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Report on the Development of the Cattle and Dairy Industries of India.

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(Summary of Principal Conclusions and Recommendations.)

CHAPTER I

The total output of milk in India is exceptionally large, being between 700 and 800 million maunds or 5,600 and 6,400 million gallons per year. Compared with other countries India stands second in volume of milk production. She produces over four times the output of Great Britain, over five times that of Denmark, over six times that of Australia and over seven times that of New Zealand.

Owing to the density of India's human population the per capita consumption of milk is, however, extremely low. Estimates indicate that the average consumption per head per day does not exceed 7 to 8 oz.

According to existing dietary standards the quantity of milk required for the maintenance of satisfactory growth and health lies between 15 and 30 oz. per head daily. The output of milk in India would, therefore, need to be at least doubled in order to meet even the minimum requirement.

The consumption of milk is shown to vary according to income level. If consumption is to be increased it is essential that the price of milk should be within the purchasing power of the majority of the population. It is therefore not only necessary to increase the existing output of milk, but to effect all possible economies in the costs of production and distribution of milk and the manufacture of milk products.

CHAPTER II

In planning the development of the dairy industry it is essential to ensure that it caters for the existing taste and dietary habits of the population. Marketing surveys show that of the total output of milk, roughly one third is consumed as liquid milk. Of the remainder over 76 per cent. is converted into *ghee* and over 22 per cent. into *khoa*, *dahi* and other indigenous products. Western products such as creamery

butter and cheese are scarcely used except by Europeans and a small number of Indians who have acquired a taste for them.

The relative unimportance of Western products is also apparent from an examination of the quantity of milk products imported into India. These represent less than half of 1 per cent. of the total value of the milk products produced in India. An increase in the value of ghee by only 1 per cent. would add more to the wealth of the dairy industry than the replacement of the whole of the imported milk products by Indian produced articles.

There is little doubt that the evolution of the indigenous milk products which are peculiar to India (i. e., *ghee*, *khoa*, *dahi*, and related products) has been largely due to the fundamental difficulties involved in handling milk under tropical conditions and to the special problems associated with the lack of adequate communications and transport facilities.

The fact that 90 per cent. of the population live in rural areas introduces a further obstacle to the introduction of Western methods into Indian dairying practice. In particular it appears that the widespread adoption of a large-scale factory system of dairying in India would involve almost insuperable difficulties.

These facts indicate that what is needed in Indian dairying is a new out-look and a new technique; an out-look which recognises the special nature of India's problems and a technique which is designed to solve these problems.

Among the more important considerations which should be taken into account in the formulation of such a technique the following may be mentioned: first, the attention should be concentrated on the production of indigenous milk products and not on products of Western origin; second, steps should be taken to ensure that an adequate supply of milk and/or milk products is available for consumption by the rural population; third, any attempt to introduce improved methods should be effected by evolutionary rather than revolutionary changes of technique; fourth, the combination of producers on a village industry basis (as distinct from a factory basis) should prove the most effective form of dairy organisation in India; and fifth, any improvements in production should be supplemented by the provision of improved marketing facilities.

CHAPTER III.

Consideration of the methods of producing and distributing milk for liquid consumption should not be limited to the supply of milk to large urban centres, which include only some three per cent. of the population. Nevertheless, in view of the abnormally low milk consumption in large cities and of certain special difficulties involved in the provision of adequate supplies of milk in such densely populated

areas, a separate section of the present Report has been devoted to problems connected with city milk supplies.

As regards the general problems of milk production and distribution, these are partly associated with the lack of knowledge of hygienic methods of handling milk, and partly with the difficulties inherent in the tropical nature of the climate, the poverty of the Indian cultivator, and the lack of adequate communications and transport facilites.

On account of these special difficulties the methods of producing and handling milk in India may have to be greatly modified from those employed in temperate zones. Extensive investigations will require to be carried out on this subject. Such investigations should not be limited to laboratory studies, but should be tried out in practice under village conditions.

Some form of heat treatment will probably prove the best and most economical method of prolonging the keeping quality of milk under tropical conditions. Such treatment should be applied as soon as possible after production. Refrigeration also offers great scope for development in relation to the transport of milk to large cities, but the costs involved are considerable and will need to be greately reduced if the method is to be capable of widespread adoption.

The distribution of milk not only introduces the risk of re-contamination but offers unlimited opportunity of adulteration. As regards recontamination, it is extremely doubtful whether the introduction of modern Western methods, such as pasteurisation and bottling, could ever be employed on any considerable scale in India. For the mass of the popoulation some form of 'loose' milk distribution is inevitable. It is suggested that cheap methods of 'loose' milk delivery, such as, those largely employed in rural areas in Great Britain should be investigated under Indian conditions, and if necessary, modified to suit local needs.

As regards adulteration, figures collected from provinces show that from 20 to 65 per cent. of samples are watered or other-wise adulterated. Assuming that milk is, on the average, adulterated to the extent of 10 per cent. of added water, the financial loss to the dairy industry amounts to over 10 crores of rupees. Legislation exists for checking adulteration, but this is not applied effectively.

A second essential in checking adulteration is the formulation of reliable methods of analysis and satisfactory standards of purity. As regards methods of analysis, it is recommended that standardised apparatus should be employed and that revised conversion tables should be worked out. As regards standards of purity, extensive investigation is still required to enable the fairness of existing standards to be assessed. It is also suggested that the feasibility of allowing the 'standardisation' or 'toning' of milk should be considered.

CHAPTER IV.

There is no doubt that the production of *ghee* must be looked upon as the most important single factor in any scheme of development of the dairy industry. This product is of special value in Indian dairying economy, since it not only provides the cultivator with a cash sale, but leaves with him the greater and more valuable part of the milk, *i. e*, the non-fatty solids contained in the *lassi* or butter-milk. This also applies to the production of ' country ' butter.

The first direction in which improvement might be effected in the production of *ghee* is in the total outturn. But it is equally essential that quality should not be sacrificed in efforts to obtain higher yields of *ghee*. The whole subject of the relationship of out-turn to quality of *ghee* requires thorough investigation.

Figures collected from provinces show that up to 65 per cent. of the samples of *ghee* which were examined were adultered. A calculation of the total quantities of adulterants available in India indicates that these amount to at least 6 per cent. of the total output of *ghee*. It is found, however, that there is a difference of opinion among authorities regarding the analytical standards for the detection of adulteration. These require re-investigation. In addition it is most desirable that a cheaper and quicker method for detecting adulteration should be devised.

It is suggested that the difficulties involved in the sale of *banaspatine* under the term (vegetable) *ghee* could be met by the adoption of legislation similar to that which governs the sale of margarine in Great Britain.

It is urgently necessary that facilities should be provided for the improved marketing of *ghee*. Additional markets should be established in those *ghee* producing areas which are not at present adequately provided for. In addition, an attempt should be made to establish grading centres, preferably under the Agricultural Produce (Grading and Markeing) Act, 1937. The value of advertisement as a means of popularising improved grades of *ghee* should be explored.

' Creamery ' butter constitutes only about 0·15 per cent. of the total output of milk products in India. There are, however, indications that the demand for such butter is increasing and the needs of this branch of the dairy industry should not therefore be neglected. The most important direction in which improvement should be sought is in the quality (flavour and texture) of the product.

CHAPTER V.

Apart from liquid milk and *ghee* the most important dairy products produced in India are *khoa*, *dahi* and certain other indigenous milk products. The quantity of milk utilised in their manufacture approximates 95 milllion maunds (760 million gallons), which is more

than twice that utilised for the whole of the production of manufactured milk products in Great Britain. It is also significant to find that the indigenous Indian milk products realise more per maund of milk than liquid milk itself. This is contrary to the experience of practically all Western countries, but re-emphasises the importance of these products to the Indian dariy industry.

Certain of these products are manufactured by a process of partial desiccation, while others are produced by the souring of the milk. The processes of manufacture are however primitive and crude, and urgently call for improvement. Attention should be given to better methods of packing and marketing and to the provision of standards of quality. It is also suggested that the munufacture of indigenous milk products might provide a useful outlet for separated milk, where this is available.

It is desirable that the nutritive value of the various indigenous milk products should be carefully investigated in view of their widespread consumption.

The production of cheese in India is negligible, and imports of cheese are equivalent to only 0·002 per cent. of India's total milk production. Nevertheless the manufacture of European varieties of cheese (to replace imports) might be encouraged at hill stations.

CHAPTER VI

The amount of separated milk produced in India is small and little if any of it is wasted. A considerable quantity is, however, made into casein, and this is lost as a source of nutriment. The question arises to whether it would be justifiable to attempt to establish milk condensing and drying factories.

The present market for condensed milk in India is relatively small. There is a considerable market in South and East Africa, in Malaya, and in other Far Eastern countries but the possibility of building up an export trade from India is open to considerable doubt. Very little milk powder is consumed in India, but there is some indication that the market for this product might be expanded. Consideration of a number of relevant factors indicates that the feasibility of establishing condensing and drying factories in India would depend largely on whether the requisite quantities of milk could be collected at convenient centres, and whether such milk would be of sufficiently good quality to be capable of conversion into condensed milk and milk powder.

CHAPTER VII

India possesses the largest number of cattle of any country in the world. Out of the world's cattle population of about 690 million animals, 215 million (or just under one third) are located in India. Owing to adverse climatic and economic conditions the productive

value of the cattle industry is not commensurate with its size. Nevertheless the actual and potential value of cattle products is very great.

Milk and milk products may be valued at about 300 crores of rupees. This is roughly equivalent to the value of India's total output of rice, and is three to four times the value of the output of wheat. India is also the largest exporter of hides and skins in the British Empire, her yearly output of this group of products being valued at roughly 40 crores of rupees, or more than the value of the total Indian production of sugar. Cattle labour also represents an important contribution of live-stock to Indian agriculture, the monetary value calculated on the basis of cultivation costs being estimated at between 300 and 500 crores of rupees.

The value of cattle as a means of raising the fertility of the soil cannot be readily computed. One estimate places the cash value of cattle manure at 270 crores of rupees. There is no doubt that the widespread adoption of 'composting' would greatly enhance the value of this manure. But the potential value of cattle as a means of introducing a 'mixed-farming' system in India, and thus of improving crop yields, is incalculable. In any such system of 'mixed-farming' the introduction of leguminous fodder crops would still further increase soil fertility, while the improvement in crop yields should off-set any apparent increase in the cost of milk production.

CHAPTER VIII

Comparatively slow progress is being made in the distribution of pedigree and approved bulls; the number of bulls at present at stud represents only one per cent. of India's requirement. There is little doubt that material progress will only be achieved by increasing the number of approved and registered stock raised in villages and by private breeders. The purchase of such bulls for distribution provides a most valuable stimulus to improved cattle breeding in selected areas and gives encouragement to progressive breeders. At the same time it is essential that 'type' should be preserved within each breed and this will necessitate the continued maintenance of Government breeding farms where the methods of breeding can be more accurately controlled.

It is difficult to assess the value of the present castration policy in eliminating the scrub bull. Progress in the number of castrations performed varies from province to province. There is still considerable difficulty in getting young stock castrated at a sufficiently early age. One direction in which future action should be concentrated is the intensification of castration measures in selected breeding areas, combined, if possible, with the inoculation of all local stock against rinderpest.

CHAPTER IX

There is probably no single measure which would do more towards increasing and cheapening milk production in India than an improvement in the milk yields of Indian cattle. At present the yields of village cattle average only about 600 lb. per year. An increase in yield would lower the cost of milk production by spreading maintenance costs and costs of depreciation and labour over a larger output of milk.

In formulating breeding policies two essentials must be kept in mind: first, the necessity for adopting a policy which will meet local requirements; and second, the need for continuity in the programme of breeding and the urgency of ensuring that the programme is not prematurely interrupted.

Certain breeders have tended to rely on cross-breeding with sires of high-yielding European breeds to raise the productivity of their stock. The immediate beneficial results of such cross-breeding on milk yield are striking, but they have invariably been obtained in herds where exceptional facilities for the control of breeding, as well as of feeding and general management, have been available. In the hands of *gowalas* and similar uneducated owners of milking stock the results have frequently been disastrous. There is no doubt that the general adoption of a policy of cross-breeding to improve the milk yields of country stock would be fatal to the development of sound dairying in India.

Breeding experiments carried out at various centres show that by careful selection indigenous strains of Indian cattle can be built up which are capable of giving milk yields comparable with those found among average European stock. It is essential that the breeding of high yielding strains should be greatly extended. In order to encourage such breeding the establishment of herd-books and of a system of milk record should be proceeded with as soon as possible.

There is no doubt that she-buffaloes must be looked upon as the premier milk-producing stock in India. Their growing popularity is reflected in the census statistics, while marketing surveys indicate that they already provide nearly half of India's total milk supply.

With intensive milk production there is inevitably a constant rivalry between constitution and economic performance. Management is therefore an extremely important factor, particularly under the exacting conditions of climate experienced in the Indian plains. The relation of management to the maintenance of a sound constitution should be looked upon as one of the major subjects for investigation in connection with the breeding of improved stock.

CHAPTER X

The majority of Indian milch cattle are seriously underfed. This is apparent not only from a superficial inspection of stock, but from

the slow rate of growth, the late maturity and the long dry periods of cattle kept under village conditions.

Estimates of the total quantities of nutrients available for the feeding of cattle in India show a marked deficiency especially in the amount of protein. If milk production is to be increased the provision of a very much larger food supply is essential.

Coarse fodders are relatively valueless for milk production. Cultivated grasses are reasonably satisfactory, but the fodders of outstanding value are the leguminous crops such as berseem (Egyptian clover) and lucerne (alfalfa). It has already been noted that these are of special importance to Indian agriculture by virtue of their ability to enhance the fertility of the soil. Wide variations in the yields and costs of production of these fodder crops have, however, been recorded. Careful and extensive investigations into the factors responsible for these variations are urgently needed. Such investigations should include a study of the effect of the leguminous crops on the subsequent growth of cash and food crops. They should also include a study of the value of different fodders in the feeding of milking stock and on the costs of milk production. The conservation of such fodder crops also requires investigation.

Efforts should be made to increase the available supply of protein-rich concentrates such as linseed, cotton-seed and earth-nut cakes. This might be achieved by encouraging the export of vegetable oils and by improving the efficiency of the mills.

It appears to be a fairly universal experience that Western rationing systems are not suitable for application to Indian cattle and buffaloes. It is therefore desirable that a suitable system of rationing should be devised for the guidance of milch cattle owners. In addition it will be necessary to obtain representative analytical figures of typical feeding stuffs for as many agricultural areas as possible.

During the past few years instances of mineral and vitamin deficiency diseases have been recorded in India. There is little doubt that such deficiencies are far more common than has been generally supposed, and that they are a source of serious economic loss. It is desirable that extensive surveys of the incidence of such deficiency diseases should be undertaken, and that the information so obtained should be supplemented by accurate studies of mineral requirements and by mineral analyses of fodders drawn from typical cattle breed- and milk producing areas.

CHAPTER XI

In order to provide an adequately staffed and equipped centre for research into the many problems which face the dairy industry, it is recommended that the existing Imperial Dairy Institute should be transferred to a more suitable site and should be reconstituted as an

Imperial Dairy Research Institute. Under the Director the work of the Institute would be divided into four sections, namely, dairy bacteriology, dairy chemistry, dairy technology and dairy husbandry. Details are given regarding the buildings, equipment and staff required for such an institute.

If such an institute is established, the need for a separate experimental creamery (such as that proposed at Anand) will not arise. The Anand Creamery would, however, provide an ideal substation for the study of problems involved in the supply of milk to large cities, should such a substation ultimately be required. It is suggested that the whole of the Anand Creamery proposals should be held over meantime until the new Research Institute has been established and preliminary experiments have been carried out on the various problems involved in dealing with liquid milk.

Side by side with the development of the new Research Institute, efforts should be made to encourage the investigation of dairying problems at provincial agricultural colleges. The Imperial Council of Agricultural Research might give valuable assistance in this direction.

The course for the Indian Dairy Diploma provides a valuable basis of instruction for students who desire general training in dairying. The proposal to extend the period of instruction from two to three years is shown to be unnecessary though certain alterations in the syllabus are desirable. In particular, more stress should be laid on the methods of production of indigenous milk products, on the need for devising cheap types of equipment, and on improvement in the methods of producing milk and milk products by co-operative enterprise and by the development of village industries. The course should also include practical training in methods of imparting instruction.

Training for the I. D. D. should be given at provincial agricultural colleges and not at the central institute. It is doubtful, however, whether such training could at present be satisfactorily arranged in all provinces. It is therefore suggested that the number of centres should meantime be limited. The transfer of instruction would necessitate the provision of certain safeguards, including the adoption of a uniform syllabus and of a reasonable degree of uniformity in the methods of instruction at all centres and the establishment of a central examining board. The appointment of a special committee under the Imperial Council of Agricultural Research is recommended.

As regards post graduate training, the course for the National Diploma in Dairying of Great Britain is entirely unsuitable for Indian students. For graduates who require training in technical dairying, the I. D. D. course provides adequate instruction. For graduates who require training in research methods facilities should be provided at the Imperial Dairy Research Institute. Opportunity should also be taken to encourage such graduates to gain further experience by

studying at recognised research laboratories abroad. For this purpose scholarships might be provided by the Imperial Council of Agricultural Research.

If improved methods for the production and handling of milk and the manufacture of milk products are to be made use of in the villages, it will be essential to have available a large number of workers trained in certain elementary dairying practices. Courses of training for such workers should be provided at provincial agricultural colleges. It is recommended that serious consideration be given to the provision of dairy training for women.

It is desirable that dairying instruction at veterinary colleges should be extended to include a knowledge of elementary dairying and of the principles involved in the production and handling of milk including the management of a dairy herd.

It is strongly recommended that provincial governments should take the necessary steps to establish an advisory service for the dairy industry. As a first step it is suggested that a Dairy Development Officer should be appointed in each province. The major duty of such an officer would be to initiate dairying developments and to take the lead in encouraging the adoption of improved methods. The Dairy Development Officer should work under a special committee representative of the various branches of government activity concerned.

In order to secure co-ordination between the central and provincial governments, it is recommended that the Director of the Imperial Dairy Research Institute should act as part-time Dairy Expert to the Imperial Council of Agricultural Research, and that in this capacity he should be responsible for maintaining contact with provincial dairy developments. He should be provided with a special officer who could relieve him of much of the detailed work involved and who could act as personal liaison officer between the centre and the provinces.

CHAPTER XII

The solution of problems connected with the breeding of cattle requires the appointment of an animal geneticist. Work in this field would include the investigation of problems of inheritance, of problems involving a study of the physiology of reproduction (including endocrinology), and of problems connected with management and constitution. In the investigation of problems of inheritance full use should be made of records available at the various Government breeding farms.

Greater use should be made of existing experimental and demonstration farms (of which there are some 200 in India) in studying problems of fodder production. Such farms should be equipped with small herds of pedigree milch cattle. They could thus fulfil a dual function by acting as centres for the study of mixed-farming methods

and by providing valuable nuclei for the breeding and distribution of pedigree milking stock.

In devising a rationing system suitable for Indian cattle and buffaloes, full use should be made of existing provincial research centres (i. e., Lyallpur, Dacca and Coimbatore) as well as of the newly established Animal Nutrition section of the Imperial Veterinary Research Institute at Izatnagar. A provisional allocation of work is suggested in the Report. The Imperial Agricultural Research Institute at New Delhi should undertake such comprehensive fodder and feeding stuffs analyses as are required.

As regards mineral and vitamin deficiency diseases, the Disease Investigation Officers who have been appointed in each province through the Imperial Council of Agricultural Research should be responsible for field surveys, while facilities should be provided at the Nutrition Section at Izatnagar for the mineral analyses of suspected pastures.

Adequate facilities for instruction in breeding and live stock management are available at most provincial Agricultural colleges. At veterinary colleges, however, facilities for practical instruction are lacking. It is recommended that, as a minimum, each veterinary college should possess a small herd of milking cows, with accompanying bulls and young stock, and sufficient land to demonstrate agricultural operations and to produce fodder for the herd.

There is urgent need for securing suitable men who can be specially trained in cattle breeding and management. The potentialities of a student for live stock work will usually become apparent during his college course, and every effort should be made to pick out such a man for further training. This training should include experience on an approved cattle breeding farm and an advanced course in animal husbandry at a central institution.

In connection with the ultimate establishment of a Genetics Section at Izatnagar a small number of trained geneticists will be required. It is suggested that the Imperial Council of Agricultural Research should consider awarding one or two special scholarships to enable promising post-graduates to obtain the necessary research training overseas.

The effective dissemination of knowledge acquired at research centres, as well as the control of breeding and live stock improvement, will ultimately depend on the employment of a large staff of trained men who can work among cultivators in the villages. For such 'stockmen' it is desirable that special elementary courses of instruction should be instituted.

It is strongly recommended that, in the interests of both efficiency and economy, live stock improvement and veterinary work should be

unified under a single department of animal husbandry. It is recognised that for local and personal reasons immediate unification may not be desirable or possible in all provinces. But it is suggested that unification should be looked upon as the ultimate goal.

If unification is adopted, it will be essential for the Director of the unified department to have on his staff a Live Stock Expert with special knowledge and experience of cattle breeding. It will also be essential to ensure close co-operation with the Department of Agriculture. This would be facilitated by the appointment of a Fodder Specialist, who would normally work in close touch with the Live Stock Expert.

Further cattle improvement cannot be effected without increased expenditure, whether the control of such improvement is under the agricultural department or is unified with the veterinary department. Existing figures show clearly that the extent of live stock improvement in the different provinces runs roughly parallel with expenditure. The unification of animal husbandry and veterinary work should not therefore be looked upon as a means of reducing expenditure on cattle improvement : rather, is it a means of making the best use of any funds available for live stock improvement and of ensuring that such improvement is effected under the most favourable conditions.

The present measures which are designed to improve the general standard of Indian cattle are largely concerned with draught breeds. Every effort should be made to augment the number of agencies which can be used for developing the milking potentialities of indigenous Indian breeds of cattle. Such agencies should include the Military Dairy Farms, district and demonstration farms, and *gowshalas* and *pinjrapoles*. It is suggested that a special officer should be appointed under the Imperial Council of Agricultural Research whose duties would include the stimulation of interest in milch cattle breeding at various centres and the giving of expert advice to *gowshalas* and *pinjrapoles* which desire to improve their methods of management and to adopt a constructive breeding policy.

In order to maintain close cooperation between all departments concerned with rural development, it is suggested that a Board of Rural Development should be constituted in each province. This Board would include the Directors of the Departments of Agriculture, Forestry, Veterinary services and Public Health, a representative of the Irrigation and Revenue Departments and the Registrar of Co-operative Societies. Specialist officers would attend the meetings of the Board. The Chairman would be a non-technical officer of the rank of Commissioner and with a special knowledge of and interest in rural conditions. The Board would act solely as a co-ordinating and advisory body, but would be in a position to make direct representations to the responsible minister in regard to any controversial matters.

STUDIES IN SUGARCANE JAGGERY

III. The Empirical Test for the End-point of Boiling in Jaggery Manufacture.

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The test usually applied to mark the end-point of boiling in the manufacture of jaggery consists in subjecting, from time to time towards the last stages in the process, small portions of the boiling mass to sudden cooling by pouring them into large bulk of cold water. At the stage when this supercooled portion assumes a sufficient degree of hardness as judged by the sound produced when struck against the sides of the pan, the boiling is stopped, the pan removed from the furnace and the mass allowed to cool until signs of the crystallisation of sucrose, or in other words, of the setting of jaggery, become visible. It is then gathered into a heap and transferred into moulds.

The cane juice contains a large bulk of water with sucrose, reducing sugars, non-sugar-organic matter and minerals, free and in organic combination, dissolved, or suspended in it in various states of aggregation. As the boiling progresses, the syrup formed thickens in consistency. When the 'rab' stage, familiar in sugar manufacture, is attained, the mass consists of a supersaturated solution of sucrose. If in this condition, it is slowly cooled, sucrose crystals separate out from the mother liquor and the latter becomes to that extent less supersaturated.

But instead of cooling at this stage, in jaggery manufacture it is subjected to further continuous heating. Due to this cause, the solvent action of the mother liquor tends to increase, while at the same time, its quantity gets diminished, due to the rapid evaporation of water from the open pan. Thus, the two processes taking place simultaneously operate in a manner mutually antagonistic with respect to quantities of sucrose held in solution.

As however the liquor gets diminished more rapidly under the open pan conditions, it would be expected that more sucrose would be thrown out than is held in solution.

Now, every external influence upon a mobile system produces a change in such a direction that the resistance of the system towards the external influence is increased as a result of this change. As such, it should be that the sucrose theoretically thrown out of solution is continually changing its phase into a fused or molten form, consequent on the absorption of heat. Thus, it can be easily visualised that a stage would be reached in the boiling of the juice to jaggery, when the

whole mass would consist of molten or fused sucrose with the impurities embedded in it, taking even the residual water only as an impurity. Therefore the answering of the empirical test seems only to mark the stage when this phase transformation is accomplished.

From this it follows that the conditions for the setting of jaggery, or the crystallistion of sucrose from the final mass, in the normal method of manufacture of jaggery, can be taken to be similar to those governing the crystallisation of any substance from its melt, i. e. to the conditions of the tranformation of liquid (melt) to solid (crystal) when the liquid phase alone is present to start with.

It is well known that the following are among the most important of the factors for the good crystallisation of any substance from its melt :—

(i) The specific crystalline capacity of the substance.

(ii) The molecules of the substance should posses high specific velocities for free and rapid movement.

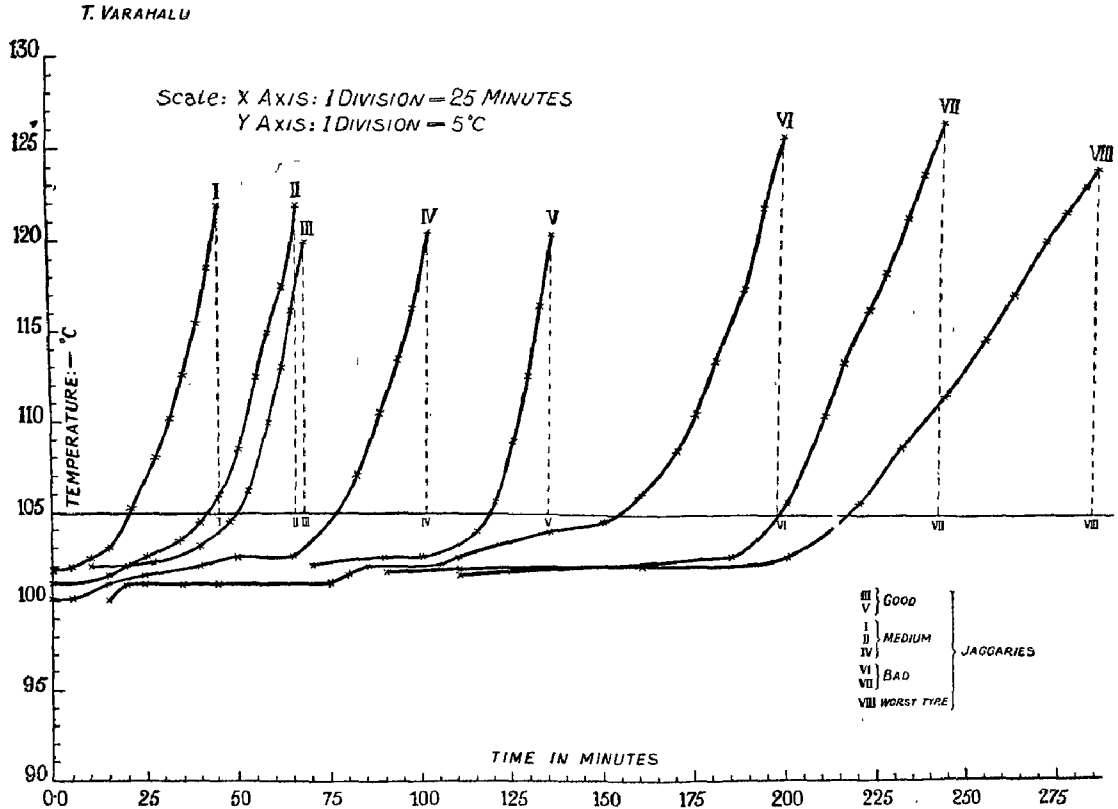
(iii) The resistance to the velocity of the spontaneous nuclei formation should be a minimum.

(iv) The system should allow of free translational movements of the molecules of the crystallising substance.

(v) The distances over which the molecules have to travel, before finding nuclei to deposit themselves on, should be short, or in other words, the thickness of the adsorbing layers should be as small as possible.

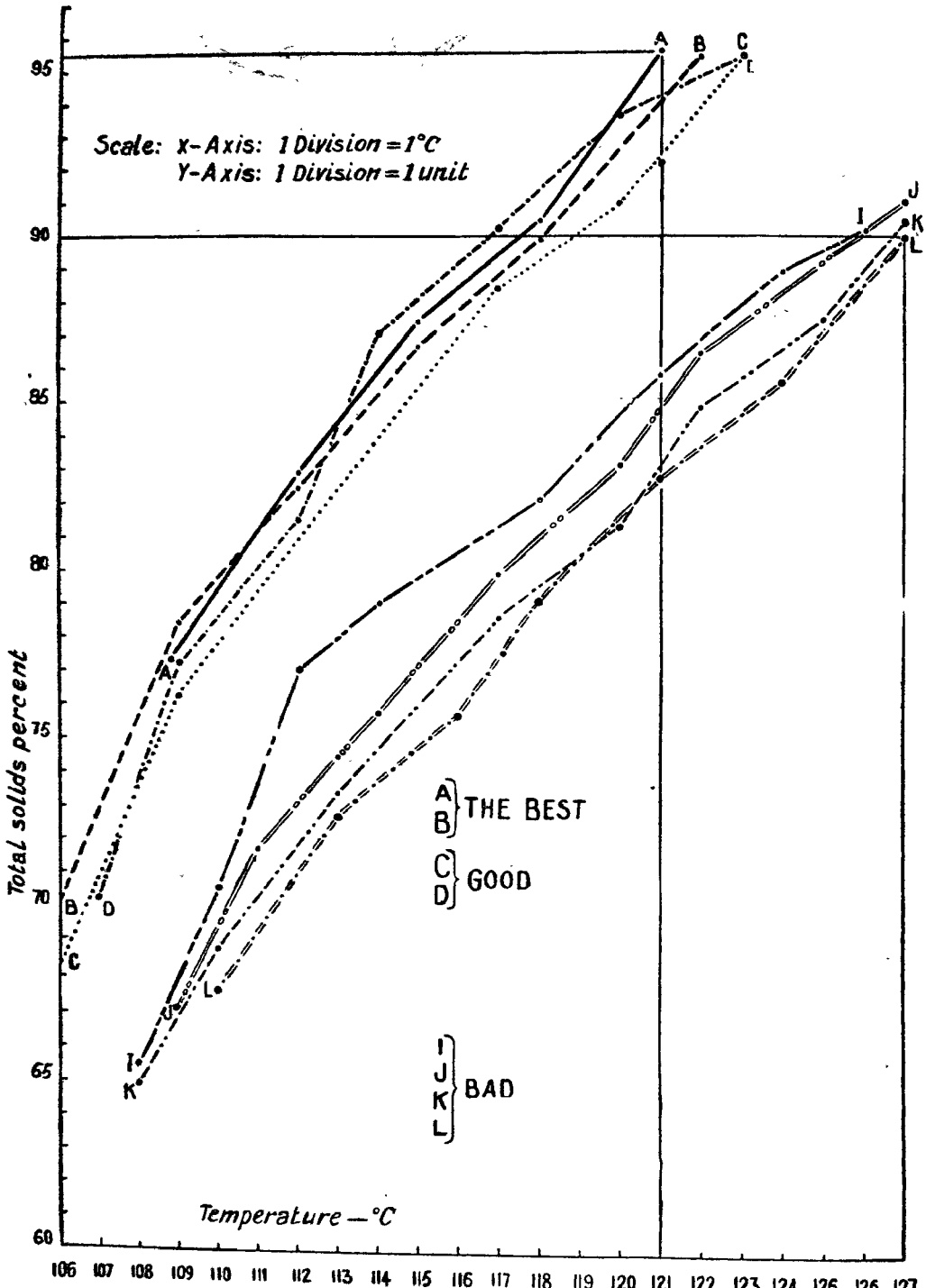
These conditions may now be applied to the crystallisation of sucrose in the setting of jaggery. The conditions (i) and (ii) are constant for purposes of the present study as the substance concerned is a chemical unit, sucrose, but the only factor on which these depend is that of temperature. But so far as the factor (ii) is concerned, it is also a function of the molecular weight of the substance, and in the case of sucrose, this is as high as 342, and is inherently comparatively sluggish in its movements. Any system in which it is present in high concentration presents conditions of viscosities of high magnitudes. Further, sucrose has very high solvating capacities. Factors (iii) and (iv) are mainly concerned with the proportion and the properties of impurities accompanying sucrose, and with the temperature of the system, and factor (v) is almost exclusively determined by the proportions of the non-sucrose materials or the impurities.

The rate at which nuclei form is a fundamental factor on which the rate of crystallisation depends. But the mere existence of the nuclei need not necessarily lead to the formation of crystals. The crystal formation and their growth is considerably influenced by the stage in the period of cooling at which the nuclei form. If the nuclei form at a high speed immediately below the melting point, they grow



GRAPH SHOWING THE MANNER OF TEMPERATURE RISE WITH TIME TOWARDS THE FINAL STAGES IN THE PREPARATION OF JAGGARY

PLATE I



Graph showing the changes in concentration & the corresponding temperatures during the boiling down of the cane juice to Jaggary.

PLATE II

quickly into visible crystals. This is what happens in the cases where good jaggeries are produced. An examination of the data in Tables 1 and 2 reveals that the setting of the masses where good jaggeries were formed took place in shorter times and at higher temperatures. But if the nuclei form at a slow rate and gradually increase on cooling, the velocity of their formation is affected to a high degree by secondary influences as (a) the presence of impurities, and (b) the viscosity of the medium, and so, on all factors on which the latter depends. Under such conditions, it is possible that the nuclei may only tend to remain latent without showing any signs of growing into visible dimensions. The several gradations which this suggests in the matter of the setting of the jaggery and the formation of the crystals and their growth, are illustrated by the data pertaining to the bad jaggeries presented in Tables 1 and 2. In all cases where bad jaggeries are produced, the time taken for setting was long, and temperature at which it took place was low.

On the concentration of the impurities and their capacities to adsorb on the already heavy molecules of sucrose depends the thickness of the adsorbing layer. This thickness of the adsorbing layer controls both the rate of the translatory motion of the molecules and also the distances over which they have to travel to find nucleus to deposit themselves on. The medium should be less dense, less viscous and be at a higher temperature to admit of free movement of molecules. Otherwise even if the nuclei form in large numbers, the crystal growth will be greatly impeded. The falling temperatures accentuate the adverse effects both of viscosity, and of the impurities.

That the impurities which accompany sucrose in the good and the bad jaggeries are so distinctly different, and cause strikingly contrasting effects in the process of jaggery manufacture is illustrated by the differences in the slopes and the forms of the curves for the two types of jaggeries in Plates I and II. It can be easily seen that the bad jaggeries contain substances which cause high viscosities, retard the progress of boiling, cause a tenacious retention of moisture, and offer resistance to the formation of the nuclei and the growth of the sucrose crystals. Such adverse effects are not present in good jaggeries. In the latter cases the boiling was taking place smoothly and quickly and the crystallisation proceded rapidly and unimpeded.

Another interesting point that becomes evident from the data in Tables 1 and 2 is that excepting in very abnormal cases, in all the rest the empirical test was answered almost normally, irrespective of the fact whether there were produced good or bad jaggeries eventually from these masses. This invariable tendency to answer the empirical test on the part of the final masses in all cases at once suggests that they all tend to approach one common physical condition, namely that

of molten or fused sucrose with all the impurities, including the residual water, embedded in it, and that the answering of the test only marks the completion of this approach.

Thus, the answering of the empirical test does not seem to convey, as such, any more meaning beyond indicating the completion of the transformation. The test does not by itself ordinarily throw any light on the probable behaviour of the final mass after answering the test, whether it would eventually yield a good or a bad jaggery. This test also does not appear to have any relationship to the quality of the juice started with. The final strikes obtained from rich good juices, as also those resulting from the use of juices which are poor, usually answer the test almost alike.

But it must be here noted that as the degree of abnormality of the juice increases, due to whatever cause, the approach to the common physical condition is either imperfect, or delayed or not approached at all, depending upon the particular conditions.

In the light of these considerations, it will be seen that so far as the physical conditions of the jaggeries are concerned, they may be considered in three distinct stages:

(i) The condition when the final concentrate answered the empirical test.

(ii) The condition when the setting of the jaggery or the crystallisation of sucrose takes place, and

(iii) The condition of the jaggery in the final form.

In stage (i) it may be considered as a mass of molten or fused sucrose with the impurities embedded in it, the molten sucrose forming the continuous phase.

In stage (ii) when crystallisation takes place during cooling, there will result a contraction of the mass in the mould, and a discontinuity in the outer phase of the fused sucrose due to crystal formation. The consequence of this would be that a sort of syneresis occurs and the previously protected syrupy fluid exudes out.

Now, if the crystallisation takes place in shorter time and at higher temperature, the crystals would grow well and the largest portion of the enclosed fluid would exude out. Due to the high temperatures prevailing, the liquid will be thin and highly mobile. In this state, and assisted by the high stresses which also prevail concomitantly, it is easily driven from the centre to the periphery in the mould, and gets compressed into thin envelope on the outside, the sucrose crystals forming a hard highly crystalline inner core. This is what happens in all good jaggeries, as will be seen in a subsequent communication.

But if the fluid is viscous and slow drying, and further, if its proportion is also high, the portions of it that first leak out, when the

discontinuity in the sucrose phase occurs consequent on nuclei formation, quickly surround and enmesh each particle, and prevent the rapid diffusion of the sucrose molecules towards the nuclei. This diffusion is further retarded with fall in temperature. Thus the crystals do not grow well and the fluid remains distributed over the entire bulk of the jaggery, without being driven far towards the periphery. These conditions obtain in varying degrees in bad jaggeries.

In stage (iii) when jaggeries have set and cooled down and as they are available for direct consumption, they may be considered as consisting of the matrix material mixed with solid crystals of sucrose of different sizes. The differences in the hardness, strength, consistency and in structures noticeable so commonly among jaggeries, are evidently intimately associated with the drying capacity of the matrix, and the number of crystals of different sizes, and the proportions which they bear to each other and to the total matrix.

Again, with lapse of time, diffusion through the matrix takes place extremely slowly, such that with ageing, crystal growth and fresh crystal formation are frequently observed to take place.

The author takes this opporunity to express his grateful thanks to Rao Bahadur B. Viswanath, Director, Imperial Agricultural Research Institute, New Delhi and to Mr. P. V. Ramiah, the Government Agricultural Chemist, Coimbatore, for the facilities and encouragement they afforded.

Table 1.

Showing the Times and the Temperatures of the Setting of Jaggery.

Variety.	Temp. at the end of boiling. – °C.	Time taken for the setting of jaggery minutes.	The temp. at which the setting took place. – °C.
	Good Jaggeries.		
P. O. J. 2878	123	9	109
Co. 213	122	9	104
"	120	7	110
Co. 313	123	8	109
B 208	119	6	108
Co. 281	121	11	105
Co. 281	121	13	106
M. A 21	122	10	105
Co. 243	119	10	104
	Bad Jaggeries.		
Co. 313	123	18	95
D. 131	124	18	93
Co. 213	123	24	95
Co. 213	121	22	93
J. 247	120	27	89
Co. 313	121	20	91
E. K. 2.	122	25	86
Purpule Mauritius	123	18	92
P. O. J. 2878	120	17	95
Co. 243	122	80	64
Co. 213	123	60	70

Table 1 (continued).

These two were not fully ripe and they were grown in dry lands. There was profuse frothing and fuming. The empirical test was not answered satisfactorily. The mass did not actually set; it only congealed on cooling. It was tough, stringy and glassy.

J. 247	124	95	60

The mass did not set but only congealed into a glassy material. The canes consisted of superfluous sets which remained over for some days during hot weather. The final mass in this case did not answer the empirical test at all. The chilled mass always remained soft. It could not be even gathered well into the hand. The mass did not show signs of crystallising even after one year as judged by the naked eye.

Table 2.

Statement Showing the Manner of Temperature Rise Towards the Final Stages in the Boiling Down of the Cane Juice to Jaggery.

Sample Number.							
I.		II.		III.		IV.	
Time in Min.	Temp. – °C.	Time in Min.	Temp. – °C.	Time in Min.	Temp. – °C.	Time in Min.	Temp. – °C.
	102		101		102		100·1
5	102	15	101·5	10	102	5	100·1
10	102·5	20	102	27	102·2	15	101
15	103	25	102·5	40	103·2	25	101 5
21	105·2	35	103·5	48	104·5	40	102
28	108			53	106·2	50	102·5
32	110·2	40	104·5	58	110	65	102·5
35	112·5	45	106	62	113	76	104·8
39	115·5	50	108·5	64	116·2	82	107
42	118·5	55	112·5	68	120	88	110·5
45	122	58	115			93	113·5
		62	117·5			97	116·3
		66	122			101	120·6
						103	124·5

Sample Number.							
V.		VI.		VII.		VIII.	
70	102		100	110	101·5	90	101·5
90	102·5	20	101	180	102 5	110	101·5
100	102·5	75	101	200	105·6	160	102·1
110	104	80	101·5	210	110·5	200	102·5
120	105·5	85	102	215	113·5	220	105·6
125	109	105	102	222	116·5	231	108·8
129	112·6	110	102·5	227	118 5	243	111 6
132	116·5	135	104	232	121·5	254	114·8
135	120·5	150	104·5	236	124·0	262	117·4
				242	127 0	270	120·4
		160	106			276	122·0
		170	108 5	Fuming and Frothing		281	123·4
		175	110·5	The test is however		284	124·4
		180	113·5	answered.		Fuming and Frothing. The test is not answered well. The chilled mass was always soft.	
		188	117·5				
		193	122				
		197	126				

Approximate Time (Min.) taken for the Completion of the Boiling from the Time when about 105°C is Reached.

Sample No.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
*Time in Min.	25	24	18	27	17	43	45	67

* These times are as measured from the graph. (Plate II).

SOME OF MY REMINISCENCES

BY RAO BAHADUR M. R. RAMASWAMI SIVAN, B.A., Dip. Agri.

I. The Madras Agricultural Students' Union.

It was nearly 50 years ago,—to be more exact, in August 1889—that I got admission as a student in the College of Agriculture at Saidapet, and, after several years' work as Clerk, Farm Bailiff and Lecturer in that institutution, I had the privilege of being one of the staff to be drafted into the Agricultural College and Research Institute at Coimbatore as Chief Assistant to the Government Agricultural Chemist in 1908 and retired, in May 1927, after nearly 20 years, as Government Lecturing Chemist and as Principal. Starting from the lowest rung of the ladder as Second Clerk and Assistant Farm Bailiff on Rs. 20 at Saidapet, it was my good fortune to be promoted to the Indian Agricultural Service and to reach the top of the ladder as permanent Principal of the Institution at Coimbatore, before I retired from service and to watch and often take part in, all the stages of development and vicissitudes, through which Agricultural Education and Agricultural Research had to pass during the last half a century; and I thought it desirable that I should give expression to some of my impressions and experiences while these are still fresh in my mind, with a view to creating some interest in the young men of to-day, towards the old order of things.

In writing these reminiscences, I do not propose to write a connected history of the Saidapet College or the Coimbatore institution, as I think that such an account has already been compiled or can be easily gathered from past Official Records and Annual Reports and may also probably be boring to the reader. What I propose to do is, to take up a particular subject, irrespective of chronological order, and say whatever may appeal to me as interesting with regard to that particular subject and, wherever possible, offer suggestions for further improvements in that particular direction.

There are three subjects with regard to the Agricultural College at Coimbatore with which I have been intimately connected from their inception, namely, *the Madras Agricultural Students' Union, the Agricultural College Officers' Club and University representation*; and these will be dealt separately.

The Madras Agricultural Students' Union: When the Madras College of Agriculture at Saidapet was ordered to be closed and the Agricultural College and Research Institute was started at Coimbatore, some of the *alumni* of the Saidapet College who were posted to work at Coimbatore realised that the institution at Coimbatore was but a continuation of the older one, with the advantage that

Coimbatore possessed a greater variety of soils and crops than Saidapet, admitting of different aspects of farming, and also provided special facilities for Research which did not exist at Saidapet. There was a desire amongst some of us that the contact between Saidapet and Coimbatore should be firm and enduring, and the Madras Agricultural Students' Union was born in one of the hostel rooms, myself having been the Hostel Warden at the time. The late Mr. S. L. D'Silva was our Guru and Chief Adviser and was our first Vice-president, the Principal of the College being always ex-officio President. Messrs. J. Chelvaranga Raju, T. V. Rajagopalachari, and K. Krishnamurthy Rao were some of the first members of the Committee. I had the honour of being elected the first General Secretary and Editor of the M. A. S. U. Journal and I had the good fortune of having Mr. K. T. Alwa as my student associate. We had a lot of controversy at the time about the naming of the new organisation; and we decided that it should be designated "the Madras Agricultural Students' Union" for a number of reasons. It was called the Madras Union because it had to include the old students of the Saidapet College and the old and new students of Coimbatore and also those residing all over the Presidency. It was called the Students' Union because it was to be an organisation between the old students of Saidapet and the old and present students of Coimbatore. The Union was formed in the year 1909 with the following objects:

(a) To encourage an *esprit de corps* among its members;

(b) To protect and promote the interests of its members;

(c) To act as an employment bureau for members;

(d) To exchange opinions and experiences in matters agricultural and make a record of the same;

(e) And to disseminate knowledge in agriculture.

Membership was open to the past students of Saidapet and the past and present students of Coimbatore and to officers of the Agricultural Department, whether they were old students or not. In the earlier years, on the plea that the Union was an Old Boys' Association, some of the offices were not open to officer-members who were not Old boys. This restriction was, however, removed as soon as it was realised that there was some friction and unpleasantness; and we are glad to say that all the offices of the Union have since been held by Officer-members who were not Old boys and by Old boys as well. The enormous amount of selfless work done with cheerfulness and enthusiasm by successive Presidents, Vice-Presidents, Secretaries and Treasurers, Editors and Managers of the Journal, members of the Council and of the Executive Committee and special Sports and Entertainment Sub-committees deserves a number of separate articles.

For several years, all were Life Members; there were Ordinary Life Members who paid a subscription of Rs. 5 and First-Class Life Members who paid Rs. 10, while Patrons gave a donation of Rs. 100. Student-members paid a Rupee every year during the college course and paid the balance of Life Membership when they left the College, and it was a common practice in those days for old students giving authorisation letters to the General Secretary to receive their caution money from the Principal towards the payment of their Life subscriptions.

The Union started with an Annual in the first year, was conducted as a Quarterly for about three years and has since been a Monthly all along. It was an understanding that every member should purchase a copy of the Journal and even the editor was not exempted from paying the subscription for the Journal, which was then Rs. 2 per annum.

The Journal of Madras Agricultural Students' Union was started as an Old Boys' Magazine and was intended to record personal events and personal experiences rather than functioning as an Agricultural Journal. It was soon felt that the Journal should cater to a wider public as several land-holders came to subscribe for the paper. The work of editing, publishing, and despatching of the Journal was all done by a few enthusiastic members of the staff of the College, assisted by some of the student representatives. There was always an Editorial Committee but the brunt of the work fell on the shoulders of the Editor and on the Manager. Some of the old boys sent contributions based on their practical experience and observation and, when these contributions were always sent officially through the superior officers concerned, it sometimes happened that some of the younger Agricultural Officers were snubbed for wasting time in writing articles. It is to the credit of Madras that the Madras Agricultural Journal, as it is now called, stands ahead of similar journals started in some other Colleges though the Madras Agricultural Journal has never received any financial aid from the Government and although all the work of editing and conducting the journal has been done in an honorary capacity by officers who have to turn out daily their routine work for at least six hours in the field and laboratories.

Apart from the Journal which demands day-to-day attention there have always been Annual functions, no less important. The College Athletic Sports are run by the Union. The College Day Celebrations are arranged for by the Union, and the holding of the Agricultural Conferences which have attracted considerable attention all over the country are also organised under the auspices of the Union.

The Madras Agricultural Students' Union is a unique organisation, has done considerable amount of useful work so far and is capable of doing much more. Hundreds of personal reminiscences flash through my mind and as many suggestions for improvement occur to me. As

this article has however, come to some length, I shall close it with the following queries :—

Are you eligible to become a member of the M. A. S. U. ?
Have you already joined the M. A. S. U. ? If not, why not ?
How can any organisation put forth its best, if all those who are eligible to join it have not done so ?
Do you witness the College Day Celebrations ?
Do you see the College Sports ?
Do you attend the Annual Conferences, if not, why not ?
If you do, how can you honestly take part in these functions, without being a member of the Union ?
Do you ever read the Madras Agricultural Journal ?
Do you subscribe for the Journal ? Do you contribute articles to the journal ? If not, why not ?
Have you ever been deputed to attend the Annual day and have you not felt a thrill when you meet the alumni of your Alma mater ?
How can an *Esprit de Corps* be created and maintained, unless all the devotees at the shrine of Agriculture join the Union ?

It is never too late to mend. The inclusive subscription for membership and Journal is so small. Join the Madras Agricultural Students' Union at once.

II. Representation of Agricultural Education in the University Bodies.

An Appeal to Graduates of the Agricultural Department.

I have had the honour of being your elected representative on the Madras Senate for five terms, on the Academic Council for four terms and on the Syndicate for two terms ; and, although I feel active enough to carry on, I think the time has arrived for me to retire from the above university bodies. Agricultural Education is now represented on the Senate by the Principal, and on the Academic Council by the Principal and two members of the teaching staff elected by themselves. You will all agree with me that this is not sufficient representation for us in the University of Madras and that there is need for us to secure a more adequate representation. A number of points must be constantly borne in mind to ensure success in the elections to the different University Authorities.

As regards the Senate, the election from the Registered Gaduates' Constituency is by proportional representation with the *Single Transferable Vote.* The first requisite is that all those, eligible to register—those who have passed any Degree examination of the University of Madras of seven years' standing and who have also taken the Degree in person or in absentia prior to August 1938—should

register themselves before the electoral list is closed for the next election. In the absence of definite information, I would suggest graduates to register at once, at any rate, before the end of August 1938.

ii. There may be some who have passed a University examination seven years ago; but who have not taken the Degree yet. Until they take the Degree, they are not Graduates of the University, nor are they eligible to add the titles of their Degrees after their names. Such persons are requested to take their respective Degrees, in person or in absentia, at the next Supplemental or Regular Convocation.

iii. The Life Registration fee of Rs. 5 is not so great as to prevent a Graduate from exercising his privilege in elections.

iv. When all those, who are eligible to register, have registered, we should see that we do not fritter our votes away, nor yield to persuasions of friends; but should, on our honour, solidly give the First Preferential Vote to our own selected representative. Who should be our representative may be decided by a Committee elected by ourselves for the purpose. The Committee of the Madras Agricultural Students' Union may be entrusted with this task, in the first instance, with power to co-opt.

v. If the South Indian Teachers' Union issues manifestoes for the election of their own teacher-representatives and if the Medical Graduates vote only for their medical friends, it is all the greater reason why the small body of the Registered Graduates of the Agricultural Department should solidly support their own representative.

vi. One of the two teacher-members of the Academic Council should always seek election to the Senate. One seat out of 20 seats by a straight vote of 200 members is not too much to ask in the interests of Agricultural Education and we are sure to succeed.

vii. I am sorry that the recommendations of the Board of Studies in Agriculture to the Syndicate to appoint one of the Research Officers as an Honorary Reader has not been accepted. An Honorary Reader has to give at least four advanced lectures every year and will have the privilege of being an ex-officio member of the Academic Council. The last word has not been said on the subject, and we hope that the Syndicate will take a more sympathetic view of the recommendation of the Board in succeeding years. Meanwhile, it is a suggestion to the Principal of the College to stress this point on the Syndicate.

viii. It is not a mere sentiment but an absolute necessity that there should be one representative of Agricultural Education on the Syndicate. Either the Principal or some senior officer of the Department, with the co-operation of the Principal, should seek election to the Syndicate either from the Senate or from the Academic Council. The election is by straight votes, one out of eight from the Senate and

one out of three from the Academic Council, out of a total of about 200 members in each.

ix. Considerable amount of canvassing is essential in all these elections and it should be an understanding among all officers of the Department to help in such canvassing. In addition to the personal manifestos of each candidate, a special Appeal may be sent, on his behalf, under representative signatures, or under the auspices of the M. A. S. U.

Correspondence with regard to these elections will be immense and may be entrusted to an energetic young man, resident at the Agricultural College Estate, who may be co-opted, if desired, as a member of the Committee of the M. A. S. U. for this purpose. All postage, stationery and printing charges incurred by him should be paid for by the selected candidates who seek election to the respective University Authorities and an advance of, say, Rs. 25 may be taken from each candidate. The S. I. T. U. levies a similar charge for all the candidates put up by them for election.

While I may not be able to do much canvassing, I shall always be glad to render all possible help towards securing adequate representation of Agricultural Education in all University Authorities.

It is also worth while trying to secure some of our representatives on the Andhra and Annamalai Universities.

Cheerio, Brother-Graduates.

EXTRACTS

A Labourer's Square Meal. The following Press Note has been issued from the Nutrition Research Laboratories, Coonoor.

A manual labourer needs at least two square meals a day. It is often impossible for him to return home to consume his midday meal and he naturally cannot afford to go and eat in a hotel. The meal, which he must perforce carry with him, should have the following qualities :—

(1) It should be sufficient in quantity and well balanced, i. e., contain the essential nutritive elements in correct proportions. (2) It should be cheap, made of easily available foods, and be simple to prepare. (3) It should be easy to carry, e. g., it should be solid to avoid the possibility of spilling, small in bulk, and not require a special utensil to contain it. (4) It should remain fresh and palatable for a number of hours.

Suitable "*missi chapatties*" may be made from the following :—

The constituents; whole wheat flour 10 ozs., Bengal gram flour 2½ ozs., onions ¾ oz., fenugreek leaves (or any other green leaves) ½ oz, milk 1 oz., ghee or butter ¼ oz. (except ghee) are mixed water being added and the whole kneaded into a dough. *Chapatties* are made from the dough in the ordinary way, good thick *chapatties* being recommended, since these remain fresh longer than thin ones. Subsequently, ghee is smeared on the *chapatties*. The weight of the whole meal is about 1 lb. It will supply about 1,300—1,400 calories, which is approximately half the daily requirement of a labourer, and about 50 grammes of protein.

The mixture is rich in vitamins and mineral salts. If fresh milk cannot be obtained, "*Khoa*" or skimmed milk powder can be used as an alternative. For those who can afford it, the addition of a greater quantity of milk, or an egg, to a dough may be recommended.

Such a meal is easy to carry folded in a broad leaf wrapped in paper. It remains fresh and palatable for a number of hours and can be eaten with no accessories except water. Its cost is about one anna. It can be recommended for travellers, picnic parties, etc., as well as for out-door labourers. (*The Mysore Economic Journal*, November 1937).

The World's Largest Plough. Several years ago, floods near Santana, California, buried fertile peat soil under several feet of silt and sand. Messrs. Post Bros. tractor rental service have since that time been building expressly designed and constructed ploughs to turn under the sand and bring the good soil back to the surface again.

The gigantic implement is their latest and largest example. Working 6 ft. deep it is estimated that the plough is constantly turning and lifting 5 yds. of soil as it moves through a field. The hydraulic lift used to raise it out of work has a pressure of 750 lbs. per sq. in., and is operated from the immediate tractor.

With three "Caterpillar" track type tractors hitched to the plough, about ½ acre per hour can be covered. It is said that often the increased yields obtained from land so treated will pay in a single season for the cost of this aptly styled "super ploughing job". (*The Implement and Machinery Review*, October 1937).

Synthetic Silk from Milk. Mr. Benjamin Roos, forty-one years old German Chemist, now working in England, is trying to produce a perfect synthetic silk from milk. Already he has been ten years on his task, and has made silk from milk in his laboratories, silk of fine texture and colour. In 1931 Mr. Roos, who lives at Prince of Wales-terrace, Kensington W., sent Government analysts in Berlin a sample of real silk and a sample of his own invention. The analysts declared it was impossible to distinguish between them.

Mr. Roos is not satisfied. So far he has spent more than £ 25,000 in research work, and for years has kept laboratories going in four countries. But always the secret of combining in his product every quality of the finest silk has eluded him. He has set himself to obtain five essentials—beauty, colour, strength, elasticity and non-shrinkableness. At present he can combine up to any four of these qualities but the remaining point of perfection escapes in the process.

Silkworm Diets for Cows. Mr. Roos has now succeeded in a remarkable experiment. He is arranging for two cows to be fed for three weeks on mulberry leaves, which is the only diet of the silkworm. "I intend taking two cows in fine condition and have them left to pasture in the ordinary way for a week," he declared. "Then I will analyse their milk, the butter made from it, and the casein remaining in the skimmed milk. Casein is the raw material from which I make my synthetic silk. Next, the cows will have a proportion of mulberry fed them. The same tests will be carried out. Later I hope to feed them for three weeks almost entirely on mulberry leaves, again testing the results. If the cows fed on mulberry leaves produce casein which is more suitable for my silk than that from ordinarily fed cows I shall attempt to make a chemical analysis to establish the difference between the two caseins. If the chemical constituents of this difference are once ascertained it should be possible to improve the normal casein by manufacturing the difference in the laboratory".

His Experiment. Mr. Roos has already been offered the cows and the necessary equipment for his experiment, but he is still in need of mulberry

leaves. An average cow, every day it is milked, can produce enough casein to manufacture nearly 21 lbs 8 ozs. of synthetic silk. This is after butter has been made from the milk.

It takes more than 30,000 silkworms, who will eat a ton of ripe mulberry leaves to yield 12 lbs. of raw silk properly reeled. (*The Sunday Statesman*, 27 June 1937.) (*The Punjab Agricultural College Magazine* Vol. V. No. 1. October '37.)

Influence of fertilisation of Washington Navel Oranges on quality and composition of fruit. The report of trials on the above emphasizes through-out the importance of a balanced nutrient solution. In this connexion the general conclusion is that, although fundamentally one nutrient is as important as another, the most important two substances that have to be present in the correct proportion and in considerable quantities are nitrogen and phosphorus. The proportion and concentration should be such that considerable quantities of both substances would be absorbed and this would have the following effects:—

High Nitrogen: High crop; low wastage.

High Phosphorus: Thin rind-high Juice (on whole fruit basis); low acid.

1. Fruit from all plots of all treatments were analysed for phosphorus, potassium, calcium, nitrogen, ash, dry weight, sugar, total soluble solids, acid, thickness of rind, and wastage due to mould.
2. A high phosphorus content in the fruit juice causes a low acid content. On the other hand, a high potassium content causes a high acid content.
3. A high phosphorus content in the fruit causes a thin rind and a low phosphorus content a thick rind.
4. High nitrogen content of fruit causes a low percentage wastage due to mould.
5. The juice content of the pulp has not been affected by any of the treatments, although treatments have affected thickness of rind, which would accordingly be reflected in juice content when the latter is calculated on the weight of whole fruit, including the rind.
6. Nitrogen applications to the soil markedly depress the absorption of phosphorus into the fruit, unless large quantities of available phosphorus are present in the root zone (*Farming in South Africa*, Vol. XII, No. 138, September '37).

Silica Dust as an Insecticide. Many substances used as insecticides are actual insect-poisons, but various non-poisonous materials in the form of very fine dust have also been tried at different times, their lethal effect being more of a physical nature. In a series of recent trials one of the most promising of these materials was a proprietary silica dust stated to consist of a pure quartz sand, ground to such a degree of fineness that the particles approach colloidal size, and to contain 98 per cent of silica, with only very small quantities of aluminium, iron, calcium, and magnesium compounds ("Versuche zur Bekampfung des kornkafers mit Staubmitteln" by B. Germar, *Z. Angew. Ent.*, 1936, 22. 603—630),

The practical trials were made with the granary weevil (*Calandra granaria*). It is believed that the fatal effect of the dust is due to a withdrawal of water from the tissues of the insect, owing to the large increase in body surface caused by the adherent dust. The effect of the dust is consequently dependent closely to the body of the insect, but the age of the insect is also a factor, the younger individuals being definitely more readily susceptible than the older. The temperature and the relative humidity of the atmosphere are also important.

The treated grain should contain 1 per cent by weight of the dust, which is best applied in the autumn or at the end of the winter, and should, of course, be stored in a dry place. The dust is non-toxic, and is removed by the usual processes preceding milling.

The treatment is said to be effective with regard to the existing weevil population, in retarding oviposition and hence preventing reinfestation, and to be economically practicable from the point of view of cost and ease of application. (*Bulletin of the Imperial Institute*, Vol. XXXV No. 3. 1937.)

Agricultural Jottings.

By THE DEPARTMENT OF AGRICULTURE, MADRAS

The Preservation of Cattle Manure. Cattle manure is collected and stored by cultivators, generally in an unsatisfactory manner. There is loss of manurial ingredients occurring in the manure heaps made by them and such losses could be easily avoided. When the cattle dung, waste fodder and other farm waste available are properly stored in pits day after day, there is fermentation taking place in the materials leading to their disintegration and when well made, the resulting material is rich, black in colour, uniform and powdery in appearance. When the manure is heaped in the open, the decomposition of the constituent materials is incomplete and a fair part of the heap is dried up and is in lumps. There is considerable aeration inside the heap and volatile poducts of decomposition, which are rich in nitrogen are lost. During rains, the heaps are soaked with water and the soluble portions of the manure rich in nitrogen are washed away and the cultivator is again a loser.

The preservation of the cattle manure can be done easily without much trouble or increased expenditure. It has to be borne in mind however that both dung and urine of cattle contain valuable manurial ingredients and have to be collected without allowing any to be wasted. The losses in the making of the manure are minimised by collecting the manure in pits, preferably provided with impermeable sides and flooring, and a roofing to guard against rain and sun. The sides of the pit should be raised over the ground level, to prevent rain water from the surrounding areas getting into the pit. All available organic wastes can be added to the manure pit. The manure in the pit has to be levelled once a fortnight and covered with a thin layer of earth, preferably tank silt. These help to increase the bulk of the manure. The silt helps to fix the volatile gases resulting from the fermentation of the manure and prevents loss of valuable manurial ingredients.

There are a few systems of stalling the animals and collecting and preserving manure that are satisfactory. The cattle shed may be provided with an impermeable flooring to permit urine being collected and led to the manure pit by means of suitable drains. The sheds can be washed every day and the washings also led into the manure pit. This is called the 'Byre System'. The byre or the cattle shed can be kept clean and tidy and is therefore pre-eminently suitable for housing cows and calves in particular.

It is not necessary to have pucca flooring for all classes of cattle. The working animals can be stalled in what is known as a loose-box, which is a combination of a cattle shed and manure pit requiring very little attention. Pits are dug to a depth of 2½ to 3 feet sufficiently large to house the animals and the entrance is made lightly sloping to permit the cattle to get in and get out easily. A feeding trough may be built on one side or a movable manger put in. The waste fodder and waste products of the farm like dried leaves, may be spread on the floor to absorb the urine voided by the animals and to provide them bedding. The dung dropped by the cattle may be spread evenly over the floor every morning and a layer of waste spread over it. The manure obtained from the loose box is very rich. Animals have been stalled in loose boxes in the various agricultural stations for the past 30 years and over and their health has not been affected.

The Loose-Earth System. This is a modification of the byre-system. The flooring is made with a layer of loose sand and silt, preferably in the proportion of 3:1, to a depth of 6 to 9 inches. The loose soil absorbs all the urine and the moistened soil is removed and added on to the manure in the pit and the moistened soil is renewed whenever necessary. This system should appeal to the cultivator in tracts where there is scarcity of fodder and waste matter in general and which could not therefore be used to absorb the urine and excess moisture in the dung.

A short note on the cultivation of Plums on the Nilgiris. Experience during the last 15 years has shown that Coonoor, Kotagiri and the surrounding villages are quite suitable for the cultivation of Japanese plums. A large number of varieties of plums have been under trial at the Pomological Station, Coonoor, and it has been found that the varieties 'Aloo-Bokhara', 'Hale', 'Rubio', 'Abundance'. and 'Shairo' grow and crop very well.

'Aloo-Bokhara' is a cooking variety, but a very prolific bearer, producing 2,000—3,000 fruits per tree. 'Hale' is a good eating plum and an equally prolific bearer as the variety 'Aloo-Bhokara.' 'Rubio' also is a fairly good eating plum and a fairly good cropper, bearing 800—1,000 fruits per tree. This is the earliest variety of eating plums cultivated on the Nilgiris and this is good for jam making. The varieties 'Abundance' and 'Shiro' are very good desert plums, but produce only 150—200 fruits per tree.

Country peach is indigenous to the Nilgiris and its seedlings have proved to be a satisfactory stock for plums. The method of propagation is by "shield" budding and nearly cent per cent success is obtained by this method if the budding is done during dry weather. The best period for this operation is during the months of December to January.

As some varieties of plums are wholly or partially self-sterile and as good results are obtained by cross pollination, it is advisable to plant varieties alternately instead of each variety in separate blocks. The spacing to be given depends upon the habit of individual varieties, as some varieties are vigours growers and some intermediate and dwarf types. The minimum spacing that should be given is 15 ft. But varieties like 'Abundance', 'Shiro' and 'Aloo-Bokhara' require a minimum spacing of 20 ft. One year old budded plants may be planted in prepared pits 3 ft. cube, keeping the union of the scion and stock above the ground level.

It may be necessary to water the plants during the dry months for the 1st year after planting. Afterwards they do not require any watering. During the first year of planting, a periodical inspection of the trees should be made and long growths should be pinched off. When the plants have made some growth, the trees have to be pruned to give them a good shape and all the superfluous and badly placed branches are to be removed leaving strong and healthy branches for further growth and fruit production.

Plum trees bear fruits on the growth of the preceding year and on fruit spurs. The aim of the fruit grower should be to stimulate a superfluous production of fruit spurs and small shoots on the main branches. A judicious pruning every year during the winter months is necessary for good fruit production.

In the case of self-fertile varieties of plums judicious pruning and manuring alone is necessary to guarantee a good crop if weather conditions are favourable at the time of flowering. But in the case of self-sterile varieties artificial pollination is necessary for fruit production. The best time for cross-pollinating is between 1 p. m. and 3 p. m.

Other varieties of plums that can be recommended are 'Kelsey', 'October Purple', 'Wright's Late', 'Czar' and 'Satsuma'. These, excepting 'Czar', are late varieties and start ripening only by the end of June.

Trials with cotton in the second crop season—Agricultural Research Station, Maruteru. Preliminary trials during 1930—1931 in wet-land with cotton sown in September at the Agricultural Research Station, Maruteru, disclosed clearly that such cultivation involving the giving up of the usual first crop paddy would not commend itself for the adoption of the wet-land delta ryot. The proper course appeared to lie in the amelioration of suitable cultural and cultivation methods to grow cotton during the off-season following the harvest of first-crop. The fact that only a portion of the entire wet-land first-crop area in the West Godavari Delta, is put under second crop, added practical and economic importance to this view. The later trials with cotton were therefore designed to elucidate the proper time and '*modus operandi*' for following up a short-duration or medium-duration paddy crop with cotton. The experience gained in subsequent seasons indicated that under conditions obtaining at Maruteru the best time for sowing was during the early part of November after the harvest of early main crop paddy *basangi*. Regarding the method of sowing, dibbling seeds in plough-furrows made 2½ feet apart in unploughed land, and passing the brush-harrow for covering, appeared most suitable. One irrigation about 2 months after sowing was found necessary and beneficial. The bullock-drawn junior-hoe frequently used for intercultivation during the growth stages of the crop, helped to conserve soil-moisture. Pickings of kappas took place during April—June.

Having arrived at the best time for sowing and most suitable method of cotton-cultivation in single-crop paddy-land after paddy harvest, it remained to determine the variety most suitable for such conditions. Trials to ascertain the most suitable variety are still proceeding, but it may be stated that yields of a little over 500 lbs. of kappas per acre have been obtained.

It might however be stated, that the favourable economic considerations which are bound to commend cotton-growing to the Godavari wet-land ryots' attention are, (i) the land lying normally fallow and unremunerative after first crop harvest till the following '*sarva*' planting, (ii) the second crop paddy zone being restricted to a portion only (about one-fifth) of the first crop area, and (iii) the paddy ryots' enforced idleness in the off-season owing to the lack of other subsidiary occupations.

Association of Economic Biologists, Coimbatore.

A meeting of the Association was held on December 1, 1937, at which the following paper was presented :—

Investigation on the Decomposition of Molasses under Paddy Soil Conditions *By P. D. Karunakar, M. Sanyasi Raju, T. Rajagopalan and M. Sundaram.* When paddy seedlings were transplanted soon after application of molasses to paddy soils (wet lands, Central Farm, Coimbatore,) they were found to die in great numbers. The present investigation was undertaken to determine the causes for their mortality and if possible, to find out the proper methods of applying molasses to soil, which may prove beneficial and not harmul to the seedlings. This investigation naturally divided itself into three different phases of study, namely, (1) agronomic, (2) biochemical and (3) biological phases.

These studies indicated that when molasses was allowed to ferment under paddy soil conditions, under artificial anaerobic conditions in soil and also in liquid medium, there was a considerable evolution of inert gases such as, carbon-dioxide. hydrogen and methane, as well as the production of organic acids, chiefly,

acetic, butyric and lactic acids during the earlier stages of fermentation. It was, therefore, found that the death of seedlings was due, (1) to one of simple asphyxiation by carbon dioxide and hydrogen, or in other words, displacement of oxygen by the gases mentioned above at the root zone of the seedlings, and (2) to the production of organic acids and the dissolution effect they may have had on minerals.

It was noticed in field as well as in pot culture house that these effects, both gaseous and acidic, passed off after a certain time, usually 2 weeks to a month, depending upon the biological population of the soil and the amount of molasses added, leaving the soil once again fit for the growth of seedlings (Abstract).

Crop and Trade Reports.

Paddy—1937-38—Second Fore-cast Report. The average of the areas under paddy in the Madras Presidency during the five years ending 1935—36 has represented 15·3 per cent of the total area under paddy in India.

The area sown with paddy up to 25th November 1937 is estimated at 8,595,000 acres. When compared with the area of 8 504,000 acres estimated for the corresponding period of the previous year, it reveals an increase of about 1·1 per cent.

The increase in area occurs in the Circars (Vizagapatam excepted), Cuddapah, the Carnatic districts, Chittoor, Trichinopoly, Tanjore and the Nilgiris. There has been a marked increase in Nellore (100,000 acres) and South Arcot (71,000 acres) and at the same time a large reduction in area in Vizagapatam (100,000 acres) and Tinnevelly (75,000 acres).

The first crop has been generally harvested throughout the Presidency, Normal yields have been reported from Kistna, Kurnool, Cuddapah, Nellore. Salem, Coimbatore, Tanjore, Madura, South Kanara and the Nilgiris. The yield is expected to be below normal in the other districts. The crop has been affected by excessive rains in parts of Chingleput, South Arcot, North Arcot, and Trichinopoly; in the other districts it has suffered to some extent from drought.

The seasonal factor for the Presidency works out at 95 per cent, of the average as against 98 per cent in the corresponding period of the previous year.

The wholesale price of paddy, second sort, per imperial maund of 82⅔ lb, as reported from important markets on 6th December 1937 was Rs. 2—15—0 in Madura, Rs. 2—12—0 in Vellore and Chittoor, Rs. 2-11-0 in Tinnevelly, Rs 2-10-0 in Trichinopoly, Rs. 2—8—0 in Vizianagaram and Hindupur, Rs. 2—7—0 in Masulipatam, Rs. 2—6—0 in Guntur and Kumbakonam, Rs. 2—5—0 in Ellore and Bezwada, Rs. 2—4—0 in Rajahmundry and Cuddalore, Rs. 2—3—0 in Cocanada, Rs. 2—2—0 in Anantapur and Conjeeveram, Rs. 2—1—0 in Negapatam and Rs. 2—0—0 in Mangalore. When compared with the prices published in the last report, i. e., those which prevailed on 8th November 1937, the prices reveal a rise of about eight per cent in Hindupur and Tinnevelly, six per cent in Negapatam, five per cent in Vellore, and three per cent in Conjeevaram, and a fall of about six per cent in Anantapur, five per cent in Kumbakonam, three per cent in Coconada and Bezwada and two per cent in Madura, the prices remaining stationary in the other centres. (*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 1937 to 10th December 1937 amounted to 502,008 bales of 400 lb. lint as against an estimate of 533,100 bales of the total crop of 1936—37. The receipts in the corresponding period of the previous year were 603,279 bales 419,408 bales mainly of pressed cotton were received at spinning mills and 204,373 bales were exported by sea while 103,784 bales were imported by sea mainly from Karachi and Bombay. (*Director of Agriculture, Madras*).

College News and Notes.

Students' Corner: Hockey. The match in connection with the Inter-collegiate Tournament which ended in a draw on the 15—10 -'37, was replayed on 19—11--'37 with the local Government college. Our college won the same by 10 goals to nil.

The next match of the above Tournament was played on 27—11—'37 with the Maharajah's College, Ernakulam, in which our college was defeated by 0 to 3 goals.

Volley ball. A friendly match was arranged on 17-12-'37 between our college and the Y. M. C. A., Coimbatore, on the college grounds. The latter won the match.

Our New Patron. We are glad to announce that Sri Ramachandra Ananga Bhima Deva Kesari Gajapathy, Rajah Saheb of Bodokhemidi, Berhampore, Ganjam, has graciously become a patron of our Union.

Our members. We are glad to learn that Rao Bahadur M. R. Ramaswami Sivan has been chosen as one of the representatives of the Universities on the crops and soils wing of the Board of Agriculture in India.

Rao Bahadur T. S. Venkataraman, C. I. E., Imperial Sugarcane Expert, has been elected as Honorary member of the South African Sugar Technologists' Association. We are very glad to hear that he is the only one elected to that honour outside South Africa.

Madras Agricultural Sub. Service. We note from the Fort St. George Gazette, dated 30th November 1937, that 8 temporary posts (for 1 year) have been sanctioned, for the performance of work in co-operative societies or union of such societies of sugarcane growers.

Visitors. Mr. P. H. Rama Reddy, M. A., I. A. S., Director of Agriculture, Madras, visited the College and Research Institute on the 14th November.

Mr. T. G. Rama Iyer, Director of Agriculture, Mysore, visited the Research Institute and Breeding Stations on the 27th and 28th November 1937. He stayed with Rao Bahadur T. S. Venkataraman, C. I. E., Government Sugarcane Expert, at the Imperial Cane Breeding Station.

Mr. A. B. H. Khoorshid, B. A., M. S., Economic Botanist, Hyderabad, visited the Research Institute and Breeding Stations about the middle of the month.

Estate activities. Some of the officers in the Estate performed Maha Abhishekham and Santharpanai at the Marudha Malai temple on Sunday the 12th December 1937.

The Dhanurmas Bhajana was started in right earnest on the 15th of December.

Hosur Cattle Farm Labourers' Club. The opening ceremony of the Hosur Cattle Farm Labourers' Club located at the old cricket Pavilon was performed by the Director of Agriculture on the 27th October 1937.

Weather Review—NOVEMBER 1937.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	0·1	−3·9	41·5	South	Negapatam	25·8	+8·1	51·8
	Calingapatam	...	−3·9	29·7		Aduthurai *	23·9	+13·9	46·0
	Vizagapatam	...	−3·8	28·9		Madura	7·5	+2·5	22·4
	Anakapalli*	0·3	−3·6	40·2		Pamban	15·2	+3·2	40·5
	Samalkota*	...	−3·5	35·9		Koilpatti*	7·9	+1·3	23·5
	Maruteru*	...	−3·5	33·8		Palamkottah	7·8	+0·4	24·1
	Cocanada	0·2	−5·2	40·4					
	Masulipatam	1·1	−4·6	34 8					
	Guntur*	0·1	−3·5	32·3	West Coast	Trivandrum	7·8	+1·2	58·3
						Cochin	6·1	−0·4	124·7
Ceded Dists.	Kurnool	...	−1·1	22·1		Calicut	4·0	−1·4	125·7
	Nandyal*	...	−1·6	19·0		Pattambi *	3·2	−0·8	89 9
	Hagari *	0·1	−1·5	15·7		Taliparamba *	...	...	...
	Bellary	...	−2·2	15·0		Kasargode *	1·7	−1·6	169·0
	Anantapur	0·5	−2·3	31·3		Nileshwar*	0·4	−2·8	150 5
	Rentachintala	...	...	32·1		Mangalore	0·4	−2·7	141·9
	Cuddapah	4·1	+0·5	25·4					
	Anantharaju-pet *	12·8	−0·4	42·3	Mysore and Coorg	Chitaldrug	...	−2·3	17·4
Carnatic	Nellore	17·7	+6·5	66·2		Bangalore	1·6	−1·3	30·8
	Madras	4·6	−9·7	34·1		Mysore	2·3	−0·2	40·2
	Palur *	...	...	...		Mercara	1·7	−1·5	117·4
	Tindivanam *	26·0	+15·0	54·8					
	Cuddalore	29·4	+14·3	52·2	Hills	Kodaikanal	10·5	+2·3	65·0
Central	Vellore	15·6	+8·7	48·9		Coonoor	0·4	...	56·3
	Salem	3·5	−0·2	27·9		Ootacamund *	7·5	+2·7	56·1
	Hosur*	...	...	...		Nanjanad *	3·5	−0·3	47·4
	Coimbatore	7·1	+3·3	24·8					
	Coimbatore A. C. & R. I.*	2·9	−1·6	20·9					
	Trichinopoly	7·0	+1·4	39·8					

* Meteorological Stations of the Madras Agricultural Department.

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

During the month five troughs of low pressure were recorded and of these three were formed in the Southwest Bay of Bengal, on 9th, 14th, and 28th, while the other two were formed in the Arabian Sea on 4th, and 16th. The depression which formed on 14th in the southwest Bay of Bengal, caused widespread rain with locally heavy falls in southeast Madras and local rain in Malabar, Mysore and the Madras Deccan, with a few falls in the North Madras Coast. The trough of low pressure, which appeared on 4th to the west of Ceylon moved northwards into the Central Arabian Sea on 7th and later moved in a westerly direction, while that formed on 16th extended over the east Arabian Sea and became less important on 18th.

Throughout the month, the monsoon was active in the South of Bay of Bengal, Southeast Arabian Sea and in the neighbourhood of Ceylon. It caused widespread and local thundershowers in the southern half of the peninsula.

Local and general rains were not uncommon in southeast Madras, Mysore, Malabar, and North Madras Coast during the month.

Rainfall was in large defect in Circars, Ceded Districts, Mysore and Coorg, while it was markedly in excess in other stations of the Presidency.

Chief falls.

Madras	5·7″ on 16th.
Nellore	3·7″ ,, 18th.
Cuddalore	9·3″ ,, 14th.
Vellore	9·2″ ,, 16th.
Negapatam	4·8″ ,, 3rd
Cochin	3·1″ ,, 19th
Anantharajupet.	3·9″ ,, 15th.
Tindivanam	8·7″
Aduthurai	5·1″

Special falls of heavy rainfall.

Vanoor	9·7″ on 15th.
Portonova	8·1″ ,, ,,
Tindivanam	7·7″ ,, ,,
Panruti	7·7″ ,, ,,
Villupuram	6·8″ ,, ,,
Chidambaram	6·8″ ,, ,,
Ulundurpet	6·0″ ,, ,,
Tirupattur	5·5″ ,, ,,
Jeyankondan Solapuram	8·1″
Peraiyur	5·7″ ,, 14th.
Tirupattur (Madura)	5·4″ ,, 20th.
Pechipara	6·0″ ,, 16th.

Weather Report for the Reasearch Institute Observatory:

Report No. 11/37.

Absolute Maximum in shade	88·0°F.
Absolute minimum in shade	62·0°F.
Mean maximum	82·2°F.
Departure from normal	−2·5°F.
Mean minimum	69·0°F.
Departure from normal	+0·3°F.
Total rainfall	2·91″.
Departure from normal	−1·62″.
Heaviest fall in 24 hours	0·78″ recorded on 5th.
Total No. of rainy days	9 days.
Mean daily wind velocity	0·40 M. P. H.
Mean Humidity	81·4%.
Departure from normal	+0·1.

Summary. The monsoon was fairly active and rains occurred mostly during the first and third week. Rainfall was in large defect and the heaviest fall of 0·78″ was recorded on 5th. The mean maximum was below normal by 2·5°F. while the mean minimum and humidity were almost normal. The skies were moderately to heavily clouded.

P. V. R. & P. G.

Errata (Total rainfall from January 1st, 1937, for Coimbatore, A. C. R. I., in the report No. 10/37 should be corrected as 18·0″ instead of 15·9″).

Departmental Notifications.

1. Transfers.

Name of officer.	From	To
Mr. M. K. Swaminatha Ayyar	F. M. Coimbatore	A. D. Dindigul.
„ D. C. Hanumantha Rao	A. D. Tenali	A. D. Gannavaram.
„ G. L. Narasimha Rao	A. D. Gannavaram	A. D. Kovur.
„ K. Raman Menon	F. M. A. R. S. Nanjanad	A. D. Coonoor.
„ M. Kandaswami	A. D. Avanashi	F.M.A.R.S. Nanjanad.
„ K. H. Subramania Iyer	A. D. Kugalur	A. D. Avanashi.
„ C. S. Sankaranarayana Iyer	A. D. Coimbatore	A. D. Kugalur.
„ P. K. Parameswara Menon	A. D. Namakkal	A. D. Dharmapuri.

2. Leave.

Name of officer.	Period of leave.
Mr. N. Srinivasa Rao, A. D. Hosur	L. a. p. for 2 months and 20 days from 11—12—'37.
„ M. Rayappa Pillai, Asst. in Paddy, A. R. S. Pattambi	L. a. p. for 2 months from 18—11—'37.
„ B. Shiva Rao, A. D. Vizagapatam	L. a. p. for 2½ months from 3—1—'38.
„ K. M. Krishna Menon, Asst. in Chemistry Section	L. a. p. from 1—12—'37 to 23—12—'37.

ADDITIONS TO THE LIBRARY, NOVEMBER 1937.

A. Books.

1. *Report of the Work of the I. C. A. R. in applying Science to Crop Production.* Russell, J. (1937). 2. *Report on the Development of the Cattle and Dairy Industries of India.* Wright, W. C. (1937). 3. *Economics of Agriculture.* Van Der Post, A. P. (1937). 4. *Indian Agricultural Economics.* Patel, A. D. (1937). 5. *Bio-Chemistry applied to Malting and Brewing.* Hopkins, R. H. and Crause, C. B. (1937). 6. *Indian Vegetable Oils (Indian Industrial Res. Bull. 10).* Brodie, N. (1937). 7. *Methods of Chemical Control for Cane Sugar Factories and Gur Refineries.* Indian Sugar Tech. Assn. Pubn. (1937). 8. *Labour Legislation in British India.* Pankaj Kumar Mukherjee. (1937). 9. *Laboratory Manual of Organic Chemistry.* Dey, B. B. and Raman, M. V. S. (1937). 10. *Fifth Progress Report of the Foot and Mouth Disease Research Committee.* H. M. Stationery Office Pubn. (1937).

B. Annual Administration Reports.

1. Mysore Agricultural Department Administration Report for 1935–36. 2. Report on Demonstration Work carried in the Southern Circle of the Agricultural Department, Central Provinces and Berar, 1936. 3. Rothamsted Experimental Station, Report for 1936. 4. Annual Report of the Department of Agriculture, Cyprus, for the Year 1936. 5. Annual Report of the Department of Agriculture and Forests, Palestine for the year ended 31st March, 1936. 6. Kenya Colony Agricultural Department Annual Report, 1936. 7. Tanganyika Territory Agricultural Department Annual Report, 1936. 8. Tanganyika Territory Reports from the General Experimental Farms, 1936. 9. Report of the Agricultural Department, Antigua, 1936 10. Report of the Agricultural Department, Dominica, 1936. 11. Report of the Agricultural Department, St. Vincent, for the year 1936. 12 Research Abstract Report of the Department of Agriculture, St. Lucia, 1936. 13. Oregon Agricultural Experiment Station—A Biennial Report of Activities and Accomplishments, 1932—1934. 14. Findings in Farm Science. Wisconsin Agr. Exp. Stn. Bull. 438. 15. A Year's Progress in Solving Farm Problems of Illinois, 1934—35.

C. Special Publications.

16. The Nutritive Value of Banana. *Columbia Uni. Pubn.* 17. Technological Reports on Trade Varieties of Indian Cottons, 1937. *ICCC. Tech. Bul. Ser. A 38.* 18. Wood's Challenge to Steel and Concrete; 19. Relative Economy of Wood, Steel, and Concrete Structures; 20 Manufacture of Small Dimension Stock—A New Rural Industry; 21. The Truth about Fire Hazard in Timber Structures; 22. Cheaper and Better Gable Roofing with Wood Shingles; 23. Treated Timber for Earthquake Resistant Structures; 24. Treated Wood Poles for Electric Distribution and Service; 25. Special Factors affecting Timber Design; 26. Better and Cheaper Fencing; 27. How to build Wooden Earthquake-and Storm-Proof houses; 28. Relative Cost of Treated Electric Poles and Overhead Construction in India and Abroad; 29. Treated Timber Bridges for Indian Highways and Railways; 30. Wood Versus Steel for Framed Buildings; 31. How to build Fire-resistant Timber Structures; 32. Wood is Good: Fire-proofing of Wood; 33. Treated Wood for Roof Trusses; 34. Treated Wood for Flooring; and 35. Treated Wood for Walls and Ceilings. *Dehra Dun For. Res. Ins. (Timber Dev. Sec.) Pub. Nos 1 to 11, 13, 15 & 18 to 23.* 36. White fish Meal as a food for Livestock. *Eng. Min. Agr. and Fish. Bul. 63.* 37. Technique of Grass Seed Production at the Welsh Plant Breeding Station; 38. Production

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