounting to 100 hours per annum. In U. S. A. evening classes are held in secondary schools, and about 76,000 adults receive instruction during the year. Besides the above mentioned adult and itinerant schools, special schools dealing with particular branches, such as dairying, horticulture, bee-keeping etc., exist in practically every country.

Itinerant or migratory schools consist of one or more teachers, and the duration of the course ranges from one week to four months, the average being somewhere near a month. The classes are held by the propaganda

officers, in the rural schools or in other public buildings. In some countries itinerant teachers impart instruction to the adults only, while in others, courses are given in elementary schools as well. In Italy, 3,415 itinerant courses were attended by 1,41,273 persons in 1934—35. The general courses last for 30 days and the specialised courses last for 8 to 15 days. The lessons are given in the country and the pupils join in the practical work which completes the course. The general course takes place in winter and as a rule during the evening hours when pupils are free after the day's work. In Hungary about 2,000 courses of six to thirty lectures are organized and the attendance exceed 300,000. In England, migratory dairy schools give courses for ten to fifteen days. In Russia, itinerant teachers have done considerable work towards the improvement of animal husbandry. In U. S. A. such instruction usually comprises sixteen weekly lectures of two hours each. Itinerant schools are provided in Belgium, Ireland and Spain also.

In Madras not more than 400 students receive instruction in agriculture. Finance stands in the way of opening more agriculture schools. The solution of the problem therefore lies in the introduction of agriculture as a compulsory subject in the fourth and fifth standards of rural elementary schools and in the lower secondary classes. The only way of quickly educating a large number of pupils in agriculture is to introduce it in 45,000 rural elementary schools of the Presidency where over 2·4 million pupils receive instruction. The middle and high schools are attended by only 73,000 pupils. Moreover proportionately a large percentage of elementary grade pupils return to agricultural vocations, than the high school students. There is no reason to think that an average ten year old Indian boy is less intelligent than his compeer across the seas.

Suitable courses for the elementary schools can be drawn up by the Agricultural Department, and necessary literature for the benefit of the teachers can be written up. For training teachers, classes can be held during the vacations in each of the taluks. The cost of deputing teachers would not be great; and little extra expenditure would be required for the introduction of agriculture in the elementary school curriculum. We are aware of the difficulties to be faced in providing school gardens but if the principle is recognised, gradually many of the schools can be provided with the gardens and till then the fields of the pupils' parents must remain the centres of agricultural activities.

For the benefit of the adults, evening classes can be arranged in rural schools and public buildings, and itinerant courses of instruction can be prepared. It may also be worthwhile to arrange agricultural tours for intelligent farmers so that they can observe new forms of cultivation and pick up new ideas.

A METRICAL STUDY IN SETARIA ITALICA (BEAUV)—THE ITALIAN MILLET

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Varieties of Italian millet are distinguished by diverse qualities such as the colour of the grain, the pigment of the plant body or the bristle, and equally well by certain metric properties like the number of tillers, the dimension of the earhead or the size of the grain. These quantitative factors are liable to great fluctuations under the influence of the environment and do not possess the constancy of the qualitative characters. Usually the variation in one factor is governed by variations in other factors. The present study is an investigation into the relationship between some salient metrical properties both inter- and intra-varietal.

Material and Method. Forty four pure lines of this millet comprising almost all the possible variation of characters were selected and grown under rainfed condition at the Millets Breeding Station. The experimental plots consisted of about 200 plants each and of these ten plants were selected at random and the following measurements on each plant were made in the laboratory. (1) Total weight of earheads, (2) total number of primary earheads, (3) total number of secondary earheads, (4) height of plant, (5) weight of main earhead, (6) length of main earhead, (7) diameter of main earhead, (8) length of peduncle on the main tiller, (9) weight of dry straw and (10) weight of 500 grains.

The method adopted is the analysis of covariance. The between-variety critical correlation coefficient is ·30 for the level of significance P = ·05 and the within-variety coefficient is ·10.

In the actual computation, accuracy up to the sixth decimal place was maintained. However, in the presentation of the results here, two places were thought sufficient for the discussion.

The inter- and intra-varietal correlation coefficients are presented in Table I and the coefficients of variation in Table II.

Discussion. TOTAL EARHEAD YIELD AND RELATED CHARACTERS The total number of tillers bearing earheads and the character of these earheads are the two factors determining the total yield. The varieties under discussion present a wide variation in the total yield. The coefficients of

variation are 31 per cent between varieties and 49 per cent within varieties. The total number of earheads is also a very variable character; 41 per cent is the coefficient of variation between varieties and 46 per cent within varieties.

It is seen from Table I that the correlation between the total yield and the number of earheads is ·58 between varieties and ·79 within varieties. When considering plants in a variety, the total number of earheads as a criterion for yield proves better than it does when comparing varieties as a whole.

It has already been observed (Rangaswami Ayyangar, 1935) in this breeding station that the earheads of a plant in this millet can be classified into three classes, main, primary and secondary. The main earhead is borne on the stalk arising right from the seed. The primary earheads are those borne on tillers which rise at the soil level along with the primordial tiller, and the secondary heads are those borne on tillers which shoot up from any of the primary or the main tiller. The main, primary and secondary earheads are in descending order of grain yield and they constitute three distinct classes. The coefficient of variation in the total number of primary earheads is 52 per cent between varieties and 57 per cent within varieties. The corresponding figures for secondary earheads are 66 per cent and 76 per cent. These are the most variable of all the characters considered. The inter-varietal correlation between the number of primary earheads and the total yield is ·43, whereas that between the number of secondary earheads, and the total yield is 61. (Table 1). Between varieties the number of primary earheads is correlated with the secondary earheads the correlation being ·66 (Table I).

The partial correlation between the total yield and the number of secondary earheads with the number of primary earheads eliminated is ·49 between varieties, and the partial correlation between the total yield and the number of primary earheads with the number of secondary earheads eliminated is ·01. The multiple correlation between the total yield and the number of primary and secondary earheads is ·61, an increase over the total correlation ·61 was detected only in the higher decimal places. So the linear regression of yield over these two variates is of no use.

The inter-varietal correlation between the number of primary earheads and the total yield is ·70 and that between the number of secondary earheads and the total yield is 63 (Table I). An increase in the number of primary earheads is not necessarily followed by an increase in the secondary earheads; the correlation is low being ·30 (Table I). The partial correlation between the total yield and the number of primary earheads with the number of secondary earheads eliminated is ·68, and the partial correlation between the total yield and the number of secondary earheads with the number of primary earheads eliminated is ·61. The multiple correlation between the total yield and the two factors namely, the number of primary and secondary earheads is ·82. The resolving of the number of earheads into two classes is not necessary in estimating the yield.

So far, the number of earheads and its classification was considered as one aspect of the total yield. The other factor namely, the average yield per head may be considered now. It is found that the main earhead is a very good index to the average type of earhead, especially it is so between varieties ; the correlation between the main earhead yield and the average earhead yield is ·86, and within a variety the correlation is ·55 (Table I).

The inter-varietal correlation between total yield and the main earhead yield is ·21 which is not significant, and the intra-varietal correlation is ·51 (Table i). The main earhead in itself gives no clue to the total yield in the comparison of varieties. But in conjunction with a knowledge of the total number of earheads, it becomes effective. The multiple correlation between yield and the total number of earheads and the main earhead yield is ·85 between varieties, and ·83 within varieties. Considering the product *total number of earheads* × *main earhead yield* as a single variate, the correlation between this and the total yield is ·86 between varieties, and ·85 within varieties (Table I). Though this does not improve the multiple correlation obtained by treating the two variates linearly, there is a practical significance in this deliberately introduced variate. The rule will be if required to estimate the yielding capacities of several varieties, to consider the products of the number of earheads and the main earhead yield.

The properties of this main earhead will be discussed in the sequel.

The straw weight in this study includes the leaves and the stems and is a measure of the vegetative activity. The total yield is correlated with straw. Between varieties $r = ·57$ and within varieties $r = ·82$ (Table i).

In this study the height of a plant is measured on the main tiller from the soil level to the tip of the earhead. Compared with other metrical factors, height is the least variable, the coefficient of variation being only 9 per cent between varieties and 7 per cent within a variety. The height of a plant needs no consideration in the estimation of total yield; the correlation between varieties is ·16 and within varieties ·25 (Table I).

The weight per grain is an essential factor in the determination of yield. The total number of grains for a whole plant is the resultant of the total number of earheads and the average number of grains is an earhead. In this study, 500 grains from the main earheads of a variety were picked at random and weighed. It was found that this factor varies but slightly in the varieties, the coefficient of variation being only 11 per cent. The varieties which yield high tend to have heavy grains; the correlation between these two factors is ·39 which is significant.

Main earhead and related characters. The first thing that strikes an observer in the Italian millet is the main earhead. It rises prominently above the other earheads before it droops by its own weight to be waving in the breeze. It typifies the other earheads in shape. As already pointed out, it characterises in its grain content the hypothetical average earhead (Table I). Its coefficient of vartation is 32 per cent between varieties and 23 per cent within varieties.

It is a curious fact that more the tillers a variety produces, the smaller is the yield from the main earhead. The inter-varietal correlation between the main earhead yield and the total number of earhead is −·55. (Table I). But contrary is the behaviour of a plant within a variety. The intra-varietal correlation between the number of earheads and the main earhead yield is ·33 which is significant (Table I). The causes that bring about the reciprocal adjustment in the number of tillers and the main earhead yield between different varieties seem to be different from those operating in the fluctuation of these characters within a variety.

The yield of the main earhead is to a great extent determined by its length and diameter, the dimensions which approximately decide the size. It is the maximum diameter that is considered here. Varieties of this millet vary in their earhead length and diameter, the coefficients of variation between varieties being 15 and 19 per cent respectively. Within a variety the fluctuation is restricted ; the coefficient of variation is 10 per cent for length and 11 per cent for diameter.

The inter-varietal correlation between the main earhead length and yield is ·53 and between the diameter and yield it is ·49 (Table I). The corresponding intravarietal correlations are ·64 and ·63.

The inter-varietal correlation between the number of earheads and the main earhead length and diameter are negative end significant, but the corresponding intra-varietal correlations are all positive and significant (Table I).

The main earhead length and diameter are themselves correlated, the correlation being ·45 between varieties and ·56 within varieties.

The length of the main earhead is partly determined by the height of the culm bearing it. The correlation between height and the main earhead length is ·59 between varieties and ·56 within varieties (Table I). Varieties which are short on the whole possess short earheads.

The height of the plant influences the yield of the main earhead, the inter and intra-varietal correlations being both ·43 and significant (Table I). This effect is through the length of the earhead. The partial correlation between the main earhead yield and height with the factor earhead length eliminated is ·16 between varieties and ·10 within varieties.

Peduncle is the last internode and its length is measured from the last node to the base of the earhead. The peduncle of the main tiller, like its height, varies but little. The coefficient of variation between varieties is 12 per cent and within varieties 16 per cent. Both between varieties and within varieties this length has no influence on the main earhead (Table I), and it need not be considered when looking for a good type of earhead.

The main earhead yield is determined by the total number of grains and the weight per grain. The yield is found to be closely related to the total number of grains, the correlation between the two factors being ·79.

The variation in the main earhead yield is not influenced by the variation of the weight per grain, the correlation between these two factors is ·02.

Straw and related characters. The relationship between straw yield and the total earhead yield has already been discussed. The coefficient of variation between varieties is 29 per cent and within varieties 34 per cent. Straw yield is correlated to the total number of earheads, the between varieties correlation being ·59, and the within varieties coefficient ·78. Within a variety the variation in straw is very closely related to the variation in the number of primary earheads (r= ·89); between varieties, however, the relationship is less manifest (r=·39). Here is another instance of a wide difference between inter- and intra-varietal correlations. Table I shows that the straw yield is also correlated to the number of secondary earheads. Between varieties the partial correlation between straw and number of primary tillers, with the factor secondary tillers eliminated, is ·13, and the partial correlation with the two factors interchanged is ·29. Whereas the partial correlation within varieties between straw and number of primary tillers with the factor the number of secondary tillers eliminated is ·94, and the partial correlation with the factors interchanged is ·80. In fact the total straw weight can be fairly well estimated by a double regression with the number of primary and secondary tillers as the independent variates. The multiple correlation is ·96. Within a variety these two factors suffice to determine the straw yield.

Summary. In 44 different varieties of Italian millet, inter-varietal and intra-varietal correlations and coefficients of variation have been determined. The factors considered are the total earhead yield, number of primary and secondary earheads, height of plant, main earhead yield, and its length and diameter, length of peduncle, weight of dry straw and weight of 500 grains.

The number of secondary earheads and the number of primary earheads are the most variable characters and the least variable are the weight per 500 grains, the height of the plant and the main earhead dimensions.

The product of the total number of earheads and the yield of the main earhead can be relied upon in judging the relative merits of varieties or of a plant within a variety, as the inter-and intra-varietal correlations are above ·8. The resolution of the total number of earheads into primary and secondary categories is without effect in improving the accuracy of the estimation of yield. In the determination of the total yield, straw is a factor to be reckoned with. The height of the plant need not be considered where yield is the concern, both in the comparison of varieties and within a variety. Those varieties which yield well tend to have heavy grains.

The main earhead characterises the hypothetical average earhead in grain content, especially in the comparison of different varieties. The yield and the dimensions of the main earhead are inversely related to the tillering capacity in the inter-varietal comparison. Within a variety, however, the behaviour is contrary; there is a significant positive correlation. The yield is dependent on the dimensions of the earhead which determine to a great extent the total number of grains. The height of the plant influences the main earhead through its length factor.

The production of straw is closely related to the number of tillers, particularly the primary tillers within a variety. The number of secondary and primary tillers almost completely determine the straw intra-varietally.

Literature Cited.

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TABLE I. Correlation Coefficients.

Correlates.	Correlation Coefficients. Between Varieties	Within Varieties
Total earhead yield and number of earheads	·58	·79
,, ,, ,, Number of primary earheads	·43	·70
,, ,, ,, Number of secondary earheads	·61	·63
,, ,, ,, Main earhead yield	·21	·51
,, ,, ,, Main earhead yield × Number of earheads	·86	·85
,, ,, ,, Straw yield	·57	·82
,, ,, ,, Height of plant	·16	·25
Number of primary earheads and Number of secondary earheads	·66	·30
Main earhead yield and Average earhead yield	·86	·55
,, ,, ,, Number of earheads	−·55	·33
,, ,, ,, Number of primary earheads	−·61	·36
,, ,, ,, Number of Secondary earheads	−·41	·25
,, ,, ,, Length of main earhead	·53	·64
,, ,, ,, Diameter of main earhead	·49	·63
,, ,, ,, Height of plant	·59	·56
,, ,, ,, Peduncle length	·08	·14
Main earhead length and Number of earheads	−·45	·35
,, ,, ,, Main earhead diameter	·45	·56
,, ,, ,, Height of plant	·59	·56
Main earhead diameter and Number of earheads	−·54	·23
Straw yield and Number of earhead	·59	·78
,, ,, ,, Number of primary earheads	·39	·89
,, ,, ,, Number of secondary earheads	·46	·62
Level of significance P=·05	·30	·10

TABLE II. Coefficients of Variation.

Factors	Coefficients of Variation Between Varieties	Within Varieties
	%	%
Total earhead yield	31	49
Number of earheads	41	46
Number of primary earheads	52	57
Number of secondary earheads	66	76
Height of plant	9	7
Main earhead yield	32	23
Length of main earhead	15	10
Diameter of main earhead	19	11
Length of peduncle	12	16
Weight of dry straw	29	34
Weight of 500 grains	11	–

ELECTROCULTURAL METHODS PRACTISED IN PARTS OF NORTHERN INDIA

By V. RAMANATHA AYYAR.

In last May I was deputed by the Government of Madras to study electro-cultural methods introduced by Dr. S. S. Nehru in Mainpuri, United Provinces, and by Col. Noel in Peshawar, North West Provinces, and report on the results.

It may be of interest to know that Dr. Nehru is a civilian officer working in the United Provinces, who had a brilliant educational career. After taking the B. A. and B. Sc. degrees at Allahabad at the early age of 16, he went to Cambridge, took two honours degrees and passed the I. C. S. examination. He then took his Ph. D. degree at Heidelberg University in Germany. He was for some time Professor of Physics, when he did some research work in aerodynamical problems. He presided over the Agricultural Section of the Indian Science Congress in 1934. He is a great enthusiast taking great interest at first in the introduction and spread of boorm corn and later on in electro farming. He has published a number of books and pamphlets on his new hobby.

Description of Methods. The treatments recommended by Dr. Nehru for the improvement of crops may be grouped under three heads :— (a) sparking (b) jacketing and (c) utilisation of what are called ' mitogenetic rays '.

(a) *Sparking.* This is done by connecting one end of an electric cable to an old magneto of a motor car, and the other terminal to the material or body to be energised, and then rotating the handle of the magneto from half to one minute, so that the current may pass direct into the body. When materials like seeds, straw etc., are to be sparked they are spread thinly over a wire gauze placed on insulated stands, and the loose end of the electric wire is connected to the gauze and the current passed Very often water is used for the transmission of energy. In those cases the loose end of the coil is dipped in the water and the handle of the magneto turned for half a minute. When water for irrigation is to be charged, the loose terminal from the magneto is inserted in the middle of the water inlet of the field and the magneto worked till the irrigation is completed. Electrically charged water is generally called ' sparked ' water. When sparked water is applied from a height so as to form a thin film or spray over various limbs of a tree or plant the process is spoken as ' Agaskarisation ' named after Mr. Agaskar, the originator of the idea.

(b) *Jacketing* is the name given to the operation of covering a portion —generally the basal region—of trees and plants with ordinary wire netting used for poultry enclosures. It is said that galvanised iron netting of $\frac{1}{2}$ to 2" mesh is very efficient for the purpose ; a band of mesh 9 to 12 inches in width is cut out and wrapped closely round the base of trunks of trees such that two to three inches of this width are buried underground. When trees

increase in girth, the jacket is loosened and a suitable length of netting added. Sometimes the base of the branches is covered when it goes by the name of "Aproning" or "Collaring". Rarely the stalks of flowers and fruits are also wrapped with small strips of the netting.

(c) *Mito-genetic rays.* These are also referred to as M.rays or Gurwitsch rays. These rays are said to stimulate growth. Roots of onion, damaged leptome bundles of potatoes, cotyledons of sunflower, mash of yellow beet, and pulp of *Sedum maximum* are reported in literature to emit these rays. To utilise their beneficial effects two methods are being employed at Mainpuri. One is to plant onion bulbs around trees; and the other is to pass the irrigation water, prior to letting it into the crop, through a series of furrows having onion plants at the sides. Dr. Misra of Jaunpur is using these rays for the treatment of human patients. He has for this purpose devised what is called "M ray gun". In that apparatus fresh onion seedlings with roots are fixed at one end of a tube while the other end is placed over the area to be treated.

It may be remarked here the last two methods do not literally belong to electric treatments, but Dr. Nehru justifies their inclusion on the ground that jacketing captures electro-magentic energy from air, while onion roots emit M. rays and they thus create a 'field' of energy similar to an 'electric field'.

It may also be said that these methods differ from those used by the previous investigators. They generally drew currents for their experiments from charged net work suspended over the crop or from the differences present in the atmospheric potential gradients. Some grew plants in iron cages devised to destroy the electrical field present in the air, while others applied currents directly to the soil by burying electrodes. Dr. Nehru himself had tried, prior to the evolution of the simple technique now recommended, cumbrous and expensive apparatus like soil ticklers, induction coil, dynamos, radio magnetic cradle, apparatus for x rays, violet rays and ultra violet rays.

Their Application and Effects. These methods are applied by Dr. Nehru and his collaborators either singly or in combination to plants, animals and human beings. Special electrotherapy has been developed for each group and a set of recipes have been formulated. A few of these together with their effects are set out in statement I.

Dr. Nehru has included all these methods in the programme of rural uplift work that is being done in Mainpuri district. Members of Fruit Growers' Association, Mainpuri of which Dr. Nehru had been the President and guide, adopt them in the various centres in the district. The results obtained by them are being recorded in the various bulletins and in the journal "Gram Sudar" published by the above association. It is learnt that as the result of electro-farming many of them were able to carry away a number of prizes in many of the exhibitions, and that, the methods are being practised by a few in Ceylon, Malaya, Central America U. S. A., Germany and Sicily with great success and enthusiasm.

STATEMENT I

Mode of application.	*Effects claimed.*
I(a). Annual crops.	
(a) Sparking the dry seed.	(1) Better and earlier germination of seeds. Seeds that are difficult to germinate sprout quickly.
(b) Soaking the seed in sparked water before sowing.	(2) More tillering in canes.
(c) Irrigating the crop with sparked water.	(3) Less of insect damage.
(d) Irrigating with onionised water.	(4) Less consumption of irrigation water.
(e) Raising the nursery on a sparked seed bed.	(5) Profuse production of flowers and fruits.
(f) Wrapping fruit stalks with a small piece of wire netting.	(6) Reduction in alkalinity.
(g) Holding wire netting just touching the top of plants infested with insects and passing the current through the wires.	(7) Growing crops out of season.
	(8) Insects killed or stunned.
I(b). Perennial crops.	
(a) Jacketing at the base of trunks and aproning the branches.	(1) Dying and sickly trees rejuvenated and revived.
(b) Sparking the jackets.	(2) Non-bearing trees stimulated to fruiting.
(c) Irrigating with sparked water.	(3) Production of more fruits.
(d) Agaskarisation.	(4) The size of fruits increased.
(e) Planting onions around.	(5) Trees raised on alkaline lands stimulated to grow and bear fruits.
(f) Planting of mango near dhak, citrus near mango trees.	
II. Animals.	
(a) Sparking the feed.	(1) In the case of buffaloes more milk and better butter are produced.
(b) Soaking the feed in sparked water.	(2) The animals are made more energetic.
(c) Using sparked water for drink.	(3) In the case of poultry, the hatchability is increased; the eggs are bigger.
(d) Activation of thyroid glands by sparking.	(4) Pullets reared on electrically treated feed grow more rapidly.
(e) Sparking the affected regions and massaging.	(5) Wounds are healed very quickly.
(f) Washing the wounds with sparked water.	(6) In the case of pigs, hairs grow quicker and longer.
III. Human beings.	
(a) Drinking sparked water.	(1) Pain in the affected parts is reduced.
(b) Sparking the affected regions.	
(c) Washing the sores with electrified water.	(2) Inflammations subside.
(d) Activating the glands by sparking them.	(3) Fever, partial paralysis are cured.
(e) Application of M. ray gun.	(4) Wounds are healed quickly.
(f) Disinfecting well water periodically by sparking.	(5) Stomach troubles are got rid of.
(g) Wearing of a necklace made of 1 to 4 strands of iron wire.	(6) Sleep is increased.

My Observations. I may be permitted to state here that my visit to Mainpuri happened at a time when there was practically no crop on the ground. My observations were therefore limited to the following

Wheat seedlings and straw-berries raised in pots; sugarcane, colocasia, melons, gourds, mango, citrus, pomegranate, papaya, falsa, peaches, and plum trees; treated poultry, buffaloes and human patients.

Mr. Ahmed, Revenue Divisional Officer, Mainpuri was conducting an interesting experiment with treated wheat in pots. He at first had groups of ten seeds sparked and sowed them in two small pots and irrigated one set with sparked and the other with plain water. It was interesting to see the seedlings watered with sparked water greener and healthier than those raised with plain water. Likewise a pot of straw berries raised with sparked water was better than the control at Turnab Farm. At Mangaon a plot of half an acre of sugarcane was raised from setts soaked in sparked water and irrigated with sparked water. In a plot of 10 cents opposite to the above-plot the same variety of cane was irrigated with plain water. On comparing both, the former was greener in appearance, had more tillers and low mortality from shoot borer. At Gorakhpur some setts were soaked in sparked water for 20' and others for 10'. When these were grown side by side, the germination was later in the group treated for a longer time; but the tillers were stouter and more vigorous in growth. A small bed of colocasia irrigated with sparked water appeared greener in Mr. Sadhu Singh's garden than the next bed receiving plain water. At Kishni a plot of gourds watered with electrified water had larger number of flowers, and the fruits that had their fruit stalks jacketted were bigger. Sardar Surjan Singh, Principal, Agricultural School, Gorakhpur reported that ash gourds gave him a second crop of fruits as a result of jacketing. He had, however, a different experience with regard to wheat, peas and grams. In a replicated experiment conducted on plots of 1/8 an acre in size, electrical treatments had not produced any effect. (vide statement II).

STATEMENT II

Name of crop.	Yield per acre.		
	Seed sparked.	Seed soaked in sparked water.	Control.
Wheat	15 maunds	13½ maunds	13½ maunds.
Peas	14½ ,,	14½ ,,	13 ,,
Gram	13·11 ,,	13·50 ,,	13·11 ,,

The farm manager, Mainpuri, informed me of a similar experience on his farm with wheat. I might also mention here that Dr. Nehru supplied me with four samples of cotton kapas, two of which were from plots irrigated with sparked water. When they were examined at Coimbatore by the technological assistant for fibre properties, the results of the duplicates were conflicting with regard to lint length; but in the case of lint and seed weights definite improvements were noticed. Sparking would, however, seem to have had no effect on fibre weight and immaturity of fibres.

STATEMENT III.

Name of cotton.	Seed weight mgm.	Lint weight mgm.	Ginning %	Lint length in. m.m.	Fidre weight - 6 10 gm.	Immaturity %
520 untreated	52·2	32·6	38·4	0·68	2 85	95 – 2
520 treated	66·0	35·8	35·2	0·80	2·52	90 – 3
Comilla untreated	76·4	59·1	43·6	0·79	3·44	98 – 05
Comilla treated	82·5	61·5	42 7	0·75	3·86	98 – 07

At a number of villages like Mangaon, Sujrai, Karhal, Bamrauli, Kusyari and Eka, it was interesting to see sickly and dying mango and citrus trees rejuvenated, and putting forth fresh shoots as a result of jacketing. In some of them the dead cores were yet visible betraying their past history. At Bamrauli, the owner of the orchard narrated to me how he failed previously to get a good stand in his garden on account of alkalinity of the soil and how he succeeded in the last trial with the help of jacketing and application of sparked water. At the time of my visit these young trees were throwing out new shoots. At Labhowa, a Jambulana tree was pointed out to me by the young Zamindar as a specimen which started bearing after the jacketing treatment. Again at Bahraul almost all the mango trees were observed in an orchard to be literally laden with fruits in a season declared bad for fruiting. Such a remarkable condition was ascribed to the electrocultural treatments (jacketing and irrigating with sparked water) practised by the owner. Again in the Raja's garden at Eka two Bael (*Aegle marmelos* Corn) trees growing side by side within a distance of 8′ were shown to me as having been in poor condition about six months back. When one of them was jacketed, it commenced to put forth fresh shoots. At the time of my visit that tree had a fairly good growth of healthy leaves, while the untreated tree was bare with no leaves. At Rodain, a few mango and citrus trees were reported by Mr. Dhar, Superintendent of Hunter's Garden, to retain fruits better as a result of Agaskarisation. It was interesting to see at Naglahar, trees fruiting well on a badly alkaline patch as a result of jacketing. Again at Gorakhpur a number of mango trees were brought to bearing at the instance of Sardar Surjan Singh by covering the base of the trunks with iron wire. Besides a small experiment was conducted in duplicate here by Mr. Singh to determine the optimum size of the wire netting required for jacketing citrus trees. It was stated that he chose the best tree for the control and jacketed neighbouring four trees with 4″, 6″, 9″ and 12″ wide wire netting. At the time of my visit the control was the poorest signifying the effectiveness of jacketing. Amongst the different widths of jackets, 9″ was found to be the best for growth as well as for the total yield. But it was at Turnab farm, that a convincing proof of the usefulness of jacketing was obtained. A series of experiments in replicated plots on peaches and plums were started there, three years ago by Col. Noel and their performances are being carefully recorded by the farm staff. The yields for the past two years were statistically examined. (Vide Statement IV). It is manifest from the analysis of the results that in both years mere jacketing around the base of the trees

has definitely enhanced the yields up to 50%, while jacketing of branches only has failed to induce any appreciable effect.

With regard to the improvement of animals by electroculture, my observations were rather very limited. At Sikandarpur, a poultry man showed me two eggs, one from a treated and the other from a normal, hen. The former was distinctly bigger which fetched him 20% more money. At Karhal and Bahraul villages two respectable men showed me pullets, bigger in size than the normal due to the feeding on grains soaked in sparked water. I saw at Chandpura a buffalo said to be fed on sparked straw and concentrates. It looked distinctly healthier and bulkier. At Ruppura where most of the residents are employed in selling dairy products at Mainpuri, I learnt that buffaloes increased their milk yield and yielded a better quality of butter when electrified feed was supplied to them. It would appear that a co-operative society was formed at Sirsaganj for the supply of 'Bijili' ghee (Bijili=electricity) to Calcutta market where it actually fetched, it seems, Rs. 2 extra per tin over the ordinary brand. Unfortunately the prime worker in that society died prior to my visit which precluded me from seeing the actual working of the society.

STATEMENT IV.

Yield of peaches on the Turnab Farm.

Treatments.	Field No. 6 A. Plot I.					Field No. 6 A. Plot II.				
		1935–36		1936–37			1935–36		1936–37	
	No. of trees.	Yield per tree in lbs.	Increase over control.	Yield per tree in lbs.	Increase over control.	No. of trees.	Yield per tree in lbs.	Increase over control.	Yield per tree in lbs.	Increase over control.
			%		%			%		%
1. Jacketing trunk	21	192·2	+31·2	203·0	+40·2	28	184·4	+18·3	176·0	+16·1
2. Jacketing trunk and branches	21	176 2	+20·2	184·5	+28·2	28	176·2	+13·2	157·5	+ 3 8
3. Jacketing trunk	21	146·0	- 0·5	157·1	+ 8·4	28	149·1	-4·2	144 4	- 4·6
4. Control	21	146·7		144·8		28	155·8		151·4	
Critical difference (P=0 05)		14 74		26·7						

Yield of plums on the Turnab Farm.

Treatment.	No. of trees.	Yield per tree in lbs.	Increased over control.	Yield per trees lbs.	Increase over control.
			%		%
1. Control (1935)	8	18·4			
2. Jacketed in 1935	8	28·7	+56·1	35·1	+36·0
3. Control (1935 & 1936)				25·8	
4. Jacketed in 1936.	5			34·0	+31·8

N.B. As the experiments on plums were not done on replicated basis and as proper precautions were lacking with regard to outskirts, their yields cannot be analysed statistically.

In the case of human beings, I happened to see a ryot at Kusyari with a scar about 5" long and about 3" wide reported to be healed entirely by the use of sparked water. Sardar Surjan Singh of Gorakpur told me of his personal experience. He had, it seems, a kind of facial paralysis and rheumatic pain in the body which he was able to shake off by sparking the affected portions from a cycle magneto. On the day of my arrival at Mainpuri, Dr. Nehru got a letter from Sri. Rao Bahadur L. Venkatakrishnan, Superintending Engineer, Tanjore, wherein he described how his old father was saved from acute attack of uraemia by electrocultural treatment at a stage when doctors had given him up.

The visits and reports mentioned above, interesting and instructive as they were, made me feel that some of the treatments advocated by Dr. Nehru had certainly something useful behind them; but unfortunately they were being carried out in such a way that it was difficult to form a decisive opinion about their individual performances.

It strikes me that testing them under conditions of normal agricultural experiments would have given them more reliable background. Provision of more controls and maintaining records of their behaviour would have given greater support to the reports made. I, however, could realise the innumerable obstacles that would have stood in their attempting to do so.

With regard to the theory of the reactions noticed,* Dr. Nehru explains that the basic principle in all these experiments is "wherever there is cellular activity electrical energy is developed and conversely wherever electrical energy is applied, cellular activity is increased and better growth is obtained". He considers that by sparking "clogged capillaries become normal and when electrified water is taken in, it is reasonable to expect metabolism to improve, nervous tension to be stabilised, functional equipoise to be regained and in short vital processes to be fastened". He further says that in Agaskarisation "a mild electric field is set up by the sparked water coming in contact with the numerous growing points and as a result cell sap moves more freely". He describes it as 'a reproduction of the natural phenomenon associated with monsoon rains when rain charged clouds are struck by lightning before they burst into showers'. Regarding jacketing very little is known about its mode of action. Dr. Nehru is of opinion that cosmic radio magnetic waves are captured by the wires. In the case of mito-genetic radiation, it is reported to be due to ultra-violet rays of very low intensity emitted by meristematic cells of certain plants. Dr. Nehru is of opinion that when irrigation water is passed through beds growing onions, the water is enriched by the emanations from the onion roots.

My conclusions are that jacketing of trees has some wonderful effects in resuscitating and improving trees, and that sparked water will be useful for the treatment of diseases. But more experiments and observations seem to be necessary before a definite opinion can be offered on the effects of sparking and mitogenetic rays on the improvement of crops.

We are doubtless much indebted to Dr. Nehru for suggesting the method described supra and for bringing the potentialities of electrocultural treatments within the reach of ordinary farmers. He has spent much of his time and money in the midst of arduous duties of a District Magistrate, in devising methods and testing them. The apparatus he now recommends is simple, foolproof and inexpensive. His jacketing idea is original and marvellous. But one only wishes that these experiments have been conducted under more controlled conditions such that greater confidence might be created for saying that the effects will be reproduceable under all conditions. Such a premise is extremely essential especially in a department like ours where a single mistake committed or a single failure experienced as a result of our recommendations will drive away all the confidence and trust reposed on the department by the farmers, and it will take years before the original position is regained. There is also another point to be considered in this connection. In all cases where good results have been achieved, it is certain that the nutrients needed for the extra growth should have come from the soil which in other words will mean that these treatments will result in the exhaustion of the soil. It is necessary to know before we take up the advocacy of the electro cultural treatments, the nature of their after-effects. It will therefore be advisable to test all the methods—barring perhaps jacketing - suggested by Dr. Nehru under more vigorous and controlled conditions and also secure more data on the optimum strength of current needed for each crop, the relative efficacy of different methods, the optimum size of wire netting, the effect of onionised water and on the nature and extent of their after-effects.

Acknowledgements. I cannot adequately express my indebtedness to Dr. S. S Nehru for drawing the programme of my tour, for making arrangements during my visit to different villages and for looking after my needs and comforts during my stay at Mainpuri. I am also thankful to Sardar Surjan Singh Siddu, Principal, Agricultural School, Gorakhpur, Mr. Dhar of Jrawhal Road and Mr. Rajab Ali Khan, Extra Assistant Director of Agriculture, Turnab Farm, Peshawar for taking me round their farms and explaining to me their experiences in electro-farming. Finally I wish to express my gratitude to the Madras Government for giving me an opportunity to get acquainted with this interesting and fascinating subject.

ADDENDUM

Subsequent to the preparation of the above note the following information was supplied by Dr. Nehru.

150′ length of Duranta hedge was irrigated with the sparked water once a week for three weeks in succession. Its Growth was one and half times better than that in another portion of the same hedge which received only plain water.

Onions were planted around 12 peach plants in the Government House at Lucknow. After three months, their growth was one and half

imes more than the normal. Further the onion planting revived two of the plants that were about to die.

In an horticultural garden, 5 six months' old papaya plants were jacketed while another set of five was kept as control. After three months, the jacketed trees showed better growth in the size and number of fruits produced. In most of them the fruits were one and half times bigger than in the untreated.

Col. Noel made an experiment of growing wheat in ordinary flower plots as well as in pots made of expanded metal. Both lots were placed on a bed of sand so as to equalise conditions of drainage and evaporation. Wheat grown in pots of expanded metal gave thrice as much yield as in ordinary mud pots. The same experiment was repeated with maize and there too, the cobs produced in the metal pots were twice as big as in the earthenware pots. Again jacketing of trees in Turnab farm had given 30% more yield for the third year in succession.

MANUFACTURE OF SYNTHETIC NITROGENOUS FERTILIZERS IN INDIA

Part II. Comparison of different Processes for the Fixation of Atmospheric Nitrogen.

By C. N. ACHARYA, M. Sc., Ph. D., A. I. C., F. A. Sc.

The three important methods for the fixation of atmospheric nitrogen are, in historical sequence, the arc, cyanamide and the synthetic ammonia processes, though other methods such as the nitride and the cyanide processes have been put forward from time to time. In discussing the relative advantages of these methods we must have certain criteria of judgment, e. g., the capital outlay, running expenses, availability of raw products in the vicinity of the factory and the suitability of the products to the local market.

The arc process requires a much larger outlay and consumes a much greater amount of electricity per unit of nitrogen fixed than the cyanamide and syntheiic ammonia methods. Hence it has been adopted only in countries where electric power is abundant and very cheap, e. g , in Norway, Sweden, Canada, etc. Even these countries have now given up the method in favour of the synthetic ammonia process, which is much cheaper.

Power Requirements of Nitrogen Fixation Processes.

(Partington and Parker)

Fixation Process.	K. w. hrs. per K. gm. N fixed.	K. w. yrs. (8760 hrs.) per metric ton of N fixed	H. P. yrs. per long Ton of N fixed.
Arc (exclusive of steam raising value of furnace gas) ...	73·7	8·41	11·45
Cyanamide	16·5 to 19·5	2·03 to 2·37	2·76 to 3·23
Haber (Assuming power supplied electrically)	3·6	0·435	0·592

The Cyanamide process was much in favour in the years preceding the War, but even that method is now giving place to synthetic ammonia processes. The disadvantages of the cyanamide method are the purity of lime and coke required in preparing carbide, the various draw-backs accompanying the use of cyanamide as a fertilizer, which will be dealt with in detail later, and the market partiality for Ammoniacal fertilisers which has necessitated the conversion of cyanamide into ammonia. Ammonia so prepared, is naturally costlier than that obtained by synthetic methods.

The synthetic ammonia processes are the ones generally adopted now, and from the figures given in the following Table, it will be evident that they are now supplying nearly 80% of the nitrogenous fertilizers placed on the market. In addition to lower capital outlay, the synthetic methods yield directly ammonia which can be converted into a number of marketable derivatives (e g. urea) and can also be easily oxidized to nitric acid without much cost.

World Production of Nitrogen Compounds in Metric tons of Nitrogen.

(From the Report of the British Sulphate of Ammonia Federation Ltd.)[*]

	1932—33	1933—34	1934—35	1535—36
Total World Production	1,677,000	1,792,000	2,070,000	2,378,000
Sulphate of ammonia				
Synthetic	560,000	535,000	533,000	630,000
By-product	258,000	307,000	321,000	365,000
Other forms of synthetic nitrogen e.g. liquid ammonia nitrochalk, Calnitro. urea etc.	462,000	516,000	607,000	720,000
Cyanamide	168,000	195,000	232,000	270,000
Nitrate of lime	118,000	107,000	153,000	156,000
Other forms of by-product nitrogen	40,000	48,000	45,000	45,000
Chilean Nitrate	71,000	84,000	179,000	192,000
Total world consumption	1,747,000	1,878,000	2,071,000	2,400,000
Agricultural consumption	1,586,000	1,673,000	1,812,000	2,068,000

Note:— For the year 1935—36, the synthetic nitrogen products were 75·1%, the by-product nitrogen compounds 17·3% and Chilean nitrate 7·6% of the total world production, based on the nitrogen content.

Below will be found some remarks on the economics and working of the three major processes, viz., (a) arc, (b) Cyanamide and (c) synthetic ammonia. For a historical review and technical working of the processes, reference may be made to text-books on the subject, a list of which is appended hereto. The following remarks presuppose a knowledge of the general working of the processes.

I. Arc Process for Nitrogen Fixation. There are different modifications of the Process, such as those of Birkeland and Eyde, Schoenherr, Pauling etc., depending mainly on the shape of the electric arc and on the type of furnace used. The principle adopted is the combination of nitrogen and oxygen of the air at about 3000 C in the electric arc, to form oxides of nitrogen, which are rapidly removed, further oxidized and condensed in

water to form nitric acid. Large installations were started in the beginning of this century at Rjukan and Notodden in Norway, consuming about 320,000 H. P. and fixing about 38,000 tons of nitrogen per year.

The method has got the advantage of simplicity, but the consumption of current is something very lavish. It yields nitric acid directly and, as such, will prove useful in times of war and for the preparation of munitions. In times of peace, calcium nitrate is manufactured and sold as fertilizer. But this salt is deliquiscent and has to be further treated to remove this feature. Where considerations of cost of current and interest on outlay do not enter, the method can be recommended. It is estimated that through the lightning discharge of thunderstorms, 100,000,000 tons of nitrogen are fixed annually and carried to the earth's surface by precipitation of rain, snow and hail.

Among the advantages of the Arc Process may be listed :—

1. Cheapest cost of nitric acid, if power can be obtained at Rs. 30 per H. P. or less and if the power is efficiently utilised in a large plant running continuously to capacity,
2. Large amount of waste heat available for producing steam for the cencentration of nitric acid and for other purposes.
3. Free raw materials.
4. Direct production of nitric acid, without intermediate products.
5. Small amount of labour involved.

Among the disadvantages may be mentioned :—

1. The large power requirements per unit of nitrogen fixed (vide Table on page 1).
2. The low electro-chemical efficiency ; only 5% of the total electrical energy is used for actual nitrogen fixation, the rest being dissipated as heat.
3. The extensive and costly character of the absorption plant.
4. Nontransportability of the nitric acid produced ; and the deliquiscent nature of calcium nitrate.
5. Difficulty of disposing of the nitric acid not needed for munitions.

Most estimates of a nitrogen fixing plant by the Arc Process include the cost of a power Station, since very large power requirements are needed and the Process works continuously day and night. The cost of the Power Station will vary with the situation and the availability of water-power or cheap coal. In India, the capital outlay on hydraulic schemes has varied from Rs. 250 to over Rs. 1000 per H. P.

Excluding the cost of the Power Station, the capital cost of plant including arc furnace installation and concentrators, will be about Rs. 1,200 per ton of nitrogen fixed per year, or about Rs. 270 per ton of nitric acid (100%). The Nitrogen Products Committee (England) estimated in 1917 the cost of production per metric ton of nitric acid (100%) to be £ 2 5 for the production of dilute acid (exclusive of the cost of energy and of interest on capital but including labour, repairs, general charges, amortization of the arc furnace at an equated value of 8%) and £ 2 for concentration of the dilute acid. Assuming electrical power to be available at £ 3 per k. w. yr. and the capital to bear interest at 6%, the total cost will be :—

Per ton of 100% HNO_3.

For preparing dilute acid	...	£ 2·5
For cencentration	...	2·0

Electrical energy, 1·87 k. w. yr. @ £ 3 per k. w yr.	...	5 61
Interest on capital of £ 20 per ton HNO_3 at 6%	...	1·20
	Total	£ 11·31

The cost of manufacture of concentrated nitric acid by this Process comes to about £ 11·31, as compared with the present wholesale rate in London of £ 16 to 18 per ton.

The cost of production per ton of nitrogen fixed, by the above method, works out to about £ 51, as compared to about £ 30 to 35 per ton of nitrogen fixed by the direct synthetic ammonia process. It is, therefore, evident that if the aim be to fix nitrogen by the cheapest process for use as fertilizer the synthetic ammonia process is cheaper than the arc process by about 30 to 40%. The additional advantages of the manufacture of ammonia rather than of nitric acid for fertilizer purposes have been already referred to.

The adoption of the arc process for atmospheric nitrogen fixation is, therefore, not to be recommended.

II. **The Cyanamide Process.** This was the method largely used before the War and the procedure was to prepare calcium carbide from coke and lime in the electric furnace and to use the carbide so prepared for the fixation of atmospheric nitrogen. The product obtained was calcium cyanamide, which was used directly as fertilizer. When, however, the demand arose during the War for a larger supply of ammonia and nitric acid, the cyanamide was decomposed with steam under pressure to yield ammonia, which was later oxidized catalytically to nitric acid.

Large plants were started in the War and post-War period in Germany, Canada and America, but many have since closed down or have changed to the manufacture of synthetic ammonia. The Cyanamide process is very good for the manufacture of cyanamide, as such, for fertilizer purposes. but the use of this fertiliser has remained almost stationary at about 200,000 to 250,000 tons of nitrogen per year (vide Table on page 383) as compared with the increase of synthetic ammonia products from 250,000 tons of nitrogen in 1925 to about 1,300,000 tons of nitrogen in 1935.

The disadvantages of cyanamide as fertilizer are:— (1) its loose and dusty nature, which creates difficulty in spreading it on land ; (2) its corrosive action on the exposed parts of the body while using it ; (3) the presence of free lime, which prevents its being used along with superphosphate ; and (4) the toxic effect produced in the soil under certain conditions, due to the presence of free calcium carbide and also due to the formation in the soil of dicyandiamide and tricyantriamide.

The demand now is for ammoniacal and nitrate fertilizers and most of the output of cyanamide in the present factories is further converted into ammonia and nitric acid, which naturally increases the cost of production of these materials, as compared with the synthetic ammonia process.

The raw materials required for cyanamide production are:— (1). High grade lime-stone, free from phosphate and containing 97 to 38% $CaCo_3$. According to Bingham[4], the impurities should be less than:— MgO—0·5% Al_2O_3 and Fe_2O_3—0 5%, SiO_2—1 to 1·2%; only traces of sulphur and phosphorus. But it is interesting to note that limestone of the following composition was successfully used in America for the process[5]:— $CaCO^3$— 96·41%, $MgCO_3$—2-3·7%, SiO_2—0·77%, Fe and Al oxides 0·55%.

(2). A coal or coke as low in ash and phosphorus as possible, akin to Anthracite coal of South Wales. The coke should contain less than $7\frac{1}{2}$% of ash and 0·04% of P_2O_5.

Dr. L. L. Fermor[6] contributed an interesting article on the "Manufacture of Calcium Carbide, Calcium Cyanamide and Cyanides in India" to the Indian Munitions Board Hand book (1919) and gave estimates for a plant of 6000 tons annual capacity of carbide; but in a foot-note he adds that he later finds that the capacity of the Factory must be at least double, if it is to be a commercial proposition. In fact, cyanamide factories must be run on a fairly large scale with a very cheap source of electricity and satisfactory availability of the required raw materials near at hand, if they are to compete with their more advantageously placed competitors viz. the synthetic ammonia plants. The cyanamide plants which continue to work at the present day are situated at centres of cheap power, e. g. in Norway, Canada Switzerland, etc.

The capital cost of a cyanamide plant, exclusive of the power plant, will average about Rs. 500 per annual ton of nitrogen fixed. If it be intended to convert the cyanamide subsequently into ammonia and nitric acid, the capital cost may go up to Rs. 1000 per annual ton of nitrogen fixed.

Official tests carried out by the U. S. A. Government on the working of their cyanamide plants[7] (U. S. A Nitrate Plant No. 2) in 1918, showed the following to be the requirements per ton of nitrogen fixed in the form of calcium cyanamide (21·34% N; weight of crude cyanamide 4 685 tons):— (1) Nitrogen gas, 97,7000 cu. ft; (2) Lime, 4·865 tons; (3) coke, 2·117 tons; (4) coal, 1·4 tons; and (5) electrical energy, 12,213 k. w. hrs. or about 1·4 k. w. yrs.

The data given by Caro and Besemfelder[8], based on German experience, go to show that one ton of nitrogen fixed by the process requires 2·75 tons of coke, 1·25 tons of coal, 0 22 tons of electrode carbons and about 1·9 k. w. yrs. of electrical energy. Ernst[6] (U. S. A.) estimates the requirements of raw materials per ton of nitrogen fixed to be limestone 8·14 tons, Coke 2·5 tons coal 0 98 ton, electrodes 179 lbs.

With regard to the possibilities of manufacturing calcium cyanamide in India, there are few places in this country which combine the advantages of a cheap source of electric power near at hand with the availability of cheap coal. The big hydro-electric installations in India are situated in the Bombay and Madras Presidencies and in Mysore, while the main coal fields are situated in Bihar and in Bengal.

Two alternatives are therefore possible - one to situate the cyanamide factory near a coal field and obtain electrical energy from coal itself, or situate it near a big hydro-electric station and import coal from outside for the manufacture of carbide. The presence of limestone of the required purity in the vicinity will also determine the location of the Factory.

If a Factory is projected in the Madras Presidency near a centre of cheap hydro-electric energy, e. g. Mettur, the following may be taken to be a rough estimate of the production costs per ton of nitrogen fixed in the form of calcium cyanamide (20 to 21% N).

5 tons of lime @ Rs. 10 per ton	Rs. 50
2½ ,, of coke @ Rs. 25 per ton	62·5
1¼ ,, of coal @ Rs 20 per ton	25
1/10 ,, of electrode @ Rs 250 per ton	25
Nitrogen gas. 10,000 cu ft	10
Electric power, 2 k. w. yr. @ Rs. 40 per k. w. yr.	80
Labour and Staff	30
Miscellaneous charges	20
Repairs @ 5% on capital value	25
Depreciation @ 10% on capital value	50
Total production expenses per ton nitrogen fixed	**Rs. 377·5**

The above price of Rs. 377·5 per ton of nitrogen fixed, may be compared with the whole-sale market price in London of calcium cyanamide at £ 7/15 per ton, which works out to about Rs. 550 per ton of fixed nitrogen.

Hence the manufacture of calcium cyanamide in India, at certain favourably situated centres, is a practical proposition. But the market for this product being very limited and the tendency among the present cyanamide factories being to convert the cyanamide into ammonia and nitrates, in order to satisfy the current market requirements, the question must be carefully considered whether at the present time, when cheaper methods of fixing nitrogen are available, we should undertake the manufacture of calcium cyanamide.

One possible advantage of undertaking the manufacture of this compound is that we have the necessary raw materials within the country itself and need not depend on imported sulphur, as we may have to do, if we should undertake the manufacture of ammonium sulphate. But it will be pointed out later that even in the synthetic ammonia process, it is possible to prepare ammoniacal fertilizers other than sulphate, which would satisfy the market demands and still be independent of imported sulphur. This has actually been done with success by countries such as Germany and England, which have no local sources of sulphur of importance.

III. **Synthetic Ammonia Processes.** These depend on the direct synthesis of ammonia from purified nitrogen and hydrogen gases with the help of a catalyst such as finely divided platinum, "promoted" iron, iron cyanides etc. The process was first worked out on a commercial scale in Germany (Haber-Bosch Process adopted at Oppau in 1913 and later at

Leuna-Meresburg), but has since been modified by various investigators in regard to important details, such as : (a) the method of obtaining hydrogen and nitrogen ; (b) temperature of reaction ; (c) pressure ; (d) nature of catalyst, etc. These modifications are generally known after their originators e.g. the process of Casale, Claude, Fauser, Mont Cenis etc.

The merits of the synthetic ammonia processes, in general, are their smaller outlay of capital, running expenses, lower power consumption and cheaper production of ammonium compounds. The capital outlay will average about Rs. 600 to 750 per annual ton of nitrogen fixed. The power consumption is about 2,500 k. w. hrs. per ton of nitrogen fixed, if hydrogen is obtained from water-gas and about 16,000 k. w. hrs. if the hydrogen be obtained electrolytically.

The relative efficiencies of the different processes that have been developed for the production of synthetic ammonia vary, however, widely and need special consideration. In the next part we will attempt a comparative study of some of the more important methods, keeping in view their suitability to conditions in this country.

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VIRUS DISEASES OF PLANTS

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In the beginning of this century the plant pathologist was familiar with only two kinds of organisms which cause plant diseases viz., fungi and bacteria. But in recent times he has to be familiar with another entity which goes by the name of virus. Virus diseases are those caused by an infective principle which is ultra microscopic in character and is capable of multiplying within the tissue of its host. The presence of this principle is indicated by the manifestation of typical symptoms on the host. Virus diseases attack man, his domestic animals and plants. Small pox, measles, mumps, chicken pox, herpes, yellow fever, cattle plague, swine fever, rabies, foot and mouth diseases of cattle are but a few examples of virus diseases among animals and man. The number of virus diseases attacking crop plants is large and every day new diseases hitherto not observed or ascribed to other causes are brought to light by workers all over the world. Of these may be mentioned the diseases affecting sugarcane, tobacco, potato, the sugar beet and the sandal wood tree.

Economic importance. The losses caused by this class of diseases are enormous. It is has been estimated that the loss due to the use of mosaic infected sugarcane setts in Cuba is 62·9 per cent in the first crop, while the successive ratoon crops show an average 79·5 per cent loss in a five years period[4]. In our presidency, an experiment carried out on the variety Co. 213 for 3 years definitely showed that the net loss is 25 per cent.[1] In other varieties especially B 3412, the entire crop may be lost and in Poovan and Red Mauritius the yield is reduced by more than 50 per cent. In a series of tests in Rio Canto the average losses from mosaic over a five year and a three year period respectively were 11 and 8 tons per acre. The loss in yield in potatoes is estimated to range between 20 to 61 per cent in England, Ireland and Wales. Very high losses have also been reported from Germany Canada and the United States of America. In Nigeria a leaf curl disease of cotton, which is also present in North India, has been found to reduce the yield by 100 lb. of ginned cotton per acre. In the year 1924, the yield of sugar beet crop in the Yakima valley was reduced to one fourth by curly top of beets. In 1925, 10,000 acres of sugar beet were abandoned in California.[4] The spike disease of sandal, as is well known, reduces the value of the yield to as low as 50 per cent.

Nature of virus. In discussing the nature of virus a comparison of the different organisms causing plant diseases will not be out of place. Many fungi and bacteria can live apart from their hosts. i. e., they can be cultivated 'in vitro'. The effect of their attack on the plant is oftentimes direct and causes immediate and perceptible damage. Till recently the consensus of opinion among the scientists was that the virus is of a similiar nature, with

this difference, namely (a) that it cannot be seen with the aid of the most powerful microscope now available and (b) that it is capable of passing through filters with pores of such dimensions through which the smallest known living organism could not pass, (c) it is not capable of being cultivated in vitro. But it was generally agreed that the agent was some kind of living entity. But recent discoveries have considerably upset the theory of a living organism and in this connection, Stanely's[6] work in 1935 is a historical landmark in the study of plant viruses. He succeeded in obtaining a crystalline substance from the sap of infected plants which he claimed to be the virus itself. Bawden and Pierie[1] have confirmed this observation in their work. The opinion is now veering round that the virus is an autocatalyse which is akin to Nucleo-protein and which is capable of permeating through plant tissues and converts other proteins to its own composition.[5] In general properties these proteins resemble enzymes. Very recent researches by Bernard have shown the possibility of some of the viruses being photographed with the aid of special apparatus. But whether the virus is a non-living substance or a living organism, it is certain that it is particulate and has a definite structure and shape as is proved by recent research on the filterability of many viruses by Elford. Evidence is also available to show that a virus may (either due to environmental conditions or by passing through another host,) change itself to another virus as was shown by Salaman[2]. Therefore in spite of considerable volume of work, it is still a difficult problem to correctly define a virus and it is still in the realm of the not fully solved mysteries of the world.

Properties of virus. The viruses resemble enzymes but vary widely in their physical properties. They react differently to heat, dilution, treatment with chemicals, and oxidation. Some viruses are capable of withstanding as high a temperature of 90° C, but many of them are destroyed at very much lower temperatures (42 to 43°C).

Toleration to dilution. The dilution end point of the most potent virus has been found to be 1 : 100,000, while some are inactivated by a dilution of 1 : 10.

Longevity in vitro. Many viruses are inactivated the moment they are extracted from the plant tissue, but there are some which are capable of remaining viable for years. In a dry state, the tobacco virus is said to have remained viable for 24 years.

Precipitation. Viruses are precipitated by lead acetate and safranin and certain other chemicals.

Pressure. Viruses are capable of withstanding very high pressures.

Chemicals. It has been found that viruses especially some tobacco viruses are capable of withstanding the effects of chemicals without deterioration to a high degree. Chloroform, carbon tetrachloride, toluene and acetone failed to destroy the tobacco virus and so also nitric, hydrochloric and phosphoric acids. The viruses can resist immerions in glycerol.

Effect on host. A group of viruses manifest themselves by producing mottling symptoms on the foliage. These are termed the mosaics. Others again cause a curling and rolling on the leaves. Others cause malformation, stunting and sterility, some reduction in the size of foliage and crowding of the auxiliary buds. Internally the virus affects the cells and its contents and profoundly alters the metabolism of the plant. In many cases cytoplasmic inclusions have been found. The net effect of the presence of the virus in many plants is the total suppression of the floral parts with the result that no seed is formed.

Means of spread of virus diseases. Virus diseases can be transmitted artificially by

(1) inoculation of sap extract,

(2) grafting,

and (3) insect vectors

but the means of their spread in the field is in some cases still an unsolved problem. In many cases, it has been definitely proved that insects, especially sucking insects are responsible for carrying infection from one plant to another. Undoubtedly, in sugarcane it is an insect that is responsible for the spread of the disease from diseased to healthy canes. The leaf curl of tobacco is spread by a white fly, but paradoxical as it may seem, the actual vector responsible for the spread of tobacco mosaic in the field is not determined, though under experimental conditions *Myzus pseudosolani* occasionally transmitted the disease. In the case of insect transmitted diseases, it is still a moot point if some of the viruses undergo a biological change in the body of the insect.

Human agency. In the case of tobacco mosaic, there is considerable observational and experimental evidence that the disease spreads mostly through human agency.

Seed. With very few exceptions, the virus is not carried through true seed, but in all cases where the plant is propagated vegetatively as in the case of sugarcane, potato, banana and cardamom, the disease spreads and multiplies by this means.

Mechanical contact. There is evidence that some diseases spread by contact of leaves of diseased plants with healthy plants.

Soil. The tobacco virus is capable of being retained in the soil along with the soil solution for nearly 8 months and infect new plantations.

Air. Whether the virus particles can be carried through air and infect new plants is a question yet to be solved. K. M. Smith has described a virus which would appear to be capable of aerial transmission.

Methods of combating the diseases. Owing to the nature of these diseases it will be evident that the usual method of plant protection such as spraying, improving the condition of the soil, etc. are of no avail in combating them.

Resistant varieties. By far the most practicable of methods hitherto found successful are the production of resistant and immune varieties by breeding. In sugarcane, this offers the most practicable solution in places where the disease is highly destructive.

Elimination of infective material. In places where the disease has not progressed considerably the methods of roguing out diseased plants seems to offer the best solution. But care must be exercised to see that the rogued plants are immediately destroyed to prevent the insect vectors transferring themselves to the healthy plants round about.

Destruction of insects which act as vectors. This may be practicable in limited areas and for such crops as are very valuable as for example, medicinal plants, vegetables and flowers grown in hot houses, but how far the methods could be utilised on a field scale remains to be investigated.

Growing plants from true seed. In the case of plants like cardamom the incidence of the disease could be minimised if new plantations are raised from true seed instead of from rhizomes.[7] In the case of tobacco, the disease can be eliminated from seed beds if the nursery is raised in a fresh area every year and the seed is thoroughly cleaned and winnowed to remove all debris of the previous year's crop adhering to the seed.

Other precautionary measures and field sanitation The removal of weeds which are likely to harbour the virus, the prompt destruction of all diseased material, the ploughing of the land and removal of stubbles immediately after harvest, the avoidance of growing the same crop in highly infected fields for a few years, are a few of the precautionary methods which have proved useful in controlling the disease.

Immunology. Yet another startling discovery of recent years in plant pathology is the possibility of immunising the crop plant by artificial inoculation similar to vaccination. The presence of one virus often inhibits the development of other viruses or a second dose of the same virus. Salaman[2] has shown that the presence of a weakly pathogenic virus in the potato variety "Up-to-date" protects it against more virulent forms.

At Coimbatore we have evidence that in some cases the virus becomes attenuated in course of time and further inoculations on such plants are not successful in transmitting the disease. Thung mentions a case where a ring spot virus confers immunity on the tobacco plant against further infection from the same virus and also other viruses.

Virus complexes. On the other hand, there is also the fact that while virus may be incapable of doing harm by itself, a combination of various viruses may prove very destructive to the host plant.

Work done in S. India. "The following is a resume of the work done in S. India in connection with virus diseases.

1. *Sugarcane mosaic.* (a) *Varietal resistance studies of 'cane mosiac'* The relative resistance of 150 varieties has been tested by field experiments[7]

(b) The loss due to mosaic in cane has been estimated on the basis of a well conducted experiment for three years.

2. *Cholam 'Freckled yellow and Stripe'.* That the insect (Pundalaya) *Peregrinus maidis* is the vector of one of the diseases is established by Cherian and Kylasam. The disease is not sap transmissible.[7]

3. *Tobacco Mosaics and Leaf Curl.* A survey of the tobacco area in Coimbatore and Salem districts has been made, and the existence of a number of strains of tobacco mosaic has been noticed. A highly destructive leaf curl is also prevalent This was not sap transmissible but grafting induced infection on healthy plants. A destructive ring spot disease has been noticed, and further work is in progress.

4. *Brinjal little leaf disease.* Recently a disease of the brinjal * plant came under the purview of the Government Mycologist Mr. K. M. Thomas[8]. It was observed at the Central Farm, Coimbatore and has been reported from Rajahmundry, Madura and some villages in the Coimbatore district. The disease manifests itself by the great reduction in the size of leaves, alteration in its shape and structure, the crowding of buds in the axils, malformation and the complete absence of floral parts. The plant is completely changed in appearance. The affected plants do not bear fruit. Careful examination of all the parts of affected plants did not reveal the presence of any organism and the disease was suspected to be of virus origin. Sap inoculation did not prove successful but grafting gave positive results. The disease was found to be reciprocally transmissible to *Datura fastuosa.*

5. *Red gram.* A disease resembling spike has been noticed on red gram (*Cajanus indicus*) plants[8]. Preliminary trials have given indication that it is transmissible by a jassid. The disease is not sap transmissible.

6. *Potato diseases.* Fortunately, the variety usually grown by ryots in the Nilgiris. 'Great Scott', is fairly resistant but a number of virus diseases have been noticed in other varieties grown in the Nanjanad Farm on a small scale. Of these, a mild mosaic affecting "Arran banner" and a kind of 'calico mosaic' affecting the varieties "Golden Wonder" and 'Up to date' may be mentioned.

The writer is greatly indebted to Mr. K. M Thomas, Government Mycologist for guidance, help and encouragement given in the preparation of this paper. The paper was primarily intended to acquaint the officers in the districts with some of the recent developments in plant pathology, and to impress on them the need for further virus research in S. India.

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STUDIES IN SUGARCANE JAGGERY

V. Macro-Structure of Jaggery.

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In previous communications (1, 2) the probability was suggested that the good and bad jaggeries might show marked differences in their gross structure as well as in their micro-texture. In verification of this suggestion, a large number of samples of Jaggery, collected from several parts of the presidency, were examined for their macro-structure and micro-texture. In addition to these, several other jaggeries, the conditions attending the preparation of which were known, were similarly examined. This examination revealed that both structurally and texturally, the two types of jaggery distinguish themselves strikingly from each other. The present paper deals with macro-structure.

The jaggeries collected were classified into good and bad ones on the basis of the physical tests indicated previously (2). Cross sections of the samples were cut, and their photographs taken after smoothening the cut faces. An examination of the sections reveals the mode of distribution of crystalline sucrose and the ground mass of the matrix within the bulk of the jaggery (plate I) and the tendencies in the two types seem to be characteristic of them.

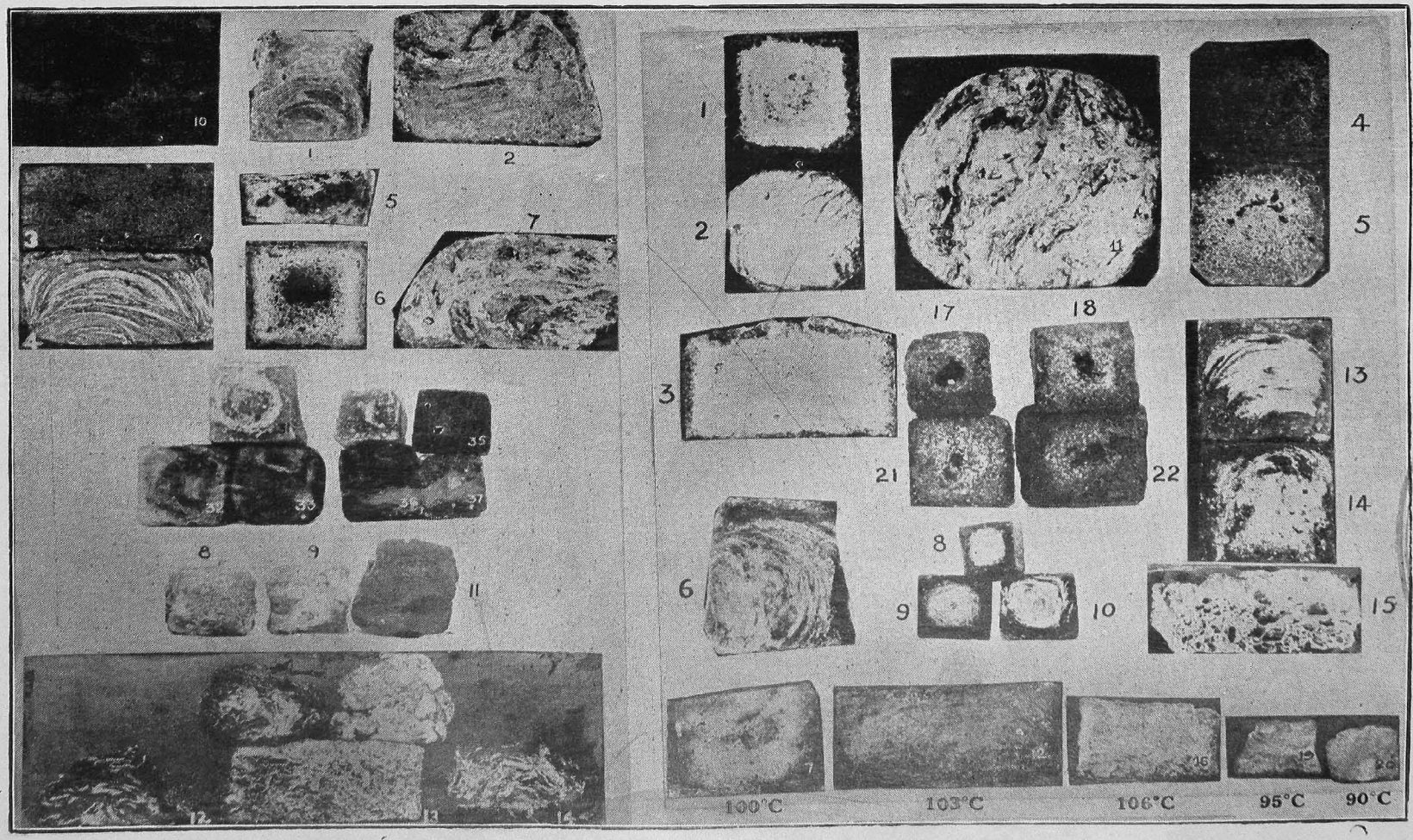
GOOD JAGGERY (Plate 1.)

1. Sucrose occurs as an extensive internal core, and the matrix, as a thin compact envelope or shell over the core (Nos. 1—5, 7—10, 12, 16—18, 21 and 22).

2. Sucrose sometimes disposes itself in wide concentric bands which tend to rapidly coalesce into what approaches an extensive core, and the matrix ranges itself as narrow veins or as envelope on the outside (Nos. 2, 6, 10, 13 and 14).

3. Occasionally sucrose occurs also as wide or extensive patches inter-spersed by thin compact veins or patches of matrix (Nos. 6,7,11, 13, 14 & 19.)

4. Cellular and vesiculer conditions within the sucrose core or its patches seems to be general.



BAD JAGGERIES

GOOD JAGGERIES

Other properties.

5. The sucrose core or patches are dry, hard and highly crystalline. The crystals are cemented together very firmly. The crystals are coarse to the feel, being with sharp angles and well formed edges.

6. The matrix is also hard, compact and adheres strongly to the adjoining core or crystalline patches.

7. The good jaggeries are rigid solids and strongly resist compressional as well as shearing and other forms of stress.

8. In their preparation, the boiling was smooth, the empirical test was answered normally and the temperature of setting was higher and the time taken was short.

BAD JAGGERY (Plate 1.)

1. The bad jaggeries are massive and frequently there exists no well defined structure. The tendency for the differentiation of sucrose into core, and matrix into compact outer shell or envelope, is not quite marked, and where any tendency for this is exhibited, it is very imperfect.

2. Sucrose occurs as scattered patches (Nos 2,5,7 & 10)

3. Sometimes sucrose disposes itself as thin veins separated by wider layers of matrix (Nos 1 & 4)

4. The tendency for sucrose to appear as incipient concentric bands, with, however, no indication to coalesce into extensive cores is noticeable, contrasting thus strikingly with good jaggeries (Nos 1,4 & 31—33.)

5. The very rudimentary character of what corresponds to the extensive crystalline core of the good jaggeries is interesting to notice (Nos 34-37.)

6. Matrix occurs either as extensive patches within the bulk of the jaggery (Nos. 5.) or as wide and less compact outer envelope or as both (Nos. 10, 31—37).

7. Vasicular condition is absent.

8. Sucrose crystals are in general embedded within the matrix.

Other properties.

9. The matrix as well as the sucrose patches are generally damp.

10. Neither the sucrose crystals within a patch or vein, nor the sucrose and the surrounding matrix portions within the jaggery, are adhering to each other with any degree of firmness.

11. The outer shell or the envelope, where one such is present, is plastic and easily yields.

12. Under compressional stress they collapse and react quickly and easily to all other forms of stresses.

13. On grinding they yield pastes of varying degrees of consistency.

14. The sucrose crystals are frequently smooth and soft to the feel.

15. The empirical test was answerd well enough in all cases; but in those which yielded the worst types of jaggeries the test was either not answered at all, or was answered only imperfectly, when it did. The boiling

in these cases was abnormal and is attended with considerable frothing, charring and the production of fumes.

15. The temperatures of setting were low and the times taken were longer.

Both types of jaggeries contain specimens which are of light yellow or brown or of other finer shades of pleasing colours as well as those which are very dark and most unattractive. Obviously the keeping quality of a jaggery seems to be independent of its colour.

The foregoing considerations lead to the inference that the conditions where the good jaggeries are formed were such that the crystallisation of sucrose could proceed quickly, freely and unhampered, and that this process must have met with considerable resistence where bad jaggeries are formed. These and other conditions have already been discussed in the earlier paper (1, 2). This argues for the fact that some at least of the impurities or other foreign materials accompanying sucrose in the two types of jaggeries must be possessing highly contrasting properties ; in the one case, they seem to permit the free crystallisation of sucrose, while in the other, they adversely interfere with the process.

That this is so, and that what these impurities comprise of and where to locate them will be considered in subsequent communications when the chemical composition of jaggeries will be taken up for discussion.

Summary. 1. Macro-structures of several good and bad jaggeries were studied.

2. The structural and other differences noted were found to be typical of the two kinds.

3. It was inferred that the degree of resistance offered for the free crystallisation of sucrose by the impurities accompanying it was the main factor controlling the structure of jaggery. In the bad jaggeries this resistance is great and their structures are therefore ill defined and imperfect, in the good ones, on the other hand, such resistance is either absent or is only negligible, such that the crystallisation of sucrose, and its separation from the matrix are carried to as near completion as possible.

4. The temperature of moulding seems to be an additional factor controlling structures.

5. The drying capacity of the matrix is yet another important factor, but this is mainly determined by the character of the impurities.

6. The hardness of some of the bad jaggeries was shown to be only apparent. It is simply mechanical rigidity maintained by fluid film pressures, but which is mistaken for true hardness.

The author takes this opportunity to offer his grateful thanks to Rao Bahadur B. Viswanath, Director, Imperial Agricultural Research Institute, and to Mr. P. V. Ramiah, the Government Agricultural Chemist, Coimbatore for the kind encouragement and the facilities they so readily gave, and for their helpful criticism throughout.

NOTES

Good jaggery.

Sample No. 3. This is typical of good jaggery. A specimen of cream jaggery from Co. 281 juice after clarification with paddy husk charcoal (Viswanath et al, 3) This preliminary clarification is not common in practice. The juice boiled freely. The empirical test was answered normally at about 120°C, setting took place in about 8—10 min. at 107°C. The extensive hard core and the very thin and compact envelope are typical.

Sample No. 15. The material is the same as for No. 3 but this portion of the mass was transferred to the mould at a high temperature even before the setting became visible. It frothed while in the mould and this was accompained by a rise of temperature by 3–4°C and by considerable evolution of steam. This is obviously due to the crystallisation of sucrose which is an exothermic change. This observation explains also the highly vesicular condition of the interior The walls of the vesicules are dry and hard (This contrasts with No. 6 among bad jaggeries.)

Sample No. 11. It is white, dry, hard and crystalline. The section at once suggests the prevalence of considerable thermal differences within the bulk of the jaggery after it has been moulded. It is noticeable that there is no sign of the formation of the outer shell or envelope. This is due to the fact that the cooling mass was not actually put in to any specially made mould in which case alone the differentiation of an envelope is possible, but it is simply made into a ball when the mass had cooled down to a temperature when it could be easily manipulated with the naked hand. This practice of converting jaggery into rounded balls is common in Chittoor district and in other tracts of the presidency. The sample under examination is typical good jaggery from Chittoor.

Sample Nos. 7, 12, 16, 19 and 20. All the samples are moulded from the same material, only the temperatures of moulding were different as indicated. The differences noted indicate that even in the cases of materials which yield good jaggeries, the stages of the differentiation into core and matrix are evidently also conditioned by the temperature at which the moulding is made.

The fluidity of the matrix is controlled by temperature and therefore also its capacity to be squeezed outwards to the periphery (Nos. 12 & 16) or to get localised in patches (Nos. 19 & 20). In these the matrix gets dried up quickly. The envelope in No 7 is comparatively wider.

Bad jaggeries.

Sample No. 4. An example of the worst type of jaggery. It is light yellow in colour, heavy and highly sticky.

One characteristic feature with this jaggery is that any thing with which it is beaten gets stuck up in it and cannot easily be removed and in fact on raising the same, the whole jaggery block would also get lifted up with it.

The rhythmic crystallisation of sucrose in thin veins is worthy of notice (c. f. No. 11 among good jaggeries wherein the matrix is present as thin veins). The empirical test was answered at 123°C. Frothing was abnormal with considerably strained bubbling. It was going into strings; was transferred into moulds after 45 minutes, although it did not yet set, and was still glassy in appearance.

Hammering would not rupture it easily; it gets beaten out and not broken as do the rest. It resists compressional stress, but easily yields to shearing forces.

It cleaves easily and neatly along the length of the crystalline veins. The crystals in the veins are fine, easily separated, and are soft and smooth to the feel thus contrasting with the conditions in good jaggeries.

Sample No. 6. Dark brown. Possesses spongy structure. It is weak ; crumbling even on gentle pressure. The jaggery is very light for its bulk. There is a huge vacuole in the centre, and its inside resembles a honey comb. Even on slight scratching, the interior gets crumbled to powder. In these respects it contrasts with good jaggeries. During its preparation, profuse frothing, charring and fuming occured. The empirical test was not answered properly. At this stage excess of milk of lime was added and vigorously boiled over a strong flame. The temperature quickly rose to 130°C. It was thereafter removed from the furnace. It dried up quickly and at a high temperature (109°C). The formation resembling that of the core in good jaggeries is evidently controlled by the temperature at which the jaggery sets, or dries up. Addition of excess lime and heating to higher temperature must have denatured the properties of the impurities. But the jaggery is still classifiable only among bad ones. Barring its structure, resembling that of a good jaggery, in all other respects, its properties are in common with those of bad ones.

The spongy interior is obviously due to the imprisoned gases (fumes).

Sample Nos. 31–33. Concentric banding, (a single closed ring) of sucrose in No. 31, and the tendency for this in Nos. 32 and 33, are noticeable. The envelope is wide, and they yield thick pastes. They are waxy in appearance.

Sample Nos. 34–37. The rudimentary character of the internal core of crystalline sucrose and the very extensive nature of the matrix in these samples constitutes the very antithesis of what obtains in good jaggeries.

Samples Nos. 1, 2, 7 and 10. All the samples possess definite geometrical shapes, and are hard to all appearances. But on crushing they yield pastes with varying degrees of consistency and mobility. The corresponding crushed masses are represented respectively by Nos. 15, 14, 16 and 12. Sample No. 4, yielded a considerably much thinner, and more easily flowing liquid, but the same could not be included in the photo.

The hardness exhibited by these and other similar jaggeries is only apparent hardness. It is simply mechanical rigidity maintained by fluid film pressures and this is often mistaken for true hardness. (A kind of 'THIXOTROPY' displayed by weak gels).

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SELECTED ARTICLES

SELF-SUPPORTING COLLEGE

By WELDON MELICK

In 1904 the Nashville Agricultural Normal Institute at Madison, Tenn. consisted of 11 students and some dilapidated farm buildings on 400 acres of worn land purchased with the last cent of its founders—Dr. E. A Sutherland and four other teachers. In addition, however, it had one invaluable asset: Dr. Sutherland's idea that a college education should be made available to any boy or girl willing to work for it.

From this idea has grown a unique institution which, practically without endowment, has put $ 520,000 from its own earnings into buildings, grounds and equipment. It now has 300—odd students from 36 states and nine foreign countries.

Madison's curriculum includes 27 campus industries, run by the students to support the college and themselves. Every student is required to work for at least half, and preferably all, of his academic expenses. He can enter Madison—as two thirds of the students do—with no more than the required deposit fee of $ 35, complete a four-year standardized college course for a Bachelor of Science degree, and graduate with the deposit intact. He will receive no outside financial aid in all that time. And he will leave college equipped to do not one job but several—multiple insurance against the caprices of fortune.

Dr. Sutherland, the man who conceived this idea, had been president of two small colleges before he started his experiment at Madison. To provide an income for his new school, and at the same time to train health workers and care for ill students, he planned a sanatorium in connection with the college. But, if he was to run a sanatorium, he must qualify as a doctor. So for four years this energetic educator ran Madison while taking courses at Vanderbilt and the University of Tennessee. Finally at the age of 50, he obtained his M. D.

Today the Madison Rural Sanatorium, with 100 rooms, up-to-the-minute equipment, and a staff of 14 physicians, is the Institute's most important industry. Although it is operated for the benefit of the college, at rates of $ 25 to $ 35 a week the Sanatorium has never turned away a charity patient. Students do all the routine work, getting practical training in the process of earning their education. The 25 to 30 graduates of its nurses' courses are snapped up each year by the best hospitals, and its pre-medical and pre-dental work is accepted by all colleges and the American Medical Association.

The school farm is as important to the college economically as is the Sanatorium. There are 60 acres of garden, 70 acres of fruit, and two greenhouses which, incidentally, supply flowers for the hospital rooms. The student canning factory puts up enough vegetables to feed students and patients the year round. And 15 years of research in food chemistry have resulted in new food products too useful to confine to campus menus

Hence, Madison Foods—an industry that is largely responsible for making the soy bean appetizing to Americans. The School's food chemists, experimenting with 200 varieties of soy beans, eliminated objectionable taste and produced savory breakfast foods, bread, coffee substitute, condensed milk, and meat substitutes which look and taste like beef but are even more nutritious and digestible. Vigorost, made from soy loaf after the milk is extracted, is featured by a cafeteria chain in New York City. More than $ 60,000 worth of Madison's packaged and canned foods was sold in 27 states last year, and the Institute runs its own health-food cafeterias in Nashville and Louisville.

Madison Foods have developed soy milk until it is now not only cheaper than cow's milk but, on the authority of the American Medical Association,

better for babies. Observers have come from Africa, India, and other conntries where milch cows are scarce, to study the methods of Madison's soy bean "dairy".

None of the commerical industries which support the school competes with established businesses. The soy bean products create their own market. The Sanatorium, highly regarded throughout the South, is in a class by itself. The broom factory, which uses 25 acres of student-grown broom corn for its daily output of 50 dozen, sells its products at prices higher than other brands. Among the school's lesser commercial industries are a rug department which buys waste from stocking factories and sells an attractive floor covering to visitors: a photographic laboratory that fills orders for colored slides from all over the world; auto repair shops that do some outside work; a printing establishment that does some outside work as well as supplies the four-color labels for the cannery.

There is no private profit from any of these industries—the income is used for the support and further development of the college. The school sets its scholars an example of self-sufficiency, receiving no aid from public funds and asking none. The only interest-bearing endowment is an unsolicited and unexpected $ 50,000 bequest from a former patient of the Sanatorium.

Income from several of the industries might be increased sufficiently to permit the hiring of outside professionals for construction and maintenance work on the buildings. But how then would the students learn practical architecture, carpentry, plastering, plumbing and steam fitting, electrical work, metal work, and so forth? For that reason no enlarged food factory will supplant with its profits the educational opportunities offered by the score of industries which make no money.

Students work five hours and study five hours daily the year round. Their work is credited against educational and living expenses at a basic rate of 10 cents an hour. Necessities, almost all of which are provided by the school industries, are scaled proportionately low. A year at the college costs about $ 318 worth of work; the largest items are tuition, $ 72 to $ 84; room, $ 60; and board, $ 90. Those who find the combination schedule too heavy may work less and make up the deficit in cash, or balance their budget with fewer classes.

The 120 college and sanatorium buildings, cottages and dormitories on the 900 acre grounds have been entirely student-designed and student-built under skilled supervision by the 28 instructors, most of whom are masters of a trade as well as of their academic subject.

About forty students will have worked on a classroom building during its year or two of construction, and no where will the workmanship look amateurish. Once a visitor, admiring the work of a student floor-layer, asked him how much experience he'd had. The youngster answered, "From here to the door." The newer buildings are roofed with a beautiful tile made by a special process in the student factory—a tile only half as heavy but sturdier than commercial types. Much of the woodwork was cut in the college's sawmill from lumber chopped on the grounds. The home economics girls prepare and serve the students' meals with food from the college farm. Some of the boys fixed up a steam roller bought from the county as junk iron, and now they keep their own roads in repair. In case of fire, they are ready with a shining, rebuilt fire truck. Exhaust steam from the student-built heating plant, run by a student-engineer, furnishes electricity nine months of the year for the entire institution.

In so far as possible, students are given their choice of work. Whether they are washing shirts or hauling cement, however, pride in earning their own way and at the same time accomplishing something visible and useful stimulates happiness, a sense of responsibility, and a keener mental attitude toward academic studies.

With limited and hard-earned funds Madison has to make money go farther than do most colleges, but it is doubtful whether material advantages of any

importance have been sacrificed. Madison's biology class grows its own specimens—and no college could buy better ones. The school has the finest arboretum and botanical gardens in the state. The physics students have constructed three-fourths of their own equipment, as well as recording machines for the voice culture classes, and a talking picture projector. There is nothing crude about these mechanisms, and it is obvious that a student who helps make a precision instrument isn't just absorbing a superficial veneer of technical phrases.

Many graduates go into nursing, medical work, home economics, or agriculture. Almost 200 of them have helped to establish three high schools, six junior highs, and 21 grammar schools in the South, all modelled on Madison's self-help principles. Usually they include a health center providing the only medical service within miles.

With twice as many applicants as can be provided for, Madison as a rule accepts only those who could not otherwise arrange for a college education. Rare exceptions are two boys whose longheaded fathers want for them the kind of education which can't be bought at Harvard or Yale. The youths relish the experience of manual labor and self reliant individuality—and their classmates do not know they are the sons of wealthy men.

There are larger and older schools that combine industrial with academic training, but Madison has shown how education can be put on a self supporting basis. (*Reader's Digest*, May 1938.)

Agricultural Jottings.

(From the Director of Agriculture, Madras.)

COMPOST MAKING

Farm Yard Manure is undoubtedly the best manure. It is as good for crops as mother's milk is for babies. All other manures are only substitutes like tinned foods or milks for children. It has been established by experimentation and research that seeds obtained from plants manured with Farm Yard Manure have better vitality than those treated with the artificials. Seeds of better vitality must certainly contribute to the better vitality of man and beast that feed on them. It is therefore of national importance to devote better attention to the proper preparation and application of farm yard manure to cultivated crops.

Farm yard Manure is nothing but a mixture of the dung and urine of farm livestock and the farm yard sweepings waste, straw, etc. To some extent cattle dung is at present converted into bratties and used as fuel while the urine goes to waste in cattle sheds except in the Ceded Districts where there are small pits in the flooring of cattle sheds in which urine collects. If the ryot is not careful even in the Ceded Districts, the urine removed from the pit by means of coconut shell is thrown on the roadside by the farm servant instead of taking it to the manure pit. On rainy days this valuable manure is usually taken and thrown on the road near the threshold of the house If, however, the urine pit is widened and filled with earth, the loss of urine is better prevented. Urine-soaked earth can be easily taken to the manure pit once or twice in a week. This system is slowly finding favour with the ryots.

The solid and liquid voids of human beings are always lost on the farm. There is no proper latrine and after the destruction of prickly pear by the Cochineal insect, places of privacy for latrine purposes have become rare. The aversion the ryots have towards human excreta can be got over by means of a *combined Latrine and Manure Pit.* Two sheds—Railway Porter's sheds—may be

put up on the edge of the manure pit. A sloping slab may be provided. The voidings will all drop into the manure pit and on this the daily sweeping of the farm yard and cattle dung may be put. When the manure reaches the brim it may be raked and drawn backwards in the pit. Ryots will not have compunction to handle this kind of mixed manure.

In spite of adopting the above methods the quantity of farm yard manure available is not enough to manure all the lands of a ryot. In order to increase the output, he has to adopt other methods and tap new sources for getting a manure equivalent to Farm Yard Manure. Composting of all farm wastes, sweepings and other vegetable refuse matter and applying them to the soil is one of them. Rarely we find people doing it; but they always throw away their rubbish or burn them as fuel. Yet another way of increasing the supply of organic manure to soilds is by the conversion of the rubbish and night soil which are at present wasted by the municipalities and Union Panchayats into innocuous and useful compost. Its conversion not only disposes off the refuse in a most sanitary way but has also proved a source of potential wealth to the Municipalities. On the advice of the Agricultural Department such compost has been prepared in Proddatur and Kurnool Municipalities during the past three years and ryots are very much satisfied with the quality of the manure and are freely handling it. The income to the Kurnool Municipality by sale of rubbish and night soil separately in the year 1934-35 was only Rs. 1,125; but in 1936-37 when they were composted according to the departmental method it was Rs. 3,353 and in 1937-38 it was Rs. 3,173. In the case of Proddatur the demonstration was made early in 1937 and the income from the manure obtained from April to December 1937 was Rs. 1,620 whereas the estimated income from the sale of rubbish and night soil was only Rs. 500.

In addition to the increased income to the Municipalities and the most sanitary disposal of night soil and rubbish it must be remembered that the application of this compost increases the humus or organic matter content of the soil which increases the water-holding capacity of the soils—a factor necessary to prevent failure of crops in the Ceded Districts.

NEW STRAINS OF PADDY RELEASED DURING THE YEAR 1937—38 FROM DIFFERENT PADDY BREEDING STATIONS IN THE PRESIDENCY

Co. 12, a strain selected from the variety known as *Sendinayagam* has been added to the list of two strains *kar samba* (Co. 9) for the first crop season and *unaikomban* (Co. 8) for the pishanam, which are already in distribution in the Tambaraparani basin in the Tinnevelly district. *Sendinayagam* has been found to give better yield of straw and grain than Co 8 even in soils of average fertility and on this account this variety is gaining ground in the upper reaches of this river system. It is, however, a long duration samba variety and as single crop, it comes to harvest about the end of January. As a thaladi or pishanam crop (second crop following immediately after kar or kuruvai) it comes to maturity about the end of February. Though it is a variety at present popular in Tinnevelly it is likely to prove useful in parts of the other Southern Districts where water supply for the thaladi crop is available till the end of February. The strain has given 13 per cent increase over the ryots' bulk seed and has recorded an acre yield of 3,000 lb. in the trial plot at Ambasamudram.

The varieties that are extensively grown in the Kistna delta are *kusuma pedha atragada*, *vankisannam* or *delhibogham* and *konamani*. High yielding strains in *kusuma* (Mtu. 7) *vankisannam* (Mtu 8) and *konamani* (Mtu. 11) are already spreading in the area. During the year, Mtu. 12, a strain in *Pedha Atragada* and Mtu. 13, another strain in *Delhibogam*, both maturing about the second week of December, were released for distribution.

Mtu. 12 is a selection in *pedha atragada* usually cultivated in the lower delta area of the Kistna and Guntur districts where drainage is defective and water stagnates for a longer period. This variety is esteemed for its food value and is ordinarily reserved for home consumption. The strain has given 10 per cent increase over the ryots' bulk and has yielded 3, 150 lb. per acre in the trial plot at Bapatla. Mtu. 12 is also expected to be useful for areas under Kaligiri reservoir in Nellore district where *pedh atragada* is taking the place of molagolukulu.

Mtu. 13 is a strain selected from *Delhi bogham*. Possessing as it does, the desirable qualities and yield of Mtu. 8, the strain already in distribution, it meets the demand for a finer type of *Delhi bogham* for export purposes to the city of Madras, Nizam's dominions, and Ceded districts. Arrangement has been made to multiply the strain at Gudivada and Repalle this season.

Agricultural Research Station, Aduturai has already released 15 strains of paddy. Though most of them are of particular interest to the Cauvery delta, yet some of them are found to meet the needs of paddy areas in other districts. Adt. 3, kuruvai, the shortest duration variety (90 days) is becoming popular in Salem and North Arcot districts for cultivation under well irrigation during summer. Adt 11 Nellore samba is spreading in the Periyar, Amaravathi and Bhavani irrigation systems. During the year two strains Adt. 16 *konakuruvai* and Adt. 17 *Muthu samba* were released from the station.

Konakuruvai is a short duration variety of 115 days and yields well in the first crop season, kuruvai season (June—September) in the Tanjore district. It is the finest of the short duration varieties and is at its best as a summer crop sown in the months of May—June. Adt. 16, the strain selected in *konakuruvai*, has given an increase of 25 per cent over the ryots' bulk and has yielded 3,670 lb. per acre at the Agricultural Research Station, Aduturai. It is not, however, recommended for the navarai or cold weather reason.

Adt. 17 was selected from *Muthusamba*, a variety grown largely in South Arcot. It is a long duration samba variety maturing about the third week of January. The strain has given 13 per cent increase over the ryots' bulk in the district and has yielded 3,700 lb. in single crop area. The strain Adt. 17 is recommended to areas where *muthu samba* is grown in South Arcot.

Crop & Trade Reports.

Paddy—1938-39—First forecast report. The average of the areas under paddy in the Madras Province during the five years ending 1936-37 has represented 14·5 per cent of the total area under paddy in India.

The area sown with paddy up to the 25th September 1938 is estimated at 6,377,000 acres. When compared with the area of 5,893,000 acres estimated for the corresponding period of last year, it reveals an increase of 8·2 per cent.

The estimated area is the same as that of last year in East Godavari, Kurnool, Madura and the Nilgiris; it exceeds the corresponding area of last year in Guntur, the Deccan (Kurnool excepted) the Carnatic and Central Districts, Tanjore, Tinnevelly and Malabar.

The first crop of paddy is being harvested in parts of Tanjore and on the West Coast. The yield is expected to be generally normal. The condition of the standing crop is fair.

The wholesale price of paddy, second sort per imperial maund of 82⅔ lbs. as, reported from important markets on 10th October 1938 was Rs. 2—11—0 in Madura, Rs. 2—8—0 in Virudhunagar, Rs. 2—6—0 in Vizianagaram, Rs. 2—5—0 in Guntur and Trichinopoly, Rs. 2—4—0 in Ellore, Bezwada, Masulipatam, Tinnevelly and Mangalore, Rs. 2—3—0 in Anantapur, Hindupur and Chittoor, Rs. 2—2—0 in Cocanada, Rajahmundry and Vellore, Rs. 2—1—0 in Kumbakonam, Rs. 1—15—0 in

Negapatam and Rs. 1—11—0 in Conjeevaram. When compared with the prices published in the last report, i. e. those which prevailed on 7th February 1938. the prices reveal a rise of 14 per cent in Kumbakonam, 12 per cent in Trichinopoly, 10 per cent in Mangalore, 8 per cent in Rajahmundry, 7 per cent in Negapatam, 6 per cent. in Cocanada and 3 per cent. in Conjeevaram and Madura and a fall of 21 per cent. in Chittoor, 14 per cent. in Bezwada and Tinnevelly, 13 per cent. in Hindupur, 12 per cent. in Anantapur, 9 per cent. in Guntur, 8 per cent. in Virudhunagar, 6 per cent. in Masulipatam, and 5 per cent. in Vizianagaram and Ellore, the prices remaining stationary in Vellore.

Sugarcane—1938—Second report. The average of the areas under sugarcane in the Madras Province during the five years ending 1936—37 has represented 3·2 per cent of the total area under sugarcane in India.

The area planted with sugarcane up to the 25th September 1936 is estimated at 90,800 acres, i.e., practically the same as the area estimated for the corresponding period of last year which was 90,790 acres.

The estimated area is the same as that of last year in South Kanara; an increase in area is revealed in Kistna, South Arcot, Coimbatore, Trichinopoly, the South (Tinnevelly excepted) and Malabar being partly counter-balanced by a decrease in area in the other districts. The variations are marked in Vizagapatam (−2,000 acres), East Godavari (−1,000 acres), South Arcot (plus 2,700 acres), Coimbatore (plus 1,700 acres) and Trichinopoly (plus 2,500 acres).

4. The condition of the crop is generally satisfactory except in South Arcot, North Arcot, Coimbatore, Ramnad and South Kanara. The seasonal factor for the Province as a whole works out to 95 per cent. of the normal and on this basis the total yield for the Province is estimated at 233,030 tons of jaggery as against 259,120 tons for the corresponding period of last year.

5. The wholesale price of jaggery per imperial maund of 82,2/7 lbs. (equivalent to 3,200 tolas) as reported from important markets on 10th October 1938 was Rs. 9—14—0 in Adoni. Rs. 8—15—0 in Chittoor, Rs. 8—1—0 in Vellore, Rs. 6—13—0 in Mangalore, Rs. 6—9—0 in Vizagapatam, Rs. 6—3—0 in Trichinopoly, Rs. 6 in Rajahmundry, Rs. 5—12—0 in Cuddalore, Rs. 5—9—0 in Cocanada, Rs. 5—8—0 in Vizianagaram, Rs. 5—6—0 in Erode, Rs. 4—15—0 in Salem and Rs. 4—8—0 in Bellary. When compared with the prices published in the last report i. e., those which prevailed on 5th September 1938, these prices reveal a rise of 56 per cent. in Adoni, 39 per cent. in Cuddalore, 30 per cent. in Chittoor, 25 per cent. in Vellore, 19 per cent. in Vizagapatam, 14 per cent. in Bellary, 11 per cent. in Trichinopoly, 10 per cent. in Vizianagaram and Rajahmundry, 6 per cent. in Cocanada and 2 per cent. in Erode and a fall of 12 per cent. in Mangalore, the price remaining stationary in Salem.

Groundnut—1938—Third forecast report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1936—37 has represented 47·8 per cent of the total area under groundnut in India.

The area sown with groundnut up to 25th September 1938 is estimated at 3,198,400 acres. When compared with the area of 3,656,400 acres estimated for the corresponding period of the previous year, it reveals a decrease of 12·5 per cent.

There is a decrease in area in the Circars, (Vizagapatam and East Godavari excepted) the Deccan, South Arcot, the Central districts (Coimbatore and Trichinopoly excepted), Tinnevelly and Malabar, partly counterbalanced by an increase in area in the other districts. The decrease in area is marked in Kistna (−61,000 acres), Guntur (−75,000 acres), the Deccan (−309,000 acres) and North Arcot (−55,000 acres).

4. The summer crop throughout has been harvested. The yield was generally normal. The yield of the early crop is reported to be normal in Salem and below normal in Coimbatore.

5. The condition of the main crop is reported to be generally satisfactory outside Vizagapatam where the crop was affected by drought and insect attack to some extent.

6. The wholesale price of groundnut (shelled) per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 10th October 1938, was Rs. 4—2—0 in Cuddalore, Rs. 3—13—0 in Guntur, Rs. 3—12—0 in Vizagapatam, Rs. 3—11—0 in Vizianagaram, Rs 3—5—0 in Vellore, Rs. 3—2—0 in Coimbatore, Anantapur and Tadpatri, Rs. 3—0—0 in Hindupur and Rs. 2—15—0 in Adoni and Bellary. When compared with the prices published in the last report, i. e., those which prevailed on 8th August 1938, these prices reveal a fall of 17 per cent. in Anantapur, 13 per cent. in Vizagapatam and Hindupur, 11 per cent. in Adoni, 10 per cent. in Bellary, 9 per cent. in Vizianagaram, Vellore and Tadpatri, 8 per cent. in Guntur and 7 per cent in Cuddalore.

Gingelly—1938—1939—Second Report. The average of the areas under gingelly in the Madras Province during the five years ending 1936—1937, has represented 15 4 per cent. of the total area under gingelly in India.

2. The area sown with gingelly up to the 25th September 1938 is estimated at 517,500 acres. When compared with the area of 468,000 acres estimated for the corresponding period of last year, it reveals an increase of 10·6 per cent.

3. The estimated area is the same as that of last year in South Kanara, an increase in area is revealed in the Circars (Vizagapatam excepted), the Deccan (Cuddapah excepted), Nellore, South Arcot, Salem, Trichinopoly and the South and it is partly counter balanced by a decrease in area in the other districts. The variations are marked in Vizagapatam (−18,000 acres), East Godavari (+10,000 acres), West Godavari (+25,000 acres,) Chingleput (−16,500 acres), North Arcot (−21,000 acres), Trichinopoly+39,000 acres) and Madura (+10,500 acres).

4. The early crop of gingelly has been harvested in parts. The yield was generally normal except in Vizagapatam, Bellary, Chingleput, Salem and Coimbatore where the season was not favourable for the crop.

5. The wholesale price of gingelly per imperial maund of 82⅔ lb. (equivalent to 3,200 tolas) as reported from important markets on 10th October 1938 was Rs. 6—7—0 in Trichinopoly, Rs. 6—1—0 in Salem, Rs. 5—14—0 in Tinnevelly, Rs. 5—11—0 in Cuddalore, Rs. 5—9—0 in Ellore, Rs. 5—7—0 in Tuticorin, Rs. 5-6-0 in Cocanada, Rs. 5—4—0 in Rajahmundry, Rs. 5 in Vizianagaram and Rs. 4—10—0 in Vizagapatam. When compared with the prices published in the last report i. e., those which prevailed on 8th August 1938 these prices reveal a rise of 9 per cent. in Tinnevelly and 7 per cent. in Ellore, and a fall of 8 per cent. in Rajahmundry, 7 per cent. in Cocanada, 5 per cent. in Vizagapatam and Salem, 4 per cent. in Tuticorin and 2 per cent. in Vizianagaram, the prices remaining stationary in Cuddalore and Trichinopoly. (*Director of Industries, Madras*).

Cotton Raw in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1938 to 14th October 1938 amounted to 458,443 bales of 400 lb. lint as against an estimate of 505,200 bales of the total crop of 1937—38. The receipts in the corresponding period of the previous year were 475,668 bales. 375,553 bales mainly of pressed cotton were received at spinning mills and 76,639 bales were exported by sea while 64,228 bales were imported by sea mainly from Karachi and Bombay. (*Director of Agriculture*).

Association of Economic Biologists, Coimbatore.

A meeting of the Association was held on 17—10—'38, with Rao Bahadur T. S. Venkataraman, C. I. E., Imperial Sugarcane Expert in the chair, at which the following papers were presented.

Frequency of flowering and boll setting in Cambodia cotton. By S. Sundaram. It has been proved by Mason and others that the development of the earlier formed bolls is mainly responsible for the shedding of the later formed buds and

bolls in cotton. Based on the above observation, it was felt that if a plant can start flowering with a large number of flowers a better yield could result.

With the above object in view flowers in a crop of Cambodia cotton were pruned from the commencement of flowering up to varying periods, such that the plants had a large number of flowers at the time of setting of bolls.

The result of the above trials indicated that an increase in the initial number of flowers was advantageous to a limited extent. But in the later stages the span of boll production declined proving thereby that an increase in boll setting exhausted the plant rapidly.

Of the different treatments examined for efficiency of boll production, plants which started with a large number of flowers during the second fortnight of the flowering phase were found to be the best of the lot. This would mean that under Coimbatore conditions a very early type of Cambodia is not necessary. One with a number of monopodial branches below the first sympodium will be more suited. Viewed in the light of the above results a little delay in the onset of flowering due to top-boring by spotted boll worm could also be considered advantageous, since by this damage the plants would be induced to produce a large number of flowers to start with.

Anthesis in Cotton. By N. G. Narayana. The time of opening of corolla and dehiscence of anther was studied in a number of varieties of cotton grown at the Cotton Breeding Station, Coimbatore. The studies have pointed out that despite wide fluctuations from day to day, a constancy in behaviour is maintained by each variety. Asiatic and American groups of cotton manifest interesting differences between themselves in this character. The time of opening is found to be more influenced by atmospheric temperature than by changes in humidity.

College News and Notes.

Students' Corner. The first and second year students assembled on the 4th instant after the Michaelmas holidays.

The final year students were taken on a study tour to Hosur, Bangalore, Hagari, Siruguppa, Kodur, Katpadi and Gudiyattam. Accompanied by Messrs. H. Shiva Rao and T. Nataraj, the students left Coimbatore on the 3rd after-noon and returned on the 18th fore-noon.

Students' Club. *Hockey* The Inter-collegiate hockey match between our college and the Ernakulam college was played on the 8th of October 1938, on the Forest college grounds when the final year students were away on tour. Our college put up a strong fight against the visitors, thanks to the unerring direction and encouragement of Kesava Reddy, the captain on our side. Early in the second half Kesava Reddy supported by Mohan Punja drew first blood, but the opponents soon after equalised. Just a few minutes before the whistle, Kesava Reddy took the entire defence of the opponents by surprise and scored the winning goal.

A friendly hockey match was played on 9--10—38 on our college grounds between our college and the Pappanaickenpalayam XI in which our college won by 3 goals to nil.

On 19—10—38, the Parnell Cup hockey match was played between Classes I and II on our grounds. The play was fast and exciting and ended in a draw.

Foot ball. On 7--10—38, the Victory Cup foot-ball match was played between Class I and Class II in which the latter won by 2 goals to one.

Cricket. On 16—10—38, a friendly Cricket match was played on our grounds between Mr. K. M. Thomas' XI and Mr. C. Ramaswami's XI. Mr. Thomas' XI declared their innings closed when the score was 200 for 6. (T. S. Srinivasan 55, C. N. Babu 50, Kothandaraman 37, S. V. Srinivasan 24, Hegde 3 for 43, Srikant 2 for 23).

C. Ramaswami's XI replied with 75. (C. Ramaswami 31 S. V. Sreenivasan 6 for 17, Kothandaraman 3 for 21):

Madras Agricultural Students' Union. A General Body Meeting of the resident non-student members of the Union was held on 1—10—38 with Mr. R. C. Broadfoot in the chair to consider the representation made by students during the last College Day and Conference.

Association of Economic Biologists. A meeting of the Association of Economic Biologists was held on 17—10—38, with Rao Bahadur T. S. Venkataraman, C. I. E., Imperial Sugarcane Expert in the chair.

Visitors. Mr. Wynne Sayer, Imperial Agriculturist, Delhi, was a visitor to the Estate on the 19th of last month.

Mr. T. J. Hurley, M. R. C. V. S., I. V. S., Director of Veterinary Services, Madras, camped here from the 19th to the 21st of September 1938. Along with Mr. Sayer, Mr. Hurley inspected the Dairy herd on 19—9—38. He inspected also the College Veterinary Hospital on 21 -9—38.

Mr. P. H. Rama Reddy, M. A., B. Sc., I. A. S., Director of Agriculture, arrived here on 21—9—38 from Madras, and returned on the 22nd.

A batch of I. D D. Students from Bangalore led by Mr. Varma visited the college Dairy on 24—9—38.

The Agricultural College Officers' Club. *The Club Day.* The Club Day was celebrated this year on the 22nd October 1938 (Deepavali day). This was as usual preceded by a series of indoor and outdoor tournaments, which attracted keen competition among the members. The Club Day dinner came off on the 20th night, and was well patronised. The Club premises were beautifully decorated for the occasion.

The Club Day opened with *Chota Hazari* kindly provided by the President Mr. C. Ramaswami. This was followed by field sports and indoor games. At 4 p m the members were entertained to tea.

In the evening entertainment programme were included the following interesting items:-'Song' by Mr. T. N. Anantanarayanan, 'Club Day Chronicle' and 'Mesmerism' by Mr. S. Krishnamurthy, 'Bul-bul-Tharang' by Mr. Ittyachan, 'Boat song' by Mr P. Abraham & Company.

The President then distributed the prizes to the winners of the several competitions. In winding up the proceedings, the President thanked the several sub-committee members and others responsible for making the Club Day a grand success.

The following are the winners of the important trophies :—

Game.	Donor.	Winners.
Tennis (Singles)	(C. Ramaswami's Cup)	M. K. Krishnaswami.
Tennis (Doubles)	(Rao Bahadur G. N. Rangaswami Ayyangar's Cup)	C. Ramaswami and Y. V. Narayaniah.
Auction Bridge	(K. Ramiah's Cup)	Dr. M. K. Nambiar and P. S. Narayanaswami.
Contract Bridge	(N. L. Dutt's Cup and T. S. Ramasub's Padmanab Shield)	G. K. Narayana Ayyar and K. C. Thomas.
Carrom Doubles	(H. Shiva Rao's Cup)	C. H. Krishnan and C. K. Kuppumuthu.
Carrom Singles	(K K. Rao's Cup)	C. H. Krishnan.
Table Tennis	(Cherian's Cup)	C. H. Krishnan.
Chess	(Vellodi's Cup)	N. Krishna Menon.
Tenekoit	(Dr. K. Narayanan's Cup)	Dr. K. Narayanan and E. J. Verghese.

Weather Review—SEPTEMBER 1938.

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	9·0	+1·5	29·0	South	Negapatam	1·7	−2·1	25·3
	Calingapatam	14·4	+7·0	31·7		Aduthurai *	3·0	+0·2	15·7
	Vizagapatam	12·3	+5·8	32·1		Madura	2·5	−2·6	19 3
	Anakapalli*	15 2	+7·8	38·2		Pamban	2·7	+1·5	15·0
	Samalkota*					Koilpatti*	4·6	+2·5	23·9
	Maruteru*	9·0	+2·4	37·3		Palamkottah	1·4	+0·1	16·1
	Cocanada	15·0	+9·2	39·5					
	Masulipatam	4·7	−1·5	27·0					
	Guntur*	7·7	+1·5	32·5	West Coast	Trivandrum	7 0	+2·9	47·3
						Cochin	7·1	−1·9	75·5
Ceded Dists.	Kurnool	6·4	+0·2	22·7		Calicut	8·1	+0·4	122·8
	Nandyal*	12·5	+7·3	34·1		Pattambi *	10 0	+1·2	79·3
	Hagari *	7·7	+2·5	22·8		Taliparamba *	12·1	+1·4	129 7
	Siruguppa*	11·4	+5·1	28 6		Kasargode *	13·4	+2·9	131·1
	Bellary	8·0	+2·9	23·2		Nileshwar*	13·0	+3·8	138·5
	Anantapur	5·7	−1·6	29 1		Mangalore	12·8	+2·4	138 8
	Rentachintala	8·5	0·0	27·3					
	Cuddapah	11·3	+5·0	32 7					
	Anantharaju-pet*	7 0	+2·4	22·5	Mysore and Coorg	Chitaldrug	5·7	+1·1	20·5
						Bangalore	6·8	−0·3	30·3
Carnatic	Nellore	12·9	+8·1	23·8		Mysore	5·6	+0·7	17 2
	Madras	5 8	+0 8	16·0		Mercara	13·9	+3·2	125·3
	Palur *	4 2	+0 7	29·7					
	Tindivanam *	5 9	+2 1	24·5	Hills	Kodaikanal	8·4	+1·1	37·7
	Cuddalore	4·5	−1·5	18 5		Coonoor		...	...
Central	Vellore	10 2	+2·9	29·6		Ootacamund *			
	Salem	3·9	−2·7	28·2		Nanjanad *	5·5	+0·6	29 8
	Coimbatore	1 5	0·0	8 6					
	Coimbatore A. C. & R. I.*	1·7	−0·1	8·4					
	Trichinopoly	2·1	+2 7	17·2					

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 published in the Fort St. George Gazette.

Weather Report. The monsoon, generally, active during the beginning of the month, slackened for some days during the second week and again strengthened from the 12th associated with thunderstorms in Malabar and Madras Deccan. From the 15th to 19th widespread thunder showers were nearly general in Malabar, Madras Deccan, North Madras Coast, and the rest of the peninsula. Again from the 22nd thundershowers were nearly general in Mysore, Southeast Madras, North Madras Coast and the West Coast. On the 26th a deep depression formed over East Central Bay of Bengal, centred the next day near latitude 15°N and longitude 90°E and later intensified into a cyclonic storm centred near Masulipatam, on the 29th and weakened the next day.

There has been nearly general rain in North Madras Coast, Southeast Madras, Madras Deccan, Malabar and Mysore throughout the month.

Skies were generally, moderately to heavily clouded in the Madras Presidency while elsewhere they were only lightly to moderately clouded. Humidity was in defect in Southeast Madras; while it was in excess in Madras Deccan

The maximum temperature in shade was below normal in Madras Deccan and Kashmir, above in Rajputana and Southwest United Provinces and normal elsewhere.

Chief amounts of rainfall.

Cocanada	5·1″	on the 29th.
Anakapalle	4·6″	,,
Vizagapatam	4·3″	,,
Kasargod	4·5″	,,
Mercara	4·0″	,,
Trivandrum	3·6″	on the 28th.

Weather Report for Research Institute Observatory.

Report No. 9/38.

Absolute maximum in shade	...	92°F.
Absolute minimum in shade	...	65°F.
Mean maximum in shade	...	88·6°F.
Departure from normal	...	−0·9°F.
Mean minimum in shade	...	69·5°F.
Departure from normal	...	−1·0°F.
Total rainfall	...	1·65″
Departure from normal	...	−0·14″
Heaviest fall in 24 hours	...	0·71″ on 23rd.
Total number of rainy days	...	4
Mean daily wind velocity	...	3 M. P. H.
Mean humidity at 8 hours	...	81·2%
Departure from normal	...	+7·7%

Summary. The monsoon was generally active during the month. The rainfall was practically received during the last week of the month. The total for the month was 1·65″ of which 0·71″ was received in one day The mean maximum temperature, the mean minimum temperature and the rainfall were slightly below normal, while the mean humidity was above normal. P. V. R. & J. C.

Departmental Notifications.

Transfers.

Name of officers	From	To
Mr. V. Ratnaji Rao,	A. D., Gudur	A. D, Venkatagiri.
,, M. Venkataramaniah,	Probationary A. D., Gudur	A. D., Gudur.
,, K. Ramanujachari,	A. D., Kavali	A. D, Sulurpet.
,, E. R. Gopala Menon,	Entomology Asst., Tellichery	Entomology Asst., Vellore.
,, I. Sambasiva Rao,	F. M., A. R. S., Gudiyattam	A. D., Bezwada.
,, R. Vasudeva Rao,	Offg. Supdt., A. R. S., Anakapalle	A. D., Bimlipatam.
,, K. Kuppamuthu,	Ware House A. D., Cuddalore	A. R. S., Palur.
,, A. K. Ramasubba Ayyar,	Van duty	A. D., Gopichettipalayam.
,, K. Ramaswami Ayyar,	A. D., Gopichettipalayam	A. D., Palladam.
,, P. P. Syed Mohamed,	A. D., Palladam	A. D., Tiruppur Co-operative Sale Society.
,, K. Vasudeva Shenoi,	A. D. (on leave)	A. D., Coondapur.
,, B. Narasimha Pattathan,	A. D., Coondapur	A. D., Puttur.

,, J. S. C. Antony,	A. D., (on leave)	A. D., Tiruvadanai.
,, P. R. Subrahmanya Ayyar,	A. D., Ramnad	A. D., Nellore Division.
,, M. C. Menon,	F. M., A. R. S., Taliparamba	A. D., Coondapur.
,, N. G. Narayanan,	Offg. Cotton Assistant, Coimbatore	Offg. Cotton Asst. Adoni.
,, S. Venkataraman,	A. D , Conjeevaram (on leave)	A. D. Madanapalle.
,, P. N. Krishnaswami Rao	Cotton Asst. Adoni	Cotton Asst. Coimbatore.

Leave.

Name of officers.	Period of leave.
Mr. C. Krishnan Nayar, Asst. in Mycology.	L. a p. for 15 days from 12-10-38.
,, D. Hanumantha Rao, A. D. Kothapeta.	L a p. for 15 days from 14-10-38.
,, P. N. Krishnaswami Rao, Asst. Cotton Section, Adoni.	Extension of l. a. p. for one week from 2-10-38.
,, K. Soopi Haji Sahib, Asst. A. D , Badagara.	L a. p. for 20 days from 7—10—38.
,, P. Uthaman, Asst. in Paddy.	L. a. p. for 20 days from 11—10—38.
,, P. Govinda Rao, Asst. in Mycology.	L. a p. for 30 days from 14—10—38.
,, M. Rama Reddy, A. D. (on leave).	Extension of l a. p for 30 days.
,, T. Paramanandham, A. D , Madanapalle.	L. a. p. for 1 month from 10—10—38.
,, V. Venkatadri Reddy, F. M , A. R. S., Koduru	L. a. p. for 20 days from 7—10—38.
,, A. Subrahmanyam, A. D., Bobbili.	L. a. p. on m. c. for 30 days from 6-10-38.
,, P. S. Athmaraman, A. D., Kumbakonam.	L a. p. for 2 months from 7—10—38.
,, A. K. Ganesa Ayyar, A. D. (on leave).	Extension of l. a. p. on m. c. for 6 weeks from 23—8—38.
,, V. K. Appaji, F. M., A. R. S., Palur.	L. a. p from 12—9—38 to 31—10—38.
,, R. G. Mal, A. D. (on leave).	Extension of l. a. p. on m c. for 4 months from 9—10—38.
,, M. Vydianathan, A. D., Guntakal.	L. a. p. for 15 days from 17—10—38.
,, S. Sitapatirao, A. D. Amalapuram.	L a. p on m c for 1 month from 5-9-38 and extension of l. a p. for 2 weeks from 5—10—38.
,, N. Krishna Pillai, A. D., Cheyyar.	L. a. p. for 1 month from 28—9—38.
,, K. Venkataswami, A. D. Kavali.	L. a. p. for 1 month from 4—10—38.
,, G. K. Subramaniya Ayyar, A. D. (on leave)	Extension of l. a. p for 3 months from 15—9—38.
,, A. M. Muthayya Nattan, A. D. (on leave).	Extension of l a. p. on m. c. for 1 month and 10 days from
,, K. Vasudeva Shenoi, A. D., Puttur.	L. a p. for 1 month from the date of relief.
,, K. Sanjeeva Shetty, Teaching Asst.	L. a. p. for 1 month from 6—10—38.
,, N. G. Narayanan, Offg. Cotton Asst	L. a. p. for 10 days from 10—10—38
,, E. R. Gopala Menon, Asst. Entomology, Tellicherry.	L. a. p. for 2 months from 7—10—38.
,, T. Gopalan Nair, A. D., Cannanore.	Extension of l. a. p. for 1 month from 11—9—38.