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Proceedings of a joint meeting of the Indian Chemical Society, Madras Branch, the Society of Biological Chemists (India) and the Association of Economic Biologists, Coimbatore held at the Agricultural College, Coimbatore.

SESSION I.

1-30 to 4-30 P. M., Friday, 7th October, 1932.

SYMPOSIUM ON THE UTILISATION OF WASTE PRODUCTS

Chairman:- Mr. S. V. Ramamurti.

Speakers:- Dr. Gilbert J. Fowler.
Mr. K. S. Viswanatha Ayyar.
Dr. V. Subrahmanyan
Rao Bahadur B. Viswa Nath
Mr. T. Lakshman Row.
Mr. M. Sreenivasaya.

THE CHAIRMAN'S OPENING REMARKS.

Let me first extend a hearty welcome to those of you who have come to Coimbatore to attend this Conference. I am particularly pleased to preside over a discussion on *Waste*. I do not know who among you deserves the credit for suggesting such a simple-looking but crucially important subject. Waste in the physical world is the counterpart of evil in the moral world. I would define evil as unused good. Waste is also unused good. When religion was the dominant

phase of human activity, the leaders of men were they who battled with evil. Now when science has replaced religion as the dominant activity of man, the battle is against waste. Therefore you who are scientists are in a goodly company—the company, namely, of Saints and Martyrs.

To be wicked is evil. To be merely good when you can be better is also evil. The throwing away of paddy husk, of cattle urine, of all manner of unused green stuff is a waste. But it is also a waste to grow only a thousand pounds of crop when you can grow double the amount. The work at Coimbatore has naturally lain against both these directions of waste. The utilisation of all organic stuff which can be used as manure, the method of treating soils so as to avoid waste of moisture, the way of avoiding losses by plant pests, as also the ways of improving upon existing strains of various crops have been receiving attention. I hope with the co-operation of the scientists at Coimbatore to orientate the research activities here definitely as a campaign against waste.

We who live in a tropical climate receive in the most bountiful measure the only income which the earth gets, namely, sunlight. Yet the heat of the sun is more often made a matter for complaint than for thanksgiving. We have not yet learnt how fully to use our wealth. In its unused form, it is a burden rather than an asset. And yet when sunlight is used to make trees, animals and all other organisms, they are, in the main, sources of wealth and comfort to us. Life bottles sunshine all round us and leaves them behind as it passes away. But we waste much of it. We waste paddy chaff while we eat the grain. We waste cattle urine while we use some of the dung and meat and milk. We use cashew nuts but waste the oily shells. We use sugarcane juice but mostly waste the molasses and the megass. We waste the nitrogen about us when more can be used to enrich the soil and yield heavy crops. We waste the bacteria which can be harnessed to do beneficent work for plants. We waste weeds and at the most destroy them when the best way would be for the soil to digest them. Any piece of organic matter which is not used is a case of waste of our wealth of bottled sunshine. To bottle sunshine and not to use it as well as the failure to bottle available sunshine is waste and therefore evil. The responsibilities of Indian scientists and generally of tropical scientists is correspondingly greater than that of scientists of temperate climates even as the opportunities for wealth and waste are greater in the former case. And yet we find that the efforts that have been put forth hitherto to attack waste with the help of science have been mainly outside the tropical climates.

It is in the last half a century or so that chemistry which deals with the internal geometry of the sunshine bottles and biology which

deals with the many manufacturers of such bottles have been considerably developed in Europe. But the conditions and problems of Europe and India are different. To the extent that they are common, the methods and results achieved in Europe have been communicated to us. The time has come when with the knowledge we have acquired, we have to develop an extension among different conditions. If sunshine in Europe is a river with its seasonal variations, it is in South India, an ocean. Our methods of navigating the ocean while based on what has been learnt of river navigation require large changes and fresh efforts. In spite of all that we have learnt of Science, there are large areas of waste which we do not know yet how to attack. Many of our agricultural products do not present problems to Europe. We grow paddy and export some of the rice but we keep all the husk. Europe has no need to study paddy husk. We grow the cashew tree and export some of the nut but we keep or throw away all the shells. Europe has no need to study cashew shells. We have no winter worth mentioning in Southern India. Our annual fallow time on paddy land is waste unless we grow green manure on it. It is not so in Europe because such fallow time is a time when nothing can grow on the land. We waste many varieties of bacteria by not knowing how to use them. They do not exist in such numbers in Europe and hence Europe has no problem of waste in that respect comparable with ours. We get an ocean of sunlight and we waste much of it. Europe gets less and its problem of waste is smaller. The time has come for us to recognise that our country is full of unused good and of unexplored possibilities and that it is we that should find methods of dealing with them.

There is one caution that I would like to give you in regard to the solutions which you may evolve. Our social and economic conditions make it imperative that the application of science should be spread over a large area rather than be concentrated in a few places. A few large industries requiring lakhs of rupees for a factory have much less chance of springing up than many small scale industries which can be run with moderate capital Any methods which you evolve of attacking waste should satisfy this condition.

There is also one suggestion that I might make to you. If chemists and biologists wish to give practical shape to their ideas, they need also to be engineers. Some of you may find it useful to gain a knowledge of engineering. It will be desirable for chemistry and biology to attract more engineers to their ranks.

Above all, we need now men who not merely have learnt known solutions to known situations, but men who have acquired the ability to solve problems. India is now a vast wilderness of unsolved problems and unrealised possibilities and it is scientific research more than anything else that is needed to help India again to life and progress. In

this work you are engaged and I offer you my heartiest good wishes for success in your fight against waste.

DOMESTIC WASTE

Dr. Gilbert J. Fowler. I have very great pleasure to listen to the speech of your President and to the very excellent introduction he has given to the subject we are going to discuss to-day. On a previous occasion four or five years ago, during the annual agricultural Conference held here, I had the privilege of addressing the gathering on a very similar subject; in fact, the title of my address was "Wealth from Waste". This fact and the points which the President has raised, about our solutions of scientific problems being capable of being tackled as small industries, make me find myself entirely in harmony with my surroundings today. I myself have been an advocate of small industries from the date of the Indian Science Congress in 1925.

I have been asked to talk to you about "Sewage and Domestic Waste". The importance of utilisation of this waste, you will realise from the example of Japan and China where for ages they have been able to manage with this waste alone for their crops, without the use of any minerals at all. The sewage problem in England and other countries is quite different from that here. There, they have a number of small rivers and the problem is to keep these rivers free from pollution. In India, however, we are concerned mainly with how best to utilise the nitrogen from sewage for the benefit of agriculture. We have vast tracts of land which are deficient in organic nitrogen. I may instance to you vast areas of nearly 125,000 acres under the Irwin Canal Scheme, which sadly stand in need of organic fertilizers.

One of the simplest ways of utilising sewage will be to pour it on the land, but sooner or later we tumble against a difficulty, viz., the formation of sewage sickness in the soil. This is because oxidation is incomplete and the collodial matter of the sewage also interferes with the healthy growth of crops. Therefore some form of preliminary treatment to the sewage is necessary before it can be applied to the soil to undergo further oxidation there. What I would call as the master-secret of Chinese agriculture is this treatment that they are giving. Investigations at Lyallpur and elsewhere have shown that raw sullage applied largely and continuously to soil is harmful and that therefore it must be copiously diluted with large quantities of fresh water. This however is not available everywhere, and where it is available, there is the danger that we will be giving very much more moisture to the soil than a healthy growth requires.

The Activated Sludge Process therefore is the best method of utilising this waste. The colloidal nitrogen is all collected and concentrated in one place and you can use it as and when you require it.

The effluent contains reduced proportion of nitrogen and can be applied directly to the land without any further dilution. This will reduce the large waste of nitrogen, the value of which is being recognised only recently. For instance, at Poona they are selling the sullage on the basis of its nitrogen content. The value of nitrogen in the sewage can be gauged from the fact that according to Chinese figures it is valued at Rs. 2 per head of the population per annum. The great task therefore before the scientists of this country is the concentration of organic nitrogen along with solar energy, which I hold to be the two factors of crop production. In this connection I would remind you of the saying of Henry Ford, of having one foot on the land and the other in the factory, for if our wealth and well being are to increase, we cannot afford to ignore this efficient method of enriching our lands by a resort to simple machinery.

UTILISATION OF FARM WASTES

Mr. K. S. Viswanatha Ayyar. In view of the fact that the organic matter of the soil gets rapidly depleted, and that the available supply of organic manures like farmyard manure, leaf compost, oilcakes etc. is far less than the demand, attempts have been made by various workers, to tap other sources of supplying organic matter to soil. The pioneers in this work, have been Richards and Hutchinson of Rothamsted who with the aid of suitable starters, evolved a method of converting waste organic matter of low manurial value, into a stuff of the standard and quality of farmyard manure, patenting a starter by name 'adco'. Hutchinson in India similarly obtained an odourless product of high manurial value by subjecting green sunnhemp to fermentation, using copper sulphate-potassium cyanide, as a deodoriser incidentally also demonstrating that the fermented stuff was far superior to the raw material.

Experiments in Madras in the direction of utilising organic farm waste, date from 1922, when paddy straw and calcium cyanamide were used as basic material and starter respectively. The resultant product which was ready in nine weeks, was very suitable as a manure, but there was a loss of 47 per cent. of organic matter, and 14 per cent. of nitrogen. This was proved to be due to the rise, during fermentation, of temperature which went up to 54 degrees. The next stage in the investigation was to introduce improvements, by providing aerobic and semi-aerobic conditions, by fermenting in heaps and in pits and by providing a shelter to minimise loss due to evaporation. These trials which were of a comparative nature showed that under semi-aerobic conditions there was less loss of nitrogen and organic matter than under aerobic, (2) that loss of nitrogen from experiments in pits was less in every case than that from heaps and (3) that sheltering minimised loss. But all the same, the experiments tended to show that the

prime factor responsible for the loss of nitrogen and organic matter, was the too rapid decomposition at the initial stages of the fermentation. This was traced to the unsuitability to Indian conditions, of starters used elsewhere.

The next step was an analysis and a bacterial examination of the starter 'adco', and the use as starter of a synthetic mixture of calcium cyanamide, tricalcic phosphate, and potassium phosphate; this was compared with the 'adco' starter both on green and dry materials under laboratory conditions. The fermentation was found to be complete but loss of nitrogen occurred and the decomposition of the waste was accelerated, probably due to the stimulation of the organisms, by the phosphates present in the starters. An attempt was made therefore to use a slow acting starter like a mixture of bonemeal and cowdung. Experiments on cane trash with slow and quick acting starters, showed that with the former there was less loss of nitrogen. Based on numerous trials conducted all over the Presidency, the following technique of manufacture has been evolved.

The basic material is spread uniformly and loosely to a depth of 9 to 12 inches in a pit of convenient size (12′ × 6′ × 3′) and water evenly sprinkled till the whole material gets moist. Then 1 to 2 lbs. of fine bonemeal are evenly broadcasted and over this an emulsion of 10 to 20 lbs. of fresh cattle dung in 5 to 10 gallons of water is applied. A second layer of basic material is placed over this and treated similarly. The whole material is thus disposed of until a heap about 2 feet high above the ground level is formed, and then the top and sides are mud plastered. After the fermentation has proceeded semi-aerobically for 4 to 6 weeks depending on the nature of the material, the plaster is removed to permit aerobic fermentation. If the heap has sunk unevenly, which is an indication of defective fermentation, the material is reheaped after forking and proper moistening. The raw material is ordinarily decomposed in 3 to 4 months and is fit for application as manure and can be made at a cost of Rs. 3 to 3-8 per ton.

Synthetic farm yard manure thus prepared compared very favourably in field trials with farm yard manure and the quality of the crop as evidenced by an analysis was also very good.

UTILIZATION OF WASTE VEGETATION

Dr. V. Subrahmanyan. Millions of tons of plant materials are being annually disposed of either as pests or articles of no value. The object of this communication is to give an account of the nature and extent of occurrence of such vegetation and their possible utilization in arts and manufacture.

There would appear to be three main types of waste vegetation.—(a) plants with gregarious habits like the water hyacinth of Bengal, the lantana of Deccan and the prickly pear of South India which are dreaded as enemies of agricultural crops and even forest plants,

(b) various types of vegetation which grow spontaneously on uncultivated lands and in jungles which are considered harmless but which are not generally used except as fuel. This group would include the numerous species of trees which are now classified as junglewood, various shrubs which are considered to be poisonous and grasses which are ignored as being too coarse or otherwise unsuitable for cattle and (c) several plants or plant materials which are obtainable in plenty but the uses of which are either not fully known or cheap processes for converting them into useful products have not yet been discovered. This category would include hardy woods like the *Mathi* of Mysore, various starch-bearing tubers like the *Kachara* of the Konkan tracts, oil bearing seeds like the *Dhupa* of the West Coast, sugar-bearing fruits like those of coffee berry, cashew apples and mahua, tannin-bearing plants like the numerous cassias and acacias of Deccan the best known among which is *Avaram* or *Thangdi*, and essential-oil-bearing grasses or shrubs which abound in most of our jungles.

The plants classed as waste vegetation cover the major part of the uncultivated tracts of the country which may be reckoned to be over 500 million acres in India alone. They thrive under a variety of soil and climatic condition and are generally resistant to disease. They are all available in great abundance and the supply is well-nigh inexhaustible except when deliberately destroyed by man as in the case of the prickly pear.

The extent to which any plant material can be utilized is determined by (a) the abundance of the constituent for which the plant is valued (b) the ease of handling and (c) cost of collection and transport. The last is a fairly serious obstacle in certain cases but it can be overcome by choice of proper localities and intensifying the production.

There are several wild tubers from which strach or sugars can be manufactured. Thus the *Kachara* with which the author is acquainted contains about 60 per cent. starch and presents no difficulty in the working.

Sugars can be obtained either directly or indirectly from several plant materials. In the case of the mahua fruit or the cashew apples they can be extracted as such while those in water hyacinth or wood fibre will first have to be treated with acid. Most of the materials are suitable for the manufacture of glucose syrup which is so valuable in several industries. Thus, the author found that juice from the cashew fruit contains about 12 per cent. sugar which can be readily concentrated to a 60 per cent. syrup after treatment with lime or alkali.

Most of the sugar-yielding products are eminently suited for the manufacture of industrial alcohol. Thus Fowler and Dinanath Talwar found that the mahua husks which are now being wasted are eminently suited for that purpose. Sen and his co-workers noted that water

hyacinth and saw dust from certain woods (e.g. *Excoecaria agallocha*) yield large quantities of fermentable sugars on hydrolysis with acid.

The more refractory types of cellulosic wastes can be converted into fuel gases by digestion with sewage. Considerable amount of useful work has already been carried out by Banerjee in Bangalore and Sen in Calcutta, but further research is needed to standardise the process.

Several fruits are rich in pectins and the fibres in cellulose: except in a few solitary instances sufficient application has not yet been found for them.

Considerable amount of work has been carried out by Sudborough, Simonsen, Sanjiva Rao and their co-workers on the essential oils from various types of grasses, shrubs and trees. Some of them are highly valuable in perfume industry ; others, as shown by the author and De, possess far greater deodourising and germinial properties than phenol and being also proportionately much cheaper can easily take the place of coal-tar disinfectants now so commonly used.

There are several jungle plants which contain highly potent insecticides and fungicides. The work of Tattersfield and his associates in England, the late Dr. Kunhi Kannan, B. T. Narayanan and their co-workers in Bangalore have gone a long way to establish that extracts from several tubers (e.g. *Derris elliptica*), flowers and leaves (e.g. *Pongamia glabra*) destroy some of the most pernicious agricultural pests without in any way poisoning the plants themselves as the mineral insecticides are often known to do.

We are today importing enormous quantities of wattle bark and bark extract though we have almost inexhaustible stock of tannin-bearing plants in the country. The main difficulty in the way of tanners using *Avaram* bark is the prohibitive cost of collection and transport but it should be possible to improve the condition by (a) intensifying the culture of the plant and (b) preparing concentrates. In both the above some useful beginnings have already been made at Bangalore.

Many of the wild plants are rich in various enzymes which now find extensive application in medicine and industry. Particular mention may be made of the lantana leaves which contain active forms of all the more important enzymes and the *hongay* seed which contains the most active urease among the plants so far examined.

It may not be generally known that most of the powerful herbs and drugs used in Ayurvedic, Unani, or allopathic medicine are derived from the so-called waste vegetation. Very little systematic attempt has however so far been made to cultivate the plants intensively so that the cost of collection is now almost prohibitive. It is known that many of the plants respond readily to artificial culture so that it

should soon be possible to develop a flourishing business in medicinal plants.

Chiefly on account of their perishing qualities, junglewoods have so far been outcasts from structural materials but thanks to the modern developments it has now become possible to preserve them even better than metal or concrete. In this communication particular mention should be made of the recent Fahl-Kamesam process which it is hoped will open out a bright future for junglewoods.

Almost every form of waste vegetation when not otherwise used is eminently suited for use as manure either in the green state or after composting with chemical and biological starters. As instances of these may be cited the observations of Fowler and Gopalakrishnamurti who noted that in addition to enriching the organic and mineral matter of the soil prickly pear also helped to fix the nitrogen of the atmosphere. Jagannatha Rao and the author observed that lantana leaves make excellent synthetic manures when composted with sewage or nightsoil. The preparations thus obtained are characterised by fairly high nitrogen content (1.2 per cent.) and a very large percentage (2.5) of phosphoric acid which our tropical soils so badly require.

Very little systematic work would appear to have been so far done on the distillation of waste vegetation. This would appear to be a highly promising line of enquiry for the future since in addition to the charcoal some valuable chemicals may thus be obtained.

The waste vegetation of today constitutes some of the sturdiest offsprings of nature which eke out their livelihood from the poor offerings of uncultivated soil unassisted by men. It is true that they have not so far found much application, but in the light of increasing knowledge with regard to their possibilities every effort should be made to preserve them. They should no doubt be prevented from invading agricultural lands or overpowering the more valuable saplings of timber trees ; but they have their own uses in the service of mankind and our ignorance of their utility should not be a plea for destroying them.

WASTE PRODUCTS OF PADDY AND SUGAR CANE CROPS.

B. Viswa Nath, Coimbatore. The possibilities of utilising paddy husk, broken rice, sugar cane megass and molasses without machinery and elaborate equipment are discussed.

Paddy husk: Paddy husk can be made into activated carbon for use as a decolourising agent in jaggery and sugar manufacture. Activated carbon can be prepared by beating paddy husk out of contact with air and treating with activating agents, either mineral or gaseous. The usual methods of activation adopted on the industrial scale are however not suitable under village conditions. A fairly simple process has been devised, in which paddy husk charcoal is activated by treating with soda or lime polysulphides and igniting a mixture of 4 of sodium

carbonate and one of sulphur or 5 of slaked lime and one of sulphur. These substances besides being cheap are easily available in any village. Laboratory experiments in the direction of decolourising jaggery solutions and dealing with 10 lbs., quantities have worked very satisfactorily and the activity of prepared carbon was found to be greater than superior grades of animal charcoal. Attempts at translation of laboratory results into large scale trial boilings were not as successful as laboratory experiments, in regard to decolourisation but appears to be effective in the removal of non-sugars. As a consequence the jaggery was hard and crystalline and appeared capable of keeping better. Experiments in the production of paddy husk charcoal of greater activity are in progress.

Starch from broken rice: Pure white starches which are in great demand in the country and which is imported in large quantities for a variety of purposes can be manufactured from surplus broken rice; starch is used in sizing, laundry, confectionery and for a variety of other purposes. It can be prepared by a simple process of elutrition and sedimentation and the hot summer months in the deltaic districts offer exceptional advantages for this. Starch is used in many industrial operations for giving "body" and texture and this depends on the viscosity of the starch used. Starches from different sources and possessing different degrees of viscosity are therefore used according to requirements. The effect of neutral salts on the swell and viscosity of starch may be utilised in producing starches of different viscosity from one and the same kind of starch. Generally the effect varies with the valency of the cation.

Pulp from Sugarcane megass: Megass is consumed as fuel in jaggery manufacture. Its coming under the category of waste product depends on condition. Where available for nothing, it may become a waste product. With centralised plants in villages either for sugar or jaggery manufacture there may be a possibility of surplus production. If and when surplus is available it may be converted into paper pulp as suggested by Fowler and Banerjee at the Indian Institute of Science, for the manufacture of cheap card board for packing and other purposes Direct conversion of the megass into pulp requires digestion under pressure and this may not be possible as a village industry. The megass may, however, be boiled with one per cent crude soda lye and washed. The resulting crude stuff is free from the attack of micro-organisms and occupies a small bulk in transport. The soda lye may be prepared either directly from caustic soda or may be made from quick-lime and sodium carbonate.

Utilisation of molasses: With the development of white sugar industry the problem of utilising molasses arises. At present its conversion into industrial alcohol appears to be the best solution to the problem. Alcohol is used in illumination, heating, manufacture of varnishes, smokeless powder, vinegar, perfumes, drugs and a number of others.

UTILISATION OF DAIRY WASTE

T. Lakshmana Rao:— In places where demand for fresh milk is limited and production is in considerable excess of such demand cream or butter or cheese manufacturing processes always leave a certain amount of waste in the form of skim milk which contains about 3 per cent. of protein, casein held in colloidal suspension. This casein has been found to lend itself to enormous number of uses in industry.

Casein paints and distempers. Casein dissolves in lime water but the casein lime compound thus formed has the property of absorbing the carbon dioxide from the air and forming insolube compounds. It is this property of casein which lends itself to the preparation of casein paints and distempers which applied on any suitable surface do not wash or rub off.

Casein adhessives. When dissolved in caustic alkalis or their salts casein has adhessive properties and as such could be applied to the preparation of glues and cements either in liquid or solid form. They are especially useful in wood work as they are ready for immediate use without previous soaking and heating as in the case of ordinary glue.

Photographic films. Casein has been used in place of celluloid in the manufacture of photographic films and in the place of gelatine for coating the photographic film, the sensilised emulsion in the latter case, consisting of a solution of casein holding the halide salts of silver in colloidal suspension.

Boot and shoe polishes. Casein has been found useful in the preparation of shoe and boot and furniture polishes, the casein in such preparations serving the purpose of a protective colloid holding in suspension considerable quantities of the other ingredients usually wax or paraffin, turpentine and colouring matter.

Alimentary casein. Being the chief protein material in milk casein is of considerable food value and has found favour in the preparation of several alimentary products some of them being peculiarly suited for invalids. Thus patent foods have from time to time been placed on the market under the names of Plasmon, Eucasein, Vitafer, Sanogen, Sanatogen etc.

Casein solids. Galalith. By suitable treatment casein could be converted into a plastic mass which could be moulded or pressed into various shapes the finished product resembling horn, ivory or tortoise shell according to the manner of treatment A variety of articles can be made from galalith for example, brush backs, combs, cigarette

holders, electrical fittings, umbrella and stick handles, buttons etc. The articles thus made are uninflammable unlike celluloid.

Lactose. The whey drained off the curd in the manufacture of cheese contains most of the lactose present in the original milk. This could be recovered by first removing the milk albumin by precipitation with acetic acid and then concentrating the clear filtrate in vaccuo until a syrup was obtained from which the sugar crystalises out on cooling.

SOME INDUSTRIAL WASTES.

Mr. M. Sreenivasaya:—The Indian lac industry, which is now passing through a crisis, has many by-products which could be exploited with advantage to the industry. The dye liquors which result in the washing of stick lac are rich sources of fat, and nitrogenous bodies, some of which yield valuable amino acids. A process of recovering these products has been developed in the biochemical laboratories of the Indian Institute of Science, Bangalore. The brewery waste offers us a source of vitamins while the slaughterhouse refuse constitutes a source of digestive ferments, harmones, and other valuable pharmaceutical products. The utilisation of these wastes constitutes towards the economic stabilisation of the industry against possible competition and should therefore be adopted as a matter of prime necessity.

DISCUSSION.

Dr. V. Subrahmanyan. There is a prevalent impression that sewage applied to sugarcane brings on disease and the quality of the cane suffers. I would like to know from Dr. Fowler whether this is so and also how best excess water from the sludge plant can be utilised. With regard to Mr. K. S. Viswanatha Ayyar's paper I would like to know what exactly he means by aerobic and semi-aerobic conditions. I disagree with him that the utilisation of night soil will be prohibitively costly. Night soil has any way to be collected and is collected. The cost will only be for dumping. With regard to Rao Bahadur B. Viswanath's paper and his reference to molasses I cannot see why it cannot be purified and used as an article of diet. Regarding Mr. T. Lakshman Rao's scheme for the manufacture of casein products I can only say that we have not enough milk for our food requirements and under such conditions I wonder what waste products we can have therefrom. As regards his reference to the preparation of photographic films from casein I want to know if they are superior to those on the market already, otherwise there is no point, just for the sake of utilising a possible waste product, in bothering about it.

Rao Bahadur M. R. Ramaswami Sivan: I want to mainly draw your attention to three things in this discussion, viz. waste, molasses and casein. What is after all waste and what exactly does utilisation mean? Everything is after all returned in the natural course of things to mother earth and there utilised. In its narrowed sense therefore utilisation of waste is probably the removal of undesirable things from one place to another where it can be made use of. This is very well illustrated by the Chinese method of preparing composts which they have developed into a perfect system; As regards molasses we must think of molasses for food, if possible avoiding the preparation of alcohol therefrom. Molasses are prepared from badly collected palmyra jaggery. All that is wanted is to prepare it in pure and good condition. In fact we can all go in for jaggery alone. Apart from its containing more vitamins possibly than white sugar it will obviate the objections of orthodox people whose sentiments stand in the way of their using refined sugar for which bone charcoal has been used. As regards casein I do not at all agree with Mr. Lakshman Rao's views on the subject. It is too valuable a food to be utilised in the directions he has outlined. In Calcutta not a bit of it is lost, but is absolutely used for the preparation of a nutritive and valuable delicacy known as 'sandesh'. If only proprietors of South Indian restaurants will learn the recipe for this sweet North Indian dish, we will get a demand even here.

Rao Bahadur T. S. Venkatraman. The first occasion when I was confronted with the molasses question was when a member of the Sugar Committee suggested that the Sugarcane Station might be closed because molasses were not disposed of. You can have an idea of the large quantities of molasses that Java produces from the fact that it is directly pumped on from the tanks to the steamers for transport to Calcutta and other markets. The problem is becoming very serious here, because sooner or later, India will become a self-contained sugar country. In Northern India mollases are used for curing tobacco; this will not however go far and many will not consider it the right kind of use, for tobacco after all is not a very desirable commodity. Messrs. Parry & Co. Nellikuppam, have been putting in the market a syrup called the 'golden syrup' prepared from molasses. This also is not a very satisfactory and permanent, solution and we have got to find ways and means of utilising it. Java's solution is to use molasses as manure added judiciously to the soil. As regards megasse the problem is not so serious, for we are now able to utilise all megasse as fuel, and in fact the demand now is for cane with more fibre. In Louisiana megasse is even used for the preparation of cardboards etc. Most Indian factories are able to utilise all the megasse. Dr. V. Subrahmanyan referred to the preparation of syrup from other kinds of vegetation than sugarcane. Scientifically it may be very interesting but practically it will be adding to our difficulties, for until chemists and bio-chemists are able to tell us how exactly to dispose of our sugarcane molasses profitably I would ask him not to continue with his researches into the preparation of other kinds of syrups. Sugarcane trash is best utilised by collecting it in drains near the field, in layers like the loose-box system for collecting manure. In about a year it forms very good manure, which on analysis compares very favourably with cattle manure. In Nellikuppam trash is being utilized by being buried in alternate trenches in alternate years thus adding to the richness of the soil. I also echo a previous speaker's remarks about the application of sewage to sugarcane. Sugarcane is a crop that does not require much food in its later stages; especially nitrogenous fertilisers applied late to the crop results in rank vegetative growth vitiating the quality of the juice. My opinion is that sewage is best not applied to sugarcane, but directed on to other crops.

Rao Sahib T. V. Rajagopalachariar. I was very much interested to listen to Dr. V. Subramaniam's reference to the prickly pear plant fixing nitrogen. A prevalent practice among the Coimbatore ryots who use the earth under prickly-pear bushes as a valuable manure for their soil is probably based on this phenomenon. I can also cite the instance of gingelly, a non-leguminous plant which is supposed to enrich the soil on which it is cultivated. K. S. Viswanathier's formula for preparing the composts is very interesting, but the cost of composting is actually more than the value of the composts themselves. With regard to Rao Bahadur B. Viswanath's paper, his work on preparing an activated form of charcoal from paddy husk is all right, but I can mention that I have seen places on

east coast where paddy husk has been ploughed into the soil for improving its physical texture.

Dr. G. J. Fowler. I listened with great interest to Mr. M. Sreenivasaya's paper; the figures given by him are very significant and his paper is not merely of scientific value, but shows a good knowledge of market conditions as well. Lac dye is one of those substances which coalesce into their component parts; its value lies in the fact that it has got very great resistance to light and it has still possibilities therefore for the future. With regard to Dr. Subramaniam's question, what to do when a crop has more water than it can do with and how to dispose of the large quantities of water from the sewage plant, I can suggest to him a practice that obtains in China, viz., leading this effluent to fish ponds and rearing fish therein; fish thrive well on this water and grow to quite a good size and so there is a possibility of pisci-culture becoming a useful side industry to a sewage plant.

Mr. C. Tadulinga Mudaliar. Dr. Subramaniam's reference to different kinds of vegetation running wild in several parts of the country induces me to bring to his notice, if he does not know about it already, the existence of a plant, *Croton sparsiflorus*, which is found growing as a weed all over the country. This is a euphorbaceous plant foreign to this country and is becoming fast established as a nuisance to our crops. It would be worth while to find out if this could be utlised in any way. With regard to the activated sludge plant at the Agricultural College, we experience a difficulty in that the only water available for us is very alkaline. I would therefore like to know if the effluent could be used for irrigation and if there is any practical way of correcting the alkalinity.

Mr. K. Krishnamurthi Rao read an extract from the International Sugar Journal which in humourous and in succint language visualized a day when mankind would be able to get on with sugar and sugar products only in the way of furniture, and home and office accessories. In the face of such an extract he was of opinion that a day would come when molasses from cane sugar refineries would be utilised to the fullest extent.

THE PRESIDENT'S CONCLUDING REMARKS

We have digested, I believe, enough of a very important subject and the discussion has tended to show that there are martyrs and saints to the cause of science as I outlined in my preliminary remarks. Mr. Sreenivasaya's hitherto unsuccessful attempts at getting a suitable dye from the red liquid of lac industry waste will dub him a martyr while Dr. Fowler's successful solution of sewage disposal will put him amongst saints.

In the evolution of a scientific solution of any problem for advancing human interest, I believe, that the solution is complete only when a scientist is no longer required and the non-scientific lay public are able to adopt the method by themselves. The direction of success should also be towards developing the method on the scale of a cottage industry. Judged by this standard Dr. Fowler's solution of the problem is complete, but not simple. Mr. Viswanatha Iyer's is simple, but not immediately useful. Dr. Subramaniam's solution is not yet complete, but his work is in the right direction. His work also shows that scientists have to run a race with time. His reference to prickly-pear being a very valuable plant comes a little too late when all the

prickly-pear in the land has been destroyed through the agency of the cochineal. Even now his work on the utilisation of the lantana plant must proceed rapidly for we are now looking on the plant as a nuisance and are out to destroy it by all means. Rao Bahadur B. Viswanath's paper is still in the formative stage like Dr. Subramaniam's; but here also the direction is all right and the Singanallur experiment may very soon give us a new kind of sugar manufactured in our own country which contains more vitamins than the one we are using. As regards Mr. Lakshman Rao's paper the concensus of opinion has been against it and I also agree that milk is too valuable a nutrient to be utilised through its waste products. Mr. Sreenivasaya's solution is complete and simple, but his paper must open our eyes to the competition we are having from synthetic products. It is a wonder to me that most of our synthetic products are manufactured from coal which is after all a dead vegetable. If science has helped us to utilise this dead vegetable in so many different ways, why not we make live vegetables yield more, for after all a day must come when even coal must be exhausted. Scientists and educationists must therefore bestir themselves and universities must change their scope of education to impart training to their *alumni* in such a way as to induce in them a spirit for research and for the practical application of science.

Vote of thanks. Rao Bahadur M. R. Ramaswami Sivan on behalf of the Indian Chemical Society, Madras Branch, Dr. V. Subramaniam on behalf of the Society of Biological Chemists (India) and Mr. S. Sundararaman on behalf of the Association of Economic Biologists proposed votes of thanks to the President after which the session terminated.

SECOND SESSION

Public lecture at 6. 30. P. M.

A CASE FOR THE ELECTRO-CHEMICAL FIXATION OF ATMOSPHERIC NITROGEN IN INDIA.

Speaker:— Rao Bahadur B. Viswanath.

President:— Major Howard.

President's preliminary remarks. The subject is of great national importance and at the present time one which should receive the very earnest attention of not only scientists but the public men and legislators in this country. It is an economic problem to increase the yields per acre of our crops and every possible attempt must be made to harness available resources to this end.

Rao Bahadur B. Viswanath's Speech. Realising that the electro chemical fixation of atmospheric nitrogen is a factor directly and intimately connected with food production, several countries in the world have paid enormous attention to this problem and are producing nitrogen in quantities suitable for areas of production; India alone is producing nothing although it is not wanting in natural resources. Authorities have estimated the probable water power of India for maximum development as 12,680,000 kilo watts. The problem has been under discussion for the past ten years having been studied by the Sugar Committee, the Board of Agriculture, the Indian Science Congress and the Royal Commission on Agriculture. The last body relegated the possibilities to a distant date. But we are not to rest content with their findings for as long as there is not over production there is no justification for India not to produce more. We are handicapped by being late in the field. The use of commercial fertilisers to the detriment of the conservation of other forms of nitrogen available for the ryots, is a disservice to the country. But if for feeding the population the available natural supplies are inadequate the artificial utilisation of atmospheric nitrogen becomes a paramount necessity.

The nitrogen position in relation to food shows on examination, that the present requirements of the world's population in terms of food nitrogen is six million tons per annum. The world's capacity for nitrogen fixation is two million tons per annum. The production of Chilean saltpetre supplies an equivalent of one-third million tons of nitrogen per year. Assuming that the food eater is vegetarian and a nitrogen efficiency of 20 % in the grain, it would require thirty million tons of nitrogen to be added as manure to make up the deficit. Assuming in India that the food requirements are lower than in America or in England, and that 75 grams of protein or 12 grams of nitrogen per head per day are required the total amount of nitrogen necessary for feeding a population of 333 millions is found to be 1,522,312 tons per year. As against this only 1,071,138 tons of nitrogen are produced as calculated by analysis of plants. Thus so far as food is concerned we are short by roughly five lakhs of tons of nitrogen. In other words we are at present producing food sufficient for the proper feeding of only two-thirds of the population.

The total amount of nitrogen likely to be supplied by our live-stock is 3,319,629 tons of nitrogen not taking into account other sources like human excreta etc. We may make up food shortage by proper conservation and utilisation of indigenous sources of nitrogen but it will be at the expense of industrial crops. This can be done (1) by increasing acreage under food crops and (2) by increasing production per acre. The former has practically reached the limit and the latter is our only way out of the difficulty. A case is therefore made out for the use of nitrogen fixation product and for their manufacture in India.

As regards the particular process—" the arc ", the cyanamide " or " the Haber-Bosch "—which would be most suitable for our conditions that is a case for the immediate institution of nitrogen research laboratories in which chemists and electrical engineers should work in close collaboration.

Chairman's Concluding Speech. Rao Bahadur B. Viswanath's enthusiastic advocacy has made me wonder whether there is any one else present in South India who would be able to present it so well as he. He has brought out very clearly the deficiency of nitrogen and how it is imminent on us to produce nitrogen. But to me the problem is how much to produce, how to go about it and how to make the people use the product that is manufactured. In my opinion the best process to be adopted here is the Arc process. The problem is also economic and must be interpreted in a much wider sense than the merely scientific. We have, at the start, to decide on giving a national orientation to this enterprise if it should be any economic success later on. What exactly I mean by nationalizing such industries can be illustrated by referring to Japan, and Italy, where great strides have been made in scientific progress on account of the Government taking a chief hand in such enterprises. I can also quote to you the instance of Egypt where two million pounds have been sanctioned for the erection of hydro-electric works on the Nile and another two millions for the manufacture of fertilizers. I am perfectly sure because they are state-undertaken that even this vast expenditure will be justified in bringing useful returns.

I am not very sure of Pykara being a suitable site. It is not merely from economic considerations but because also that it is not particularly suitable. Nearer to us we have Mettur, an ideal site in my opinion. It is not very safe to take our figures from Norway. Norway was the first to start nitrogen fixation electro-chemically and the figures are of pre-war days. Power in Norway is produced at £ 2 a kilo-watt a year. The Nitrogen Fixation Committee's finding is that this would be equivalent to £ 4 at present. We can produce at Mettur easily at £ 4 and that with profit.

One thing however we must bear in mind and that is the competition from foreign markets. The Agricultural Commission went into this and it was this that made them argue against electro-chemical projects in this country. In the early stages at least, therefore, we must start with protection from the Government and in my opinion that is the only economic solution. I am in sympathy with the lecturer not merely sentimentally but also practically.

THIRD SESSION.

Saturday 8th October, 1932. 1--30 p. m.

CHAIRMAN. **Dr. Gilbert J. Fowler D.Sc., F. I. C.**

1. THE INFLUENCE OF ATTACHED RINGS ON THE FORMATION AND STABILITY OF HETEROCYCLIC COMPOUNDS.

T. N. Ghosh, Bangalore. Some aryl-carbamidopropionic acids have been prepared which, on treatment with acetic anhydride, yield oxazine derivatives. The evidence obtained from the action of hydrolysing agents on the above oxazine derivatives and B-lactylurea on the one hand, and benzoxazine derivatives and o-benzoylenurea on the other, points to the well-marked influence of the benzene ring in increasing the stability of the heterocyclic systems. The remarkable stability of an eight-membered lactone ring obtained from salicylideneanthranilic acid is attributed to the presence of two benzene rings.

2. DILATOMETRY OF HOMOGENEOUS CHEMICAL REACTIONS. PART I.

Complexes of Mannitol with Arsenic, Boric and Molybdic Salts.

M. Srinivasan and M. Sreenivasaya Bangalore. The formation of the complexes of mannitol, which is accompanied by an enhancement of the optical rotation, has been found to give an elevation in the dilatometric column. A 5% solution of the sugar alcohol, with arsenite, yields an elevation of 3.5 c. c. per litre.

3. THE NATURE OF INULASE.

N. Keshava Iyengar and M. Sreenivasaya, Bangalore. The original enzyme extract derived by the cytolytic maceration of the dessicated fungus powder has been analysed for total solids, total and amino nitrogens, total ash and inulase and invertase activities. These data have been determined for different extracts subjected to dialysis for different periods of time. The dialysis has been carried out at room temperature (23°-24°C) against a stream of distilled water in parchment and collodion thimbles. It has been found that while parchment allows the passage of both the enzymes at slightly different rates, the collodion thimble, during the first 5 days' dialysis, does not allow the passage of any enzyme as evidenced by the rentention of the original activity, the dialysis effecting the enrichment of the enzyme 40 times when the total solid content is considered. The total nitrogen content also decreases to more than fortieth of its original value without loss of activity.

4. CALORIMETRY IN ENZYME ACTION PART I. THE CALORIMETER.

H. B. Sreerangachar and M. Sreenivasaya, Bangalore. A modified form of Bunsen's ice calorimeter has been constructed and calibrated employing diphenylmethane. The precautions to be taken for its working are described. The apparatus has been employed for a preliminary study of invertase-sucrose and ureaseurea systems.

5. THE ORIGIN OF COHESIVE FORCES IN PLANTS.

M. Sreenivasaya, Bangalore. A bio-chemical explanation of the origin of cohesive forces in the capillary conduits of the plant is given. Results of recent dilatometric studies in enzyme action lend experimental support to the theory.

6. TRANSPORT OF THE INFECTIVE PRINCIPLE OF SPIKE DISEASE.

M. Sreenivasaya, Bangalore. Several experiments on the transmission of spike-disease to healthy sandals by patch grafting under controlled conditions have shown that the region between the bark and the wood is the most susceptible, infection not taking place when the diseased tissue is inserted in any other vertical section of the stem. This has been confirmed by ringing experiments. Further corroboration has been obtained from experiments on sandal plants which have been split vertically up to the root; infection introduced into one of the fork, manifests itself at the other. From this it appears that the infective principle is transported by the downward current of sap.

7. THE USE OF ARSENICALS AND OTHER CHEMICALS IN THE ERADICATION OF SPIKE-DISEASE OF SANDAL.

A. V. Varadaraja Iyengar, Bangalore.

8. STUDIES ON THE SPIKE-DISEASE OF *VINCA ROSEA.*

A. V. Varadaraja Iyengar, Bangalore.

9. THE MECHANISM OF SYNTHESIS OF PROTEINS IN PLANTS.

K. S. Varadachar, Bangalore.

10. EFFECT OF INJECTION OF AQUEOUS EXTRACTS OF ORGANIC SUBSTANCES ON THE GROWTH OF *HELIANUHUS ANNUS*

G. S. Siddappa, Bangalore. Sun flower plants of Sutton's Giant Yellow variety were raised on washed sand supplied with complete minerals and when they had grown sufficiently they were injected first with distilled water and then with aqueous extracts of dried yeast, farmyard manure, dried blood, soil and sewage effluent. It was observed in almost all the cases that the injected plants responded to the treatment as indicated by their all-round development such as height, stem-thickness, foliage, dry weight and root formation. The effect on flowering was striking as previously observed, yeast coming at the top with a flower per plant of an average dry weight of 9·64 gms. While the control plant give a flower of only 3·29 gms. Farmyard manure and soil extract were equally good in their influence on flowering.

11. RESPIRATION OF MANGOES

G. R. Rao, Bangalore. The amount of CO_2 given out by a fruit during normal ripening indicates the progress of ripening. The respiration of mature greenish yellow Neelam mangoes was studied at various temperatures, 22°C. (room temperature), 10°C. and 5°C. On an average the amount of CO_2 given out per Kilo of fruit in 24 hrs. at 22°, 10° and 5°C. was 1.642 gm., 0.748 gm., and 0·596 gm. respectively.

At 22° the amount of CO_2 given out increased till about the 4th day (when the fruit ripened) and then fell till about the 10th day when rotting started. At 10°C. the amount of CO_2 given out increased gradually. The fruit ripened on the 12th day. At 5°C. the amount of CO_2 given out appeared to be fairly constant but the fruits did not ripen even after about 25 days. The fruits were all kept at about 70° humidity and these were healthier looking and better coloured than those kept without humidity control. Although they had lost considerably in weight they did not appear to have shrivelled up.

From these respiration studies it appears that the best temperature for preservation of mangoes is between 5°C. and 10°C. Mr. B. N. Banerjee finds through actual storage experiments that 5-10°C. is the best temperature for storage of Neelam mangoes and Dr. Cheema (Horticulturist to the Govt. of Bombay) finds that 40-45°F. is the best temperature for preservation of Alphonso fruits.

12. A BIOCHEMICAL STUDY OF THE *RAGI* PLANT AS AFFECTED BY MINERAL TREATMENTS AND SEASONAL FACTORS

S. Rajagopal & A. V. Varadaraja Iyengar, Bangalore.

13. THE RELATIVE VITAMIN-A VALUE OF 5 DIFFERENT FRESH WATER FISH OILS

N. C. Datta, Bangalore.

14. TANNINS IN CASSIA AURICULATA 1. ESTIMATION

N. Srinivasan, Bangalore

15. DETERMINATION OF NITROGEN IN SOILS

A. Srinivasan, Bangalore.

16. THE NATURE OF FENUGREEK MUCILAGE

B. N. Sastri & C. R. Harihara Iyer, Bangalore.

The mucilage obtained from the bran has been purified. Saturation of the aqueous solution of the mucilage with magnesium or ammonium sulphate removes the associated nitrogen and phosphorus containing impurity. Similar results are obtained by treatment with trichloracetic acid, suggesting that the nitrogenous impurity is of the nature of a protein. The purified mucilage is free from silica and phosphorus and is a mannogalactan or a galactomannan, containing the two sugars in equal quantities.

17. RHAPONTICIN FROM *REEUM EMODI—WALL.*

M. Ghouse Mohiyuddin, Bangalore

18. THE PLATE METHOD OF COUNTING SOIL POPULATION.

M. Ghouse Mohiyuddin, Bangalore.

19. ON THE ESTIMATION OF TOTAL ALKALOIDS OF PLANT MATERIALS

B. H. Krishna, Bangalore. **Two new methods are described;—(1) of extraction of the material with trichlorethylene and (2) using methyl alcohol. Colouring matters which are observed to affect the results in a number of cases along with extractable carbohydrates, are removed by preliminary treatment of material with copper sulphate and freshly prepared milk of lime. Comparative figures are given of the results obtained with a number of cinchona barks and also by methods suggested for the new B. P. by self *et. al.* employing ammoniacal alcohol.**

20. PROTEINS OF FENUGREEK.

R. Rajagopalan, Bangalore

21. CONTRIBUTIONS TO THE STUDY OF SPIKE DISEASE OF SANDAL

Part III. Nitrogenous constituents.

Y. V. Sreenivasa Rao and M. Sreenivasaya Bangalore.

22. DECOMPOSITION OF ORGANIC MATTER IN PRESENCE OF CERTAIN INORGANIC CATALYSTS.

J. Jagannatha Rao, Mysore.

23. PHYSIOLOGICAL PRODUCTS OF THE LAC INSECT PART I. NITROGENOUS CONSTITUENTS.

N. K. Ranga Rao, Bangalore.

24. DEVELOPMENTAL STUDIES ON RICE PLANT IN RELATION TO APPLICATION OF FERTILISERS

K. Ramiah, Coimbatore. **To get the maximum outturns from a crop, adoption of improved and judicious agronomic practices have to go hand in hand with the growing of improved strains. Application of fertilisers is an important practice that may have to be increasingly resorted to in future, to augment yields. Yield is an end result of the vital activities of the plant in relation to its surroundings throughout life, and to understand the response of the plant to its environment and the effect of such response upon the final result, the important phases of plant development must first be determined. The paper discusses the relationship between the developmental phases of the rice plant and the application of fertilisers.**

The two important phases of development in rice plant, as in most cereals, which bear a direct relation to final yield are (1), tillering, which is an index of

vegetative development and (2), the ear formation, which is the reproductive phase. The interrelationship between these two phases is traced.

The object of the application of fertilisers should be (1), to increase active early tillering and thus increase the number of ears and (2), to increase the size of the individual ear; both these are known to contribute to bigger yields. It is found that the significant increase in yield brought about by the application of a quick-acting manure like ammonium sulphate in an experiment conducted at Coimbatore, was mainly due to the increase in the size of the ears. These results are confirmed by similar studies conducted at Aduturai, Pattambi, and Maruteru, where the maximum yields were obtained by the application of ammonium sulphate, one or two months after the transplanting of the crop when the active tillering phase was over.

25. STUDIES OF COTTON OVULES WITH REFERENCE TO THEIR POSITION ON THE PLACENTA

V. Ramanathan, Coimbatore. **The history of development of cotton ovules located in a lock, is traced through different stages of growth, with a view to determine the period and the manner of production of differences in the lint weights. Variation is first observed among the ovules a few days after the formation of ovular primordia. But on the day of flowering, the ovules at the middle region show highest weight, while the mode of distribution of the number of hairs is similar to that noticed on the matured seeds. Fresh crops of hairs continue to be produced in the same ratio, without being affected by the fertilisation of the embryos. During the thickening stage of the fibres, the mode for seed coat and lint weights gradually shifts from the centre to very near the base of the lock, while the mode for embryo weights continues to be at the middle zone. This observation indicates that factors for the embryo and the lint development are different.**

A study of the several chemical analyses made on lint reveals that there is a distinct fall in the nitrogen content, as bolls mature.

It is suggested that the appearance of a type of colloidal particles in the lint cells, may be responsible for the transformation of the nuclear contents and for the surface expansion of the lint cells and that the differences in the amount of colloidal particles may be a cause of the variation observed in the number of lint cells produced.

26. POD FORMATION IN GROUNDNUT, (*Archais hypogea*).

Dr. J. S. Patel. **The stalk of the ovary or the gynaphore is visible in about five days after fertilisation. The gynaphore grows downward and pierces the ground to a depth of 2 to 5 cms. in about two to three weeks depending upon the position of the flower. It takes nearly sixty days from the time of fertilisation to the complete development of the pod**

The gynaphores formed pods in sand, vegetable charcoal and clay irrespective of the medium being wet or dry. It would appear that a certain amount of resistance is required in the mediums, as pods failed to develop in cotton, sawdust, water and darkened atmosphere. Though the gynaphores are capable of taking in water, its presence in the media was not found necessary.

The shelling percentage, moisture content of shell and kernels, percentage of oil in fresh and dried kernels and the acid value of the oils were determined at intervals of a week from 25 to 60 days after fertilisation. The transference of organic materials from the shells (pericarp) to kernels begins about the thirtieth day and continues up to the sixtieth day, and the development of the kernel is very rapid in the last two weeks. The rate of oil formation is rather slow in the earlier stages. The curve of the oil formation does not follow a parallel course with that of the transference of the materials from the shells to the kernels. The

acid value is high at the time the pod starts developing and is very low in mature seeds with a rapid fall in its value between 32 and 53 days. The moisture content of the shell is always higher than that of the kernels, but the fall in the moisture contents of both run a parallel course.

27. STUDIES ON THE MOVEMENTS OF COTTON POLLEN TUBES.

V. Ramanath Ayyar & G. Seshadri Ayyangar, Coimbatore. The results obtained on the order of fertilisation of cotton ovules within a lock, definitly show that the ovule nearest to the stigmatic end is not the first to get fertilised, and that the maximum frequency of fertilised ovules is at the ovule of third position. It was also seen that the frequencies were less in all the even position ovules than in ovules of odd positions.

As all the even ovules belonged to one placentum and the odd ovules to another, the observations led to the study of the course of pollen tubes in the placenta themselves.

Three interesting facts were noted:— (1) A large number of pollen tubes on entering the ovarian cavity, were deflected towards the side bearing the first ovule. (2) There was a crowding of the tubes near the third ovule. (3) The pollen tubes were often found to cross from one placentum to the other.

This behaviour of the tubes in relation to the placenta and the ovules was examined and three possible causes were made out. (1) The variation in the perceptive capacity of the pollen tubes. (2) The presence of an exciting influence in the ovules. (3) A variation in the intensity of the orienting stimulus.

Attempts were also made to study the developmental variation in the placenta themselves. But no definite conclusions were arrived at.

The growth of the pollen tubes in culture media, with reference to ovules of different positions was studied. (1) Positive, negative and indifferent reactions. were noted with regard to the direction of their growth in relation to the ovules (2) There was a greater positive reaction with reference to odd ovules and greater negative reaction with reference to even ovules. These facts emphasise the possibility of the presence of a chemotropic stimulus which directs the course of the pollen tubes.

28. THE OCCURRENCE AND INHERITANCE OF A TYPE OF LAX EAR-HEAD IN THE ITALIAN MILLET

G N. Rangaswmi Aiyangar and P. Seshadri Sarma, Coimbatore. A type of lax panicle, characterized by fewer spikes, and fewer spikelets than the compact normal ear-head appeared and behaved as a simple monohybrid recessive to the normal condition. There was chronic sterility and the duration was a little longer. Evidences of primitive affinities in the bristles were noticeable. This appears to be a negative single gene mutant.

29. PERIOD OF RECEPTIVITY OF STIGMA IN RICE

K. Ramaswamy, Coimbatore. A knowledge of the period of receptivity of the stigma is necessary for any hybridisation work towards crop improvement. The paper deals with investigations carried out at the Paddy Breeding Station, Coimbatore, to determine this period for rice.

The rice flowers were emasculated in the usual way and the stigmas were pollinated at definite intervals commencing from two hours after the normal flower opening, up to 8 days, and the percentage of setting determind by growing the set grains. It was found that the stigmas were most receptive for the first three days after emasculation, and the receptivity gradually declined and was lost entirely after the sixth day.

30. THE PROBLEM OF LODGING OF RICE CROP IN GODAVARI DELTA

C. R. Sreenivasa Ayyangar, & K. Ramiah, Coimbatore. The lodging of straw is a serious problem of the tract mentioned, particularly, in the western delta.

The paper discusses the observations recorded about the morphological differences of plants in lodged and non-lodged areas at the Agricultural Research Station, Maruteru. Detailed measurements of internodes, heights etc., of the two sets of plants show, that lodinging is brought about by too rapid a growth in the initial stages resulting in comparatively longer bottom internodes.

The conditions which bring abuut lodging and the cultural practices adopted by the rice growers of the tract to overcome the defect are described. Improvements in such practices, such as judicious pruning of the vegetative growth at the right time, planting seedlings which have been kept for some time after pulling out, application of fertilisers in partial doses after planting etc. are suggested.

31. THE ECONOMIC DANGER IN THE INTRODUCTION OF SOME FOREIGN ANIMALS AND PLANTS

Dr. T. V. Ramakrishna Ayyar, Coimbatore. It is well known that, due to the action and reaction of various factors in nature, there is maintained what is called 'a balance of life' in this world. Human agency sometimes upsets this balance by indiscriminate transport of plants and animals from one country to another. The introduction of the mungoose into the West Indies, the rabbit into Australia, and the Prickly pear and Lantana into the old world are examples of how man, without any evil intentions, was responsible in bringing about an undesirable state of affairs.

Though the geographical position of India is more or less isolated, in these days of quick and easy transport facilities for all sorts of agricultural products there is every likelihood of undesirable exotic forms of insect pests and weeds gaining admission into the country without our knowledge. An attempt is made in this paper to survey the present position with regard to some of the important introduced exotic plants and insect pests, studied by the writer and suggestions are offered for preventing such introductions in future.

32. BETELVINE WILT (CAUSED BY PHYTOPHTHORA SP)

C. S. Krishnaswamy, Coimbatore. A serious disease causing enormous amount of damage to the Betelvine crop has been prevalent in some villages of Chingelpet District since 1927. The disease is caused by a species of Phytophthora, and control measures are difficult owing to the peculiar cultivation practices, obtaining in the locality. Absence of rotation, lack of adequate drainage facilities and excessive use of nitrogenous manure are the chief predisposing causes of the disease.

The disease is most virulent immediately after the North East rains. Experiments have been laid out in the locality to test the effect of lime, iron sulphate, and Bordeaux mixture on the incidence of the disease

Systematic spraying of the vines and the soil tends to keep the disease in check.

33. ERI SILKWORM REARING AS A COTTAGE INDUSTRY IN S. INDIA

Dr. T. V. Ramakrishna Ayyar, Coimbatore. In these days of increasing unemployment, the rearing of silkworms as a cottage industry may be found to be a suitable and practical proposition.

Among the different varieties of silkworms found in India, there are only two kinds which can be utlised for domestic breeding. One is the well known mulberry silkworm (*Bombyx mori*), which produces the great bulk of world's commercial silk. The other is the one known as 'eri' or castor silkworm (*Attacus ricini* Boisd), a native of the submontane tracts along the south eastern Himalayas, the rearing of which was till lately confined to parts of Assam and known as Assam silk on that account.

The eri silkworm possesses some special qualities which would readily appeal to the Indian farmer, the most important of them being, that no life is destroyed in the production of silk as in the case of the mulberry insect. Another factor is that castor, which is grown everywhere can be utilised both for oil seeds and as food for the worm.

The paper deals with the salient characteristics of the eri worm and suggestions regarding its culture. As early as 1910, the writer had successfully bred out fifteen generations of the worm between September 1910 and August 1912, and introduced the industry into some places in S. Canara. Some of the facts and figures collected during these early trials of the writer are included in the paper.

34. SUGARCANE MOSAIC—LOSS DUE TO DISEASE

C. S. Krishnaswamy, Coimbatore. Very few attempts have been made to estimate the actual loss caused by the mosaic disease of cane. An experiment laid out at the Agricultural Research Station, Taliparamba indicated

(1) that there is a loss of 10 per cent in the weight of cane,
(2) that the percentage of sucrose is appreciably reduced,
(3) that glucose ratio is slightly increased in diseased canes,
and (4) that the brix value is lower in diseased canes.

35. VITAMIN ASSAY OF SOME SOUTH INDIAN VARIETIES OF MANGOES.

P. Satyanarayana and P. V. Ramaih, Coimbatore. Two varieties of mangoes were tested partially for their vitamin contents. Both varieties had appreciable quantities of A-vitamin, and were definitely deficient in B. The 'Imam Phasand' variety appeared to be richer in A than the 'Jehangir' variety. The C-vitamin content could not be determined, but good growth of rats deriving their supply of that vitamin solely from the mango, pointed to a high C-content.

36. CHANGES IN THE CARBOHYDRATES OF BATAVIAN ORANGES DURING RIPENING.

G. Ganapathy Ayyar, Coimbatore. Samples of Batavian oranges—those covered for, protection from insect damage and those not covered were analysed for sugars polysaccharides, water solubles and acidity periodically from August to December 1931.

Both the covered and the uncovered fruits showed an increase in sugar content from August to October. No further increase was noticed in sugar content with the former, while the latter gave a further rise subsequently in December analysis. The amount of water solubles behaved similarly. The rise in soluble sugars was accompanied by a fall in hemicelluloses, suggesting thereby that the latter possibly act as an intermediary product.

There was a fall in acidity in both the cases.

The results show that the covered fruits become fully ripe at least a month earlier than the exposed fruits though the latter contained ultimately about 1% more sugar than the former.

37. INVESTIGATIONS IN BASE EXCHANGE METHODS:—

G. K. Chidambaram, Coimbatore. Methods for the determination of exchangeable calcuim in calcareous soils are discussed. Kelley's alcoholic potassium chloride method is shown to give accurate results. Correction for dissolved calcium carbonate can also be made by titrating an aliquot of the leachate for carbonate on the assumption that magnesium carbonate is non-existent in the soil.

The barium hydroxide—ammonium chloride method and the ammonium acetate method for the determination of the exchange capacity of soils are discussed and the former is shown to give higher results, the discrepancy being marked, however, only in the case of soils rich in organic matter.

Methods for the determination of exchangeable hydrogen and the degree of saturation of soils are discussed, and the method of Crowther and Basu is shown to be inapplicable to humic soils. The need for accurate and reliable methods is emphasised.

38. THE CHEMISTRY OF BORDEAUX MIXTURE.

R. Satyanarayana, Coimbatore. In spite of a large amount of work done on the subject, the Chemistry of Bordeaux mixture still continues to be a disputed problem. Millardet thought that the interaction of calcium hydroxide with copper sulphate resulted in the formation of copper hydroxide and calcium sulphate. Pickering, Wober and others objected to this and suggested the existence of basic sulphates of copper The products of the reaction under different conditions, such as variations in the equivalents of interacting substances and the reaction period, were examined. The basic sulphate theory of Pickering and others is not substantiated. Copper hydroxide is formed at 1.0 equivalent and the presence of calcium sulphate checks the decomposition of the hydroxide.

39. A NEW METHOD FOR DETERMINING NITRITES IN WATERS INCLUDING SEWAGE.

P. D. Karunakar amd T. Rajagopala Ayyangar, Coimbatore. Dimethyl—alpha—napthylamine was tried in place of alpha—napthylamine with success. The colour produced is identical in both cases. In the case of the former the colour developed keeps longer within a limited concentration of nitrite. The addition of sodium chloride up to 100 parts per million accelerates the development of colour and at the same time prevents it from fading over a long period. The hydrogen ion concentration of the solution has a very great effect on the colour production.

40. A NOTE ON THE DETERMINATION OF NITRATES IN SEWAGE.

P. D Karunakar and T. Rajagopala Ayyangar, Coimbatore. Oxidation of the colourless and soluble organic matter as well as nitrites by hydrogen peroxide rather than by potassium permanganate was more effective. A modified procedure has been worked out in detail.

FOURTH SESSION

Saturday, 8th October 1932. 8-30 to 11-30 a. m.

THE PRESENT STATUS OF THE SANDALWOOD SPIKE DISEASE IN SOUTHERN INDIA

Speaker:- Mr. M. Sreenivasaya.
Chairman:- Rao Bahadur K. R. Venkataramaier.

CHAIRMAN'S INTRODUCTORY SPEECH

I greatly appreciate the honour done to me in being asked to preside over the Session when scientists of repute are met to discuss a very important disease of sandalwood. And I particularly appreciate the spirit of goodwill and brotherhood with which scientists and laymen are brought together to tackle a scientific problem. The sandalwood spike has recently been very much in the public eye and I am sure Mr. Sreenivasaya and others will help us to a correct understanding of the present status of the disease.

Mr. M. Sreenivasaya: The sandalwood spike disease has been noticed as early as 1899 by McCarthy and others. Right from the

beginning, there have been at least two schools of scientists and others, who have advanced reasons for the incidence of this disease. One, the physiological school, quotes that it is due entirely to physiological factors affecting the plant, while the other school contends that the disease is due to an infection which is capable of being communicated. A large amount of experimental work has been done to elucidate information about what you may call the infectious theory. In 1917 Dr. Coleman of Mysore gave experimental support to the infectious theory by his grafting experiments wherein diseased scions were grafted to healthy stocks and communicated the disease. There were of course certain defects in Dr. Coleman's experiments; they do not take into account the percentage of success attained or the nature of controls run. The possibility of transmission from the soil was also not eliminated.

The lecturer then explained clearly with a number of slides how experiments were devised to test the physiological and infectious theory. As regards the first, the disease could not be produced although the symptoms were created and the most significant factor was that the symptoms could not be communicated whenever they had been produced by alterations of physiological conditions. On the other hand, experiments designed to test the infectious theory by means of the leaf insertion method tended to show that the disease was communicable. This proved definitely that the sandalwood spike disease was due to some infectious principle. During the study of the disease every host plant of sandal was examined to find, if possible, any resistance could be attained to the disease by host association and in fact, hosts like *accacia*, *cajanus*, *pongamia* were found to render the sandal plant susceptible to disease while plants like *melia*, and *cassia*, impart relative resistance to the infection. The future of the work will depend for its success on selecting such resistance-imparting plants as hosts and by pollarding suspected trees in order to reveal the masked disease and then eradicating all deceased trees to eliminate the sources of infection.

Discussion. Mr. C. Tadulinga Mudaliar referring to a botanical survey in 1903 of the Mysore zone by Dr. Barber and others, wished to suggest to Mr. Sreenivasaya to infest if possible the *olocacia* family with spike disease as a preliminary to get some information on the incidence of disease and varietal differences.

Mr. C. Dover gave a short account of the entomological work done in connection with this disease to accumulate information about possible insect vectors for the spread of the sandal spike disease. A survey of the insect fauna of sandal wood forests is being systematically made and it is hoped that very soon the particular insects responsible for carrying the disease might be located.

Mr. G. N. Rangaswami Ayyangar speaking with the experience of one privileged to deal with annuals and the difficulties a crop specialist has to surmount, gave a note of warning about dealing with a costly parasitic tree like the sandal. He suggested a broad genetic attack of the problem with a view to get more knowledge about the sandal tree.

Dr. T. V. Ramakrishna Iyer wished to have more information about the bodies which had been isolated from diseased specimens. Apart from sandal wood he wanted to know if any one example of transmissibility of disease could be cited as having been passed by physiological conditions.

Rao Bahadur T. S. Venkataraman remarking humourously that a systematic botanist works in straight lines while life gets on in a circle, said that while on the authority of a systematist we might be working on different varieties it might happen that they were all the same and vice-versa. Genetic composition is sometimes different from systematic label and he would therefore suggest more study of the varietal differences as regards the incidence of disease.

Mr. C. S. Krishnaswami observed that transmissibility of the disease was the crux of the whole matter and if physiologically well nursed plants do take the infection it cuts at the root the physiological theory. With reference to Mr. Dover's observations that only insects found on the sandal might be possible vectors of the disease he quoted the instance of *Aphis maidis* which thrives on cholam but has been known to be the carrier of the sugarcane mosaic.

Rao Sahib T. V. Rajagopalachariar speaking as a layman referred to his observations of a sandal thriving on pomegranate as a host and wanted to know if sandal hosted on itself was more inclined to spike.

PRESIDENT'S CONCLUDING REMARKS.

I must thank Mr. M. Sreenivasaya for the very clear exposition he has given of the subject. We forest department people have been trying to find ways and means of stamping out the disease but it has been sylviculturally impossible. It is a matter of regret to me that Mr. Jivanna Rao is not here today to give us the benefit of his arguments in support of the physiological theory. I myself for a long time was a disbeliever in the infection theory. As a forester I have had occasions to come in close contact with the sandal tree. I observed one tree spiked, and another not, and others escaping for years together. My inference naturally was that it could not be infectious. Only when I had positive proof of communicability by artificial inoculation in experiments done by myself at the Institute, as a result of my own handling, did I get occular satisfaction and became a convert to the infection theory.

Sandal is a deciduous associate formation and is naturally limited through reserves. The species is transitory reaching a climax type in virgin forests and vanishing near the fringes of reserves. It therefore grows under a covered condition hugging shelter of lantana and other bushes and is denied sun light till a particular stage of growth. Unbalanced circulation of sap sets in and this was for a very long time supposed to be the predominant cause for the disease. The peculiar conditions of light and shade in which it grows and the fact that it is a root parasite and therefore does not get normal food supplies, are reasons which make one believe in this unbalanced circulation of sap. This in fact is the basic argument for the physiological school.

I will now enumerate to you the several points against this physiological theory. If food is cut off or rapidly used up the

irresponsiveness of the root to continue to supply to the leaves results in difference of osmotic pressure. This is the argument of the physiologist. Treating host plants therefore not to do their function must therefore result in this physiological condition. If you cut the roots the sandal must produce the spike. Such things have been done but never was spike produced. In fact single trees were isolated, dug up all round, roots cut off and even a polished platform provided to cut off moisture. The tree of course did not show normal growth but never produced spike symptoms. Even stronger measures were adopted. Strong sulphuric acid was poured into the roots. The lantana bushes were destroyed ruthlessly. Even fire as a killing agency was tried. The trees after sometime put on new flesh but no spike was produced.

All these conclusively dealt the death blow to the physiological theory. I however still believe, convert as I am to the infactious theory, that physiological and ecological factors have something to do with the disease. If they do not cause the disease they are at least responsible as predisposing causes for the trees to take on infection. I am not also yet convinced of the efficacy of destroying wholesale valuable plantations to stop the spread of the disease. Because even after destroying the trees one is not quite sure that the infection may not yet spread. There is no point therefore in eradicating these trees. Until therefore more efficient methods of combating the disease are found my opinion is that it is unwise to cut off plantations. My own experience is that there is an equilibrium set up by nature itself and sooner or later the infected trees get naturally immunised. Statistics as far as I know do not warrant our destroying so much wood of commercial value.

Notes and Comments.

Universities and Applied Sciences. Though no one can deny the need for research in the fundamental and general problems of the sciences it must be accepted that the time has come for those responsible in carrying on scientific investigations such as Universities and Research Institutes to divert the lines of research as far as possible, from the time-honored beaten tracks of mere academic lines towards the utilitarian aspects of scientific research. So far most of the Universities, at any rate in India, have been arranging their research courses in such sciences as Botany, Zoology, Chemistry, etc., more along the aspects of pure science than along fields of the applied aspects of such sciences. It is needless to add that these are times when the mere academic pursuit of any pure science will not be of any great help to the immediate needs of the country ; workers in different branches put their hands together, co-operate, and make the very best use of their scientific knowledge towards the urgent needs and the calls of the country. Specialisation in different branches is certainly essential and commendable but as the writer in ' Nature ' put it ' Science is so specialised to-day that workers in any one branch of science are liable to have their attention so concentrated upon their own particular subjects that they see little of the field around them and are unconcerned in its general activities or problems '. There must therefore be co-ordination in research and the latter should as far as possible be planned and carried out with the hope of getting some results which will prove of some material use to the country. It may not be possible to produce the desired results in all such cases, but a great deal depends upon the Universities and Research Institutes in the way they direct research in the various sciences. That the pure academic mentality of scientific workers has not as yet fully reformed may be seen from the attitude taken by the recent British Association meeting at York which in full session refused to adopt a resolution brought forward by one of the sections to the effect that " the Government invite the leading scientific institutions and societies to appoint in conference representatives to co-operate with them to formulate plans for dealing with the present problems facing the country !" Though this is disappointing it is high time that the scientific worker realises that he has to shoulder some of the responsibilities of citizens to meet the needs of the country and help towards its material welfare ; especially is this the case in India and scientific workers all over the country will do well to bear this in mind.

A New Method of Producing White Sugar from Sugar Cane. Recently what appears to be a revolution in the manufacture of white sugar from sugarcane was demonstrated by the Industries and Agricultural Departments at Singanallur. The cost of materials for the demonstration is being met by the Coimbatore District Agricultural Association. The process consists of crushing sugarcane in the ordinary method by a power-driven sugarcane mill with the aid of 12 H. P. Peter oil engine. The juice is then boiled in a special multiple open pan furnace of the Rhilkand Bell type consisting of five pans, the fuel used being the trash and crushed bagasse obtained from sugarcane. A solution obtained by crushing bendi stem and a solution got from *sajji* (alkaline earth) are being used as clarifying agents, just when the juice commences to boil. The scum on the surface is then removed with laddles. When the juice comes to a consistency above that known as '*thenpagu*' and just below that used for the manufacture of jaggery it is removed and led into earthern vessels where it is allowed to cool. This is called '*rab*', and is kept for a period varying from 7 to 10 days and then treated in a centrifugal machine for about 15 to 20 minutes when it is converted into white sugar. The centrifugal separates the molasses from the white sugar formed. The molasses are also alternatively mixed with cane juice in order to get jaggery which fetches a second-rate price. In this process as soon as all the molasses get down a little water is syringed in the white sugar inside the

centrifugal so that all further impurities might be driven out. The sugar is then dried and a quality of sugar known as '*burra*' sugar in the bazaar is obtained. The operating cost appears to be very economical. The whole process involved appears to be within the means of an average ryot cultivating 15 to 20 acres annually. The furnace used was designed by Mr. Srivatsava, Sugar Technologist to the Imperial Council of Agricultural Research and the local departments of Agriculture and Industries are actively co-operating in these experiments. If such trials prove economically successful there is sure to be a great future for the Indian Sugar Industry.

M. Sc. Degree in Agriculture. We understand that the Madras University authorities are inclined to institute post graduate research courses for our agricultural graduates and offer the master's degree in Agriculture. This is certainly an incentive to young men working on different aspects of the agricultural sciences to earn distinction in their own special line of work. The arrangement proposed is that the candidate for the M. Sc. Degree should be an agricultural graduate of sufficient attainments and should after working under the supervision of a science expert recognised by the University for at least two years submit a thesis on some special agricultural subject which will be examined by experts appointed by the University. The institution of such a post graduate course will also help the Agricultural and Industrial Departments to select specially trained men for particular appointments under them instead of having to select from a number of graduates having the same general training but of doubtful value for special lines of work.

Recent Grants for Agricultural Research. The governing body of the Imperial Council of Agricultural Research at its meeting held on the 7th October, sanctioned a number of research schemes as recommended by its Advisory Board. The more important of those were (1) An application from the Madras University for a grant of Rs. 25,830 for research in the cytological study of Indian crop plants, (2) A scheme from the Indian Institute of Science for the preparation of cheap synthetic manure, (3) A scheme for the continuance of investigations regading the different aspects of cereal rust problem, (4) A scheme from the Madras Government for research into the indigenous drugs of India and the application of Lt. Col. Chopra for a grant to carry on research in the systematic collection of medical plants, (5) An applicaton from the Director, Imperial Institute of Agricultural Research, Pusa, for a grant to carry on research in the Genetics of sugarcane at Coimbatore, (6) A scheme for an economic enquiry into the cost of production of crops in the sugarcane and cotton tracts in India, (7) An application from the Government of the Nizam of Hyderabad for a grant of Rs. 59,383 for dry farming research, (8) An application from the Government of Mysore for a grant for

investigation of the Indian fish poisons, and (9) Provincial schemes of fruit research from Madras, Bombay, Bengal, United Provinces, the Punjab, Bihar and Orissa and Assam, as recommended by the Fruit Committee and the Advisory Board. We understand that all the various schemes submitted were considered chiefly on their merits and that in all a sum of Rs. 104,000 was available for the new items excluive of sugar schemes. We congratulate those who have succeeded in submitting useful items of research and succeeding in getting grants. We have no doubt that research on these schemes will prove of real benefit to the agricultural needs of the country.

A Train held up by Insects. It may be surprising to many of our readers to know that a railway train was actually held up for over an hour's time on the 21st of October by a horde of caterpillars which covered the railway track for over a mile's length near Uttamangalam on the Vriddachalam line (S. I. Ry.) It would appear that the caterpillars got crushed under the wheels of the running train and the permanent way was so much covered with the sticky and greasy remains of these creatures that the line had to be cleared with a gang of coolies and covered with showels of sand to allow the rolling stock to move along the rails. It was only a few months ago that we read of an account of a locust plague extending along a hundred mile line in East Africa when the help of the military had to be indented on for getting the tract clear of the pest. Educated agriculturists might have heard of such insects as army worms and swarming caterpillars which under favourable climatic and other conditions multiply remarkably and become a regular menace to human progress. In some parts of the world especially in the malarial tropics there goes on perpetually a regular fight between man and insects and the question is often asked Insects or Man? This incident is an example to show the importance of insect pests and the necessity for studying their habits and influence on human activities. This appears to be the first case of such a nature in India though in America the moving army worms and locusts have been known to block the highways occasionally.

Joint Meeting of Science Associations. The recent joint session during the 2nd week of October (7th & 8th) of three science associations *viz.* the Association of Economic Biologists, Coimbatore, the Madras Branch of the Indian Chemical Society and the All-India Society of Biological Chemists, is an indication of the modern trend of scientific research calling for more and more co-operation and mutual help from workers on different aspects of the various sciences. The numerous subjects which were dealt with which were chiefly biological and chemical problems were of very great general importance and the discussions that followed were of a very high order and very instructive to all. The discussion on the symposium on "Utilisation of

waste products" presided over by the Director of Agriculture deserves special mention; almost all the aspects of the possible utilisation of waste were dealt with by the local scientific workers and the visitor delegates and the President summed up the whole situation in a remarkably suitable speech. Another important subject that received special attention was the "Sandal spike disease" a discussion on which was opened by Mr. M. Sreenivasaya from Bangalore, who has been carrying on research on this problem for some years. This session was presided over by Rao Bahadur K. R. Venkataramana Ayyar, Conservator of Forests, Coimbatore, a very experienced forest officer who has had a good deal to do with the Sandal Forests of South India. The subject was dealt with in its various aspects both by the opener and the other botanists and zoologists interested in the problem and the President gave a very interesting resume of the subject including his own personal and long experience of the problem. In addition to these main discussions a joint session of the societies was held over which Dr. Gilbert Fowler, the well known biochemist, presided. Numerous papers were read during this meeting including those from workers at Coimbatore and Bangalore.

All the three associations especially the conveners have to be congratulated for bringing about just a joint session and giving opportunities for various scientific workers to meet together and discuss important problems. The benefits of such meetings are very substantial and we welcome such joint meetings as often as possible. We would at the same time urge on the departments or institutes to which the various workers belong to encourage such conferences and give them all facilities to attend and take part in such gatherings. Details of this joint conference may be found elesewhere in this issue.

Gleanings.

Inherited differences in Taste Reactions. It has recently been shown that individuals differ in their capacity for tasting certain substances and that these differences are inherited. The results of an experiment with phenylthio-carbomide, made at the New Orleans meeting of the American Association for the Advancement of Science, last December, are recently published by Dr. A. F. Blakeslee and Dr. A. L. Fox (Jl. Heredity Vol. 23 No. 3). Of 2550 persons tested 65.5% tasted the substance as bitter, 28% found it tasteless while 2.3% found it sour and 4.2% reported another taste. Earlier tests of families had shown that the failure to taste is inherited as a simple Mendelian recessive. When both parents are non-tasters, all the children are the same. This was found to be the case in 39 children from such parents. Individuals also differ in the threshold of stimulation, some being able to detect the taste in a few drops of a 1/500,000 solution while some non-tasters require a hot saturated solution to perceive any taste at all. This substance which is bitter to most people, differs in dalcin, which is three hundred times sweeter than sugar, in that an atom of oxygen is replaced by sulphur. The related p-ethoxy-phenyl-thio-carbomide is identical in taste, but apparently gives a slightly weaker reaction. Similar fumar-proto-cetraric acid, a bitter constituent of certain tichens, distinguishing them from closely selected

species, is tasteless to some while others find it bitter in varying degrees. The odours of certain verbenas, and freesias are also found to produce various sense reactions in different individuals some finding particular varieties odourless. By tests of this kind inherited differences in our sense organs are coming to light. (Nature—September 24, 1932).

A New Process for Wood Preservation. (R. Falk and S. Kamasam, Ind. Pat., 18580 of 1932). The invention is based on the observation that when mixtures containing arsenic compounds and chromium salts in aqueous solutions are used for impregnating wood, neither of the two compounds get washed out within a certain range ($As_2O_5 : K_2Cr_2O_7$ :: 1 : 1·25 to 1 : 1·75) while at others either the arsenic or the chromium salt passes out quite readily. A preservative containing both within the optimum range is very efficient against wood destroying fungi and insects and can be applied by injection in closed vessels or dipping in the open or painting with the solution. It can also be combined with other insecticides and fungicides or fire-proofing chemicals provided the latter are present in small proportion, generally less than 20 percent. (Current Science, September 1932).

India as importer of Copra. The Malayan Agricultural Journal writes:—"In the July number of this journal we directed attention by means of an Editorial and of an article on coconuts and copra in 1931, to the importance of India as a market for high quality copra. It was pointed out that India not only consumes the whole of her Malabar production, but in 1931 took an increasing quantity of Ceylon copra. We further suggested that if Ceylon copra is to be permanently diverted to India it behoves Malaya to export an improved product to the European markets to replace the Ceylon supplies. The Ceylon papers recently to hand publish a memorandum by the Minister of Agriculture and lands, Ceylon recommending a cess on copra for the purpose of a propaganda campaign to extend the market for cocoanut products in India. Our references to the increasing importance to Ceylon of her Indian market however, cannot but be of interst to Malaya because it indicates that Europe will have to obtain from other courses the supply of high grade copra to replace any shortage of supplies fromCeylon. We are ambitious enough to hope that Malaya may be able to satisfy this demand, should it arise. (Malayan Agricultural Journal, September 1932).

Field Control of Mosaic Disease in Hawaii. At the present time mosaic disease in Hawaii is a problem only in a few localized areas and as regards a limited number of highly susceptible cane varieties. The methods used in the field for controlling the disease are outlined as follows:

(1) Rigid selection of healthy cuttings only for seed material. Labourers can be trained to differentiate between healthy and diseased plants, and where such a system of selection is in effect it is possible to have a newly planted field almost entirely free from the disease. It is now known that the mosaic virus can be transmitted by cane knives. Hence these implements should be disinfected frequently.

(2) Substitution of resistant for susceptible commercial varieties. This is the most effective of all means of controlling mosaic; an example is the substitution of D. 1135 in place of Striped Top.

(3) Systematic roguing of fields at frequent intervals in order to remove all diseased plants as soon as possible.

(4) Clean field cultivation. Weed control is of paramount importance in any field. Grasses, even though not affected by the mosaic disease, may harbro the corn aphis.

(5) It is recommended that host plants of the corn aphis such as corn, sorghum etc., should not be grown near corn fields. (*Facts about Sugar*. Vol. 27, Number 8. August 1932.)

Green wrapping protects food. Wrapping paper, of a grassy green hue, is superior to transparent wrappers for oil-bearing foods, according to scientists who have recently conducted tests on various wrappers. The green paper, they say, delays development of rancidity by excluding photochemically active light rays. Black paper has about the same effect:—(*Scientific American*, October, 1932).

Molasses valuable as Fertilizer. Intensive experiments are being carried on by the Hawaiian Sugar Planters' Association looking to the disposal of the 250,000 tons of molasses produced annually by the manufacture of Hawaiian raw sugar, says "Food Industries". The market, hitherto enjoyed, for this molasses has largely disappeared, until the industry is faced with the problem of disposing of about 90% of the annual production. It contains on an average about 4·5% of potash and somewhat less than 1% of nitrogen. Its percentage of organic humates is very high. Partly to render the fertilising constituents available but mainly to make a portable mixture of the very heavy, viscous molasses, it is subjected to a charring process with sulphuric acid, followed by the addition of basic crude fertilizers which, together with mill ash, result in the formation of a dry, granular, and readily handled product. Experimental research on the fertiliser has been transferred from the laboratory of chemistry to a plantation factory where, at the present time, several types of mixtures are being prepared on a semi-plantation basis. Soil pot-tests carried out at the experiment station have shown extremely gratifying results. One observation points to the possibility that the undefined humic constituents of molasses give the mixture a value to the plant not to be obtained by the employment of any commercial inorganic fertilizer when used on the same basis of plant food content.—(A. E. B. in *Scientific American*, October 1932).

ABSTRACTS

The Cultivation of Coimbatore Seedling Sugar-canes in South India.—A. C. Edmonds, S. Sitarama Patrudu and M. Ramamurti (*Madras Agri. Dept. Bull. No. 30, 1932.*) The authors attribute the almost stationary area planted under sugar-cane in the Madras Presidency (about 120,000 acres) during the past some decades, and the lack of progress in this direction, to difficulties in regard to water supply. The water requirements for sugar-cane are not definitely known under different soil and climatic conditions, but information obtained at Anakapalli and Samalkotta show that on an average from 4 to 5 acre—9 inches are applied per irrigation, exclusive of losses in irrigation channels, i. e. equivalent to about 100,000 gallons per irrigation per acre. J 247, which is the hardiest of the exotics now being grown, requires the minimum quantity of water, but gives a low yield (about 6,000 to 7,000 lbs. of jaggery per acre) and, except in favourable seasons, a proportion of the canes die. Among the new varieties of thick canes released from the Sugar-cane Breeding Station, Coimbatore, the authors have tried Co. 213 at Anakapalli during the last four years (1927—1931), and the results of a comparative trial between J 247 and Co. 213, which are given in the present Bulletin, show that Co. 213 is a hardier and more resistant variety than J 247 and gives a higher yield of jaggery (about 10,000 lbs. per acre, with a higher percentage of Sucrose (16·02 %), a lower glucose ratio (3·30 %) and a higher coefficient of purity (87·38 %). This new variety tillers well and requires only moderate manuring (1000 lb. of groundnut poonac per acre, provided green manure crops are grown in rotation). The methods of cultivation are described in detail and the authors hope that the introduction of this hardy variety would serve to increase the area planted to sugarcane in this Presidency. (C. N.)

Preliminary Report on the Vitamin content of the Mange.— Edith O. V. Perry and S. S. Zilva (*Bulletin issued by the Empire Marketing Board, March, 1932*). Samples of Indian Mangoes of the "Alphonso", "Cawasji Patel" and "Shendrya" varieties, obtained from India by mail-steamer and preserved at minus 20o C, were analysed in England for A, C and D vitamins. The results showed that: (1) the pulp of the "Alphonso" variety is one of the most potent sources of vitamin C. The "Cawasji Patel" variety is slightly less active, but is as potent as the previously best known natural antiscorbutic source (Lemon or orange juice). The "Shendrya" variety contains in comparison, little vitamin C. One test carried out on the rind of the Alphonso variety showed that it contained at least as much vitamin C as the pulp. (2) The pulp of all the three varieties contains vitamin A in quantities similar to that possessed by butter. The Alphonso variety is somewhat better than the other two varieties in this respect. (3) No very significant amount of vitamin D was found in the pulp of any of the three varieties. (C. N.)

Methods of Hand-milking. A Comparision. K. Boyes and J. Mc Clement. (*Jour. Ministry of Agri., London, vol. 39, pp. 541—544*). As the authors found some difficulty in convincing hand-milkers that contamination may and does follow on the use of wet or greasy hands, they carried out experiments in order to compare three methods of hand-milking, viz. (1) milking with clean, dry hands, (2) with clean, wet hands, and (3) with clean, dry hands lubricated with vaseline. The "dry-handed" milkers washed their hands thoroughly in soap and water and dried them on a clean towel before starting to milk. The "Wet-handed" milkers washed and dried their hands, but moistened them with milk before and during the progress of milking; while those milking with greasy hands, washed and dried their hands, but rubbed them with a small portion of clean vaseline before starting to milk. Precautions were taken by change of milkers, time and place and by use of sterile bottles and packing in ice, etc., to exclude as far as possible all sources of contamination likely to cause variation in the bacteriological content of milk, other than that arising from the condition of the milker's hands. The samples were analysed for bacterial count and for the presence of B. Coli. Out of 30 samples of "dry-handed" milk, none showed the presence of B. Coli, while for an equal number of "wet-handed" and "greasy-handed" samples, there were 15 and 16 samples respectively which showed the presence of the Bacillus. Out of 30 samples of each of the three classes, 22 samples of "dry-handed" showed bacterial counts less than 1000 per c. c. of milk, while 16 samples of the "wet-handed" and 10 samples of the "greasy-handed" showed counts up to 10,000 per c. c. of milk. The "dry handed" milk showed the least contamination with loose hair. The results demonstrate that milk drawn with clean, dry hands, is cleaner than milk drawn by wet or greasy hands. (C. N.)

Annual Report of the Indian Central Cotton Committee for the year ending 31st August 1931. (Indian Central Cotton Committee Bombay, 1932). This Report reviews the activities sponsored by the Indian Central Cotton Committee in connection with the Technological Laboratory at Bombay, the Indore Institute of Plant Industry and the various provincial centres of activity organised in cooperation with the Provincial Departments of Agriculture. Progress in the introduction of improved varieties of cotton is followed and statistics given regarding the production and consumption of different varieties of cotton in the various provinces of India. Tests made in the Technological Laboratory at Bombay with 5 samples of *Karunganni* containing from 16% to 31% of low quality cotton known as *Pulichai*, show that on the average, the mixture was suitable for 12's only, while the average over seven seasons for pure *Karunganni* was 24's; the authors of the Report infer from this, the urgent necessity for stamping out the cultivation of *Pulichai*, which is grown in the Tinnevelly District as an

adulterant. Preliminary trials with 289 F cotton showed that it was fit for 60's and 80's yarns when it is combed to the extent of 20 to 30%, showing that the finer counts of yarn could be produced in India itself. A brief account is given of the various Research schemes in progress in the different provinces, which are financed by the Committee. In the Madras Presidency, three schemes are financed by the Committee, viz., (1). The Madras Herbaceum Scheme, commenced in 1923 in the hope of obtaining an *Uppam* strain of cotton which will spin and yield as well as *Karunganni*. (2). The Fodder Cholam Scheme, mainly intended to examine the causes for the poor yield of cotton when grown in rotation with foddor Cholam (Andropogon Sorghum), a phenomenon which does not occur when "cumbu" (Pennisetum typhoideum) is the alternative crop. (3). The Pempheres and Physiological Scheme, which consists of an investigation into the methods of combating the Cotton Stem Borer (Pempheres affinis) which is a major pest in Madras and some other parts of India. Two officers of the Madras Agricultural Department have been sent for training in this connection to England. The Committee is financing in all 33 schemes at an estimated cost of Rs. 6,83,843 per annum. Total receipts of the Committee for the year under review amounted to Rs. 9,05,804 and expenditure Rs. 7,35,412, against an estimated expenditure of Rs. 9,70,677. (C. N.)

Lucerne cut at various stages of growth :— E. Griffith and A. A. Ramsay (Agri. Gaz. New South Wales, 1932, vol. 43, pp. 657–665).—The authors have examined the variation in yield and composition of lucerne cut at different stages of growth, viz. (a) when about 6 inches high, (b) in the "bud" stage, and (c) in "full flower". Their results show :— (1). Protein content is highest in lucerne cut when 6 inches high (25.96%), is very slightly less (25.65%) in bud stage, and markedly less (19.37%) in lucerne cut when in full flower. (2). Fibre content is lowest in lucerne cut when 6 inches high (13.91%), and rises steadily to 14.77% at the bud stage and to 19.59% at the full flower stage. (3). The ash content is highest at the "6 inch" stage (14.82%) and falls continuously to 13.34% at the bud stage and to 12.36% at the flower stage. (4). The "nutritive value" of each 100 lb. dry matter in lucerne cut when 6 inches high (76.12) closely approximates that of lucerne cut at the "bud" stage (75.99) while it is 4.3% lower at the "full flower" stage (72.85%). The albuminoid ratio is approximately the same at the 6 inch stage (1:1.93) and the "bud" stage (1:1.96), while it is wider at the "full flower" stage (1:2.75). (5). Lucerne cut when 6 inches high yielded 3,043 lb. per acre dry matter with an albuminoid ratio of 1 to 1.83. When cut at the "bud" stage, 4,164 lb. dry matter was obtained (an increase of 36.8%), having an albuminoid ratio of 1 to 1.93. When cut in full flower, 4872 lb. dry matter was obtained (being an increase of 60.3% compared with lucerne cut at the 6 inch stage), and the albuminoid ratio was 1 to 2.62. (6). Approximately one third more stock (36%. could be fed on lucerne cut in the "bud" stage than if cut when 6 inches high). The albuminoid ratios of both lucernes would be practically the same. The lucerne cut when in full flower, would feed 60% more stock than if cut when 6 inches high, but the albuminoid ratio of this lucerne would be slightly wider, viz. 1:2.62. (C. N.)

Report on the Marketing of Honey and Bees-wax:— (Ministry of Agri. and Fisheries, England, London, 1931). This interesting pamphlet gives the results of a detailed investigation of the marketing of honey in England, Wales and Ireland. Part I deals with the general aspects of the collection and storage of honey, including the composition and properties of different kinds of honey, and also examines the question of the internal supplies and demand within the country. In 1929, there were about 56 active associations of Bee-keepers in England and Wales, with a total membership of about 13,500. There were about 100,000 colonies of bees, each colony yielding on the average from 30 to 40 lb. of honey per year. The total output of honey in England and Wales in 1929, was estimated at about 34,300 cwt., valued at about £200,000. Besides internal production, Great Britain imported about 100,000 cwt. of honey, chiefly from New Zealand, Australia and America. The wholesale price of imported honey was about 50 sh. per cwt. and that of home-produced honey about 100 sh. per cwt. The retail price varied from 1 sh. 9 d per lb. for home-made to about 1 sh. for Canadian honey. Part II of the Report deals with the important question of preparation of honey for the market, e. g. the problem of quality, processing, grading and packing, while Parts III and IV deal with methods of organization among Bee-keepers, for co-operative sale and distribution, as practised in other countries like New Zealand, Australia and America. The closing parts deal with the question of transport and storage and also with methods for utilization of Bees-wax. In the concluding remarks, the authors observe that out of the present consumption of honey in England amounting to about ¼ lb. per head of population, only about 1 oz. per head is produced within the country itself, and that there is great scope for expansion in home-production, for which purpose they recommend the formation of effective Marketing Boards similar to those organized in New Zealand and Australia. (C. N.)

Social Consequences of Scientific Discovery. The concern for the social consequences of the application of scientific discoveries which has been voiced by Dr L. P. Jacks in a series of recent articles was reflected in several of the addresses and discussions at the recent British Association meetings. Dr. Jacks suggests that instead of lending itself to the creation of endless desires, science might regard its task of giving man control over the forces of Nature as sufficiently advanced for the time being and turn its attention to the equally important task of assisting man to control himself. Recognition of this necessity was as explicit in Sir Alfred Ewing's presidential address before the British Association as in the forceful address delivered by Prof. Miles Walker to Section G (Engineering), which referred frankly to the hampering of developments by vested interests and the middleman, as well as to the value of the contribution to the improvement of the lot of mankind made by those who possess the power of devoting their whole energy to the execution of sound, practical, and beneficient projects for the sake of those projects themselves and not primarily from selfish motives or in pursuance of some irrational prejudice. Long after science has shown the way to make things better for the people, unintelligent control and stupid prejudice preserve the old evils and prevent the spread of better ways. If effective action is to be taken, now that in so many fields physical science has instructed man how to control and eliminate waste, the human sciences must show him how to control the waste forces of his own nature.

As an example of the potentialities, Dr. Jacks and Prof. Miles Walker both refer to Lord Baden-Powell's discovery of how the play-hunger of the young human animal, his love of adventure and fun, his sporting instincts, and even his devilries, can be used by skilful hands for the development of self-control, self-respect, courage, loyalty, discipline, good fellowship, responsibility and competence. This is a great discovery, to be ranked with any of the achievements of physical science, and is a token of what may be possible when we really address ourselves to the development of social sciences. The picture Prof. Miles Walker draws of the State as controlled by the engineer, with the elimination of waste at its source, the control of production, improvement of distribution so as to secure the manufacture of things men want and their distribution in the simplest way with the minimum addition to the cost, involves drastic curtailment of competition and perhaps a profound change in our social habits and attitude towards buying and selling. In insisting on technical knowledge and administrative

ability as a qualification for public office, he is, however, expounding a doctrine freely voiced in NATURE for many years, and the proposed experiment of a small, relatively self-supporting community is one that should not be without appeal to scientific workers. The time is opportune for courageous and adventurous experiment. The world has yet to receive an object-lesson in the high standard of life which should be possible by good organisation and modern methods, where prejudice and incompetence are no longer allowed to deny to society the benefits of leisure or material possessions with which the application of scientific discoveries would endow them.

"NATURE" Vol. 130. No. 3280. pp. 292—393.

Reviews.

The Technique of Field Experiments.— (Rothamsted Experimental Station, Harpenden, England, 1931, 64 pp., 1 sh. 6 d. net). This pamphlet contains a collection of papers read at a conference held at Rothamsted in May 1931, to discuss methods for the incorporation of statistical principles into the conduct of Field Experiments, and opens with a Foreword by Sir John Russell, wherein he traces the historical development of statistics as applied to agricultural experiments, with special reference to the introduction of methods like Beaven's half-drill strip arrangement, the Randomised Blocks and the Latin Square. Fisher's contribution towards the perfection of the mathematical technique is emphasised. With the improved methods of plot arrangement and cultural practices now in use, it is found that the standard error per plot at Rothamsted ranges from about 8 to 10% for Randomised Blocks, and from 4 to 8% for the Latin Square arrangement. Heavier crops like potatoes or Beet-root, give lower values for standard error. As there are usually several plots of each treatment, the standard error of the final result is much less than the figures of errors per plot; it is usually now at Rothamsted about 2 to 4 % of the mean yield.

Among the interesting papers included in the present publication, those of Dr. Fisher on the principles of plot experimentation in relation to the statistical interpretation of the results, of Dr. Wishart on the methods of field experimentation and statistical analysis of the results, of S. F. Armstrong on the technique of variety trials, and of H. V. Garner on the practical details of experimentation on ordinary commercial farms, deserve special mention. Dr. Wishart clearly explains with illustrations, the detailed working out of results in the case of Randomised Blocks and the Latin Square method. The practical details of the application of Beaven's half-drill strip method to varietal trials, as developed by the National Institute of Agricultural Botany, England, are dealt with in Armstrong's paper. The growing importance attached to the statistical analysis of agricultural experiments of all kinds, and the extension of statistical methods to new fields where special difficulties arise due to the wide heterogeneity of the populations under study and the present imperfection of technique both in regard to cultural practices and suitable modifications of statistical treatment, is shown by the contributions of Prof. Stapledon, who deals with the technique of grassland experiments, of Hoblyn who expounds the technique of horticultural experiments, and of Lewis *et al* who deal with Multiple-schemes of field experiments. On the whole, the pamphlet offers a refreshing series of glimpses into the different aspects of statistics in relation to agriculture, and is worth a perusal by all those interested in the conduct of field experiments. (C. N.)

Coir or Cocoanut Fibre.—A Report on its extraction and properties—S. G. Barker (Wool Industries Research Association, London, 1932.) As Fowler and Marsden have observed, "there is practically no literature on the subject of coir preparation", and the present brochure is intended to summarise what little scientific knowledge is available in regard to methods of extraction, properties and uses of Cocoanut fibre and related products. The author believes that like the cotton and other industries, the cocoanut-products industry also, will, in course of time become organised on factory basis; and the proper utilisation of products like fibre, shell, kernel, oil etc. can only be rendered possible by a more intensive scientific study of the products themselves so as to improve their competitive status, and by a co-ordinated production of all by-products at centralised factories. The pamphlet deals in detail with the chemical and technical principles involved in the preparation of cocoanut fibre, e. g. the stage of maturity of nuts to be used, methods for removal of husk or opening of nuts, separation of the fibre from the husk, degree of soaking, and retting, extraction of the coir from the retted husk, chemical and mechanical methods for quick retting of the husk like the Nanji process the Van der Jagt process, the "H. G." process etc., sorting the fibre, utilisation of the residues from fibre extraction, physical and chemical properties of the fibre and subsequent manufacturing processes, like bleaching, spinning etc. Though little of the author's own original investigations or observations are included, the pamphlet contains a useful summary and treatment of the available literature relating to the manufacture of cocoanut fibre and other cocoanut products. (C. N.)

College News & Notes.

Our Tour. The Final Year B. Sc. Ag., students were taken on an Agricultural Tour for 10 days from 2nd to 13th October, the Lecturer in Botany and two Assistant Lecturers accompanying them. The party first proceeded to Aduturai where they were warmly welcomed by the Superintendent and staff of the station. The party went round the station observing the various lines of work in progress at the station. The superintendent explaining the students the various aspects of work including the trials with the sorgum-cane hybrids, soya beans, pillipesara for green etc. They were also told about the relative importance of several paddy varieties in the tract, Nellore samba being the most important and the various agricultural practices of the tract with regard to paddy cultivation. The party was later entertained at Tea by the Station Staff and left for Tanjore the same evening. The party then proceeded to Thillastanam and Trivadi where they were shown by the Tanjore Demonstrator some of the plantain and betel vine gardens and the methods of cultivation explained. After studying the agricultural practices of the places visited the party took the opportunity to see the local Mandir where the statue of Saint Thyagaraya is situated and the sanskrit college situated on the banks of the Cauvery. On their return from Trivadi the students played a Hockey Match with the Tanjore United Club team. The play was appreciated though our students lost the match by 2 goals to one. Early the next day the party visited Pattukotai and had a thorough study of the areas to be brought under the Mettur project. By the morning of the next day the party reached Trichinopoly Town and visited the Grand anicut and the trial plots run by the Lalgudi Sivagnanam Society, the Deputy Director of Agriculture Mr. Kolandaiswami Pillai accompanying the students. Mr. Pillai had arranged for a sumptuous tea at the Grand Anicut and also gave an address to the students advising them to take up private farming. He explained how he has been trying to solve the unemployment problem by obtaining free of cost 50 acres waste lands situated in the Perambalur Taluk to each one of the graduates of the College at a nominal rate of Re. 1

assessment per acre. The Secretary of the Lalgudi-Sivagnanam Society entertained the students at a grand dinner and gave an interesting lecture on the several advantages they as members of the society were deriving by adopting our improved methods of agriculture particularly the growing of paddy strains and new sugarcanes. Returning to Trichinopoly the same day the students played some hockey and tennis matches with the National College Teams. The hockey match ended in a draw whilst the visitors lost the match in Tennis.

That very night the party took train to Koilpatty where the farm staff received them the next morning. Though the stay at Koilpatti was very short the students made a detailed study of the work of the farm and the Superintendent of the station explained the students the agricultural conditions of the tract represented by the station and brought to their notice some facts and figures obtained at the station with regard to the dry land cultivation of the tract. The next day the party left for Madura.

At Madura the students visited Pasumalai where the American Mission has established an Agricultural School and is running a farm having Dairy, Poultry, piggery and orchards. Tirumangalam was next visited where the students learnt the economics and the various aspects of the cultivation of rose and jasmine for the Madura market. The cultivation of paddy, plantain and coconuts was studied at Sholavandan north of Madura. The party also paid a visit to the Municipal Sewage Farm situated about five miles from Madura and later left for Palni. At Palni, though it was raining heavily the students proceeded to an adjacent village and observed the Kolinji (Indigofera tinctoria) cultivation as a green manure crop grown over 500 acres. The demonstrator there enlightened the students with a description of the several agricultural practices. In the evening the local agricultural society entertained the party at Tea to which Mr. R. C. Broadfoot, the Deputy Director of that Circle had also come. Mr. Jivanna Rao, Lecturer in Botany brought to the notice of the students the excellent work done by the society in improving the agricultural situation of the place. Mr. Broadfoot explained to the students several advantages of taking to private farming. Leaving Palni the next day the party returned to Coimbatore late in the evening.

Students' Corner. On Thursday 1st September a public meeting was held when Mr. E. H. Stanes spoke on the development of wireless broadcasting with Mr. N. G. Charley in the chair. After narrating in a general way about the development of wireless broadcasting he discussed the possibilities of its development in India. The main retarding force in India against its rapid development and popularising was stated to be a disturbing atmospherics and as such it may not have a bright future as in other countries. The lecture was extremely interesting and was well appreciated. The lecturer also answered some questions at the end and after the concluding speech of the president the meeting terminated with the usual vote of thanks.

Athletics. Our College entered for the Coimbatore Hockey tournament this year. We lost our first match which was against the Coimbatore United Club a very strong local combination but our opponents were disqualified by the Committee for violation of rules. We thus qualified for the Semifinals and in our next match defeated the Reserve Police by 3 goals to 1. The finals which were played on Saturday the 29th October with the Stanes European High School provided a very interesting struggle and although we led early by one goal, the match ended in a draw of one all. The replay on Monday the 31st October was even more exciting and packed with thrills right from the beginning. It was any body's game and we lost the match by a narrow margin of 3 goals to 2 K. M. Narayanan played a great game at cntre half on both occasions.

Cricket. On Saturday the 15th October our College met the Forest College on a friendly game on our grounds. Our team entering first scored 154 runs for 6 wickets and declared. Ramanatha Rao was top scorer with 41 runs, H. Shiva Rao coming next with 25. The Forest College were all out for 34 runs, Lakshmanan capturing 5 wickets for 12 runs, Narasinga Rao 3 for 15 and Narayanan 1 for 5. It may be mentioned that Forest College were handicapped by the illness of their best all rounder Mr. K. Krishnamurthi who took ill the previous day and could not play the match.

Y. M. C. A Tournament It will be recalled that the completion of the original fixtures our team tried with the Coimbatore United Club for championship honours. The Committee forthwith arranged an extra fixture for the 22nd October to decide the championship. Winning the toss we entered first and scoreda very creditable total of 166 runs against the best bowling talent in Coimbatore. The game was very lively throughout and Suryanarayanamurthi of Class I turned out to be the hero of the day. He was top scorer with 40 runs included in which were 5 fours and a soaring sixer. Shiva Rao (30), Narasinga Rao (22), Varadarajan (19) and Thomas (17) were other useful run getters. The Coimbatore United Club entering in their turn made a very disastrous start and lost 2 wickets for a mere paltry 4 runs. Later batsmen adopted purely defensive tactics with the result that 5 wickets were down at the close of the game for 52 runs. Thus the match ended in a draw. To obviate further draws the Committee decided to play a two day match on the 11th and 12th November. On the previous night of the match the Coimbatore United Club Captain asked for a postponement to some date in December but as this would involve the violation of the tournament rules we were reluctantly obliged to disagree. The Coimbatore United Club team after further consideration decided to withdraw from the tournament and failed to turn up for the match. Thus we were declared winners by the Committee and the Rhondy Shield has come back to us after a lapse of nearly 10 years.

Cricket Tour. For the first time in the annals of our College our Cricket Team ventured on a tour and the first tour came off on the 28th October when we met the Palghat Town Team at Palghat. The homesters had first knock and were dismissed for 83 runs. Varadarajan bagged 3 wickets for 16 runs, Lakshmanan 2 for 20, Narasinga Rao 2 for 18 and Narayanan 1 for 19. Our team passed their total for the fall of a single wicket, Ananda was top scorer with 39 (not out) Varadarajan scored 22 (not out) and Narasinga Rao 17 (retired hurt). Thus the College team won the match by 8 wickets.

Tennis. The Tennis courts which were under repair during the first term were ready for use by the beginning of the second term and there has been a great rush among students to join the tennis section. There are now 84 members equally distributed among the three courts the classification being carried out on the individual proficiency of each member in the game. As usual there has been some changes by lower court players challenging others in the higher courts and thus winning their way for a place in the higher courts.

Obituary. We have to record with great sorrow the demise of young Mr. M. Ranga Ram a student of the first year class at the early age of 20 at his residence. Mr. Ranga Ram was a member of our cricket team and was actively interested in sports. Of a genial temperament and affable character he made many friends during his short stay of 3 months at the College and went home quite hale and healthy for the Michaelmas recess. He suddenly took ill and the news of his death came as a shock to his many friends and acquaintances. At a meeting of the students and staff of the College it was resolved to send a message of condolence to the relatives of the deceased.

Go back to the Land. A public meeting of the Students' Club was held on October 1932 when Mr. A. Ranganatha Mudaliar B. A. B.L., M. L. C., ex-Minister for Development addressed a large gathering on the theme "Go Back to Land". The lecturer after dealing in a lucid manner on the conditions obtaining in the villages at the present day analysed the defects of the present day and exhorted the students to go back to the land and help the country in its rapid advancement. He said that the students of this College were best suited to take up reconstruction work in the villages. The President, Mr. C. Tadulingam endorsed the views of the lecturer and assured him that his students will not be failing in enthusiasm to perform their duty to the country. After the usual vote of thanks by the Secretary the meeting terminated.

THE LATE RAO BAHADUR J. CHELVARANGA RAJU

The news of the passing away at Saidapet, on Friday, the 22nd of October 1932—due to diabetic carbuncle—of Rao Bahadur J. Chelvaranga Raju, Retired Deputy Director of Agriculture, must have come as a rude shock to many of his friends and admirers in the Department. He retired about ten years ago, from official life, but not from active service, for after retirement he was taking a large amount of interest in affairs of local self government, and was in fact, at the time of his death, the Chairman of the Saidapet Municipality.

The Late Mr. Raju passed out of the Agricultural College, Saidapet, in the early nineties, and entered service as Farm Bailiff at the Saidapet Farm. During well nigh three decades of service, he steadily mounted, through merit and hard work, the official ladder, being finally one of the first Indians to get into the Imperial Service. As a lecturer in agriculture for some years at the College of Agriculture, Coimbatore, he won the esteem and regard of his students by his wide and experienced knowledge of practical agriculture. As an executive officer, he endeared himself to all his subordinates, by his sympathy and by the readiness, with which he would always set about, to teach junior officers and help them even in matters of official routine. As a propagandist, he was eminently successful, for he combined in himself a rare knowledge of practical agriculture, and a clear exposition in the vernacular of scientific facts. He was in fact publishing a tamil monthly "The Agriculturist", and in spite of vicissitudes, was sticking to it, till his very end.

Mr. Chelvaranga Raju came of a well known Raju family of Tinnevelly. His elder brother—the late Rao Bahadur J. Dharmaranga Raju (also an 'old boy' of Saidapet)—was the Dewan Peishkar of Pudukottah. His younger brother, Mr. J. Ranga Raju, is the well known novelist and dairyman of Madras. All the three brothers believed in agriculture as a profession, and practised it, successfully.

Mr. Chelvaranga Raju was one of the founders of the Madras Agricultural Students' Union; he was its first treasurer, a Vice

President during the early years of its life, and was responsible along with other pioneers for its early nurture and healthy growth.

A man of sturdy independence, with confidence in his powers which was fully justified, a hard and sincere worker who paid great attention to minute details, and a gentleman with broad outlook and strong common sense, Mr. Chelvaranga Raju was a typical of the best products of old Saidapet and in his death, yet one more link between Saidapet and Coimbatore has been snapped. May his soul rest in peace!

Weather Review (OCTOBER—1932)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	4·1	−4·4	23·5	South	Negapatam	5·9	−4·3	24·5
	Berhampore *	3·5	−6·5	27·6		Aduthurai *	11·6	+2·9	27.3
	Calingapatam	6·8	...	25·0		Madura	10·0	+2·8	23·3
	Vizagapatam	4·3	−4·6	19·5		Pamban	12·2	+2·8	16·4
	Anakapalli *	2·4	−7·2	28 8		Palamkottah	6·7	+0·3	17·4
	Samalkota *	5·6	−3·9	28·1		Koilpatti *	5·8	−1·7	26·8
	Cocanada	6·8	−1·9	29 0					
	Maruteru *	4·8	−8·3	32·7					
	Masulipatam	6·2	−2·8	28·8					
	Guntur *	.			West Coast	Trivandrum	20·3	+9·7	75·0
						Cochin	35·6	+22·4	125·6
Ceded Dists.	Kurnool	2·3	−1·1	18·6		Pattambi *	19·5	+9·9	110·9
	Nandyal *	1·5	−2·0	17·9		Calicut	31·1	+20·8	152·2
	Hagari *	5·8	+3 6	21·7		Taliparamba *	24·9	+14·2	153·9
	Bellary	6·6	+2·7	21·7		Kasargode *	21·6	+13·6	121·9
	Cuddapah	1·7	−3·7	13·2		Nileshwar *	30 6	+23·0	156·4
						Mangalore	18·8	+11·0	117·4
Carnatic	Nellore	4·5	−5·4	16·5					
	Madras.	21·9	+10·5	31·9					
	Cuddalore	12·5	+2·0	26·4	Mysore and Coorg	Bangalore	13·3	+7·6	38·6
	Palakuppam *	14·2	+4·6	28·4		Chitaldrug	7·9	+3·8	31·1
	Palur *	9·6	+6·9	27·3		Mysore	5·1	−1·2	27·5
						Mercara	11·8	+3·0	133·2
Central	Vellore	3·9	−2·8	20·9					
	Salem	11·9	+5·0	39·1					
	Hosur Cattle Farm *				Hills.	Kodaikanal	15·0	+3·9	52·2
						Coonoor *	13·3	−0·3	39·4
	Coimbatore Town	5·2	−1·1	21·8		Kallar *	17·9	+3·9	47·4
						Nanjanad *	15·1	+6·4	55·5
	Coimbatore Res. Inst. *	6·6	+0·7	23·5		Ootacamund *	17·2	+5·0	48·2
	Trichinopoly	5·6	−1·5	30·7					

* Meteorological Stations of the Agricultural Department.

General weather conditions: The whether was generally unsettled over the whole of the area till about the 10th, under the influence of a pressure distribution which determined uniform pressure over the central regions of the Bay and northeasterly winds over the peninsula. A wave of low pressure propagated

westwards influenced the weather over the south and on the 11th lay off the Malabar coast. It concentrated into a depression and persisted in the east Arabian sea till the 26th by which time it drifted northwards and disappeared.

The second disturbance formed in the Andaman sea on the 19th and developing into a strom of small diameter moved rapidly in the northwesterly direction, crossed the Circars coast near Calingapatam on the 20th and recurving to the northeast disappeared over Upper Burma on the 26th. The third depression appeared off the coast of Ceylon and concentrating into a depression on the 30th lay centred about 11°N and 83°E. It moved northwards and was centred about 13°N and 83°E and was approaching the Circars coast on the 31st. The first depression caused widespread rainfall over the south and west of the peninsula, the second owing to the rapidity of its progression over the Bay did not influence the weather to any great extent beyond causing a heavy fall at Calingapatam on the day it crossed the coast. The third depression gave rise to very heavy rain on the coromandel coast and widespread rain over the greater part of the presidency. Rainfall was markedly above the average on the west coast, Coromandel coast, parts of Mysore and the Hills and below normal elsewhere. Some heavy falls were reported, the chief of which are:— Cochin 4·7″ (2nd), Madras 6·0″ (8th); Cochin 4·7″ (12th) Calicut 4″ (21st) Calicut 5·7″ (25th) and Madras 7·3″ (30th).

Temperature was above normal at the beginning of the month but fell rapidly and was below normal generally over the south till the end of the month with the frequency of rainfall.

Weather Report

Report No. 10/32

Absolute maximum in shade	...	...	91·3
Absolute minimum in shade	...	...	69·0
Mean maximum in shade	...	...	86·4
Mean minimum in shade	...	...	91·2
Total rainfall in month	...	...	6·64 inches.
Mean rainfall for month	...	...	5·97 ,,
Departure from normal	...	...	0·67 ,,
Total number of rainy days	...	...	13
Mean daily wind velocity	...	...	1·0 M.P.H.
Mean 8 hrs. wind velocity	...	...	0·6 ,,
Mean humidity at 8 hrs.	...	...	86·2%
Total number of hours of bright sunshine		...	166·0
Mean daily hours of bright sunshine		...	5·4

Summary of Weather Conditions.

The weather was generally unsettled throughout the month and numerous thunderstorms occurred. The rainfall was slightly above the normal. Temperature was nearly normal, and humidity in excess.

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

Departmental Notifications.

Gazette Notifications: Mr. C. Narayana Aiyar, Deputy Director of Agriculture (provisionally substantive), to be Deputy Director of Agriculture (Permanent) from 25th October 1931. Mr. N. S. Kulandaiswami Pillai, Assistant Director of Agriculture and Officiating Deputy Director of Agriculture to be Deputy Director of Agriculture (permanent), with effect from 18th December 1931. Mr. K. Gopalakrishna Raju, Assistant Director in charge, III Circle, Bellary, to be Deputy Director of Agriculture (permanent), with effect from 15th August 1932. Mr. M. C. Cherian, Assistant in Entomology and Officiating Lecturer in Entomology, Agricultural College, Coimbatore, to be Assistant Director of Agriculture,

with effect from the date of the notification. He will continue to officiate as Lecturer in Entomology, Agricultural College, Coimbatore, in the vacancy consequent on the deputation of Mr. Ramachandra Rao as Deputy Locust Entomologist under the Imperial Council of Agricultural Research, Quetta. Mr. V. Ramanatha Aiyar, Superintendent, Cotton Breeding Station, Koilpatti, and Officiating Cotton Specialist (permanent), Coimbatore, with effect from the date of notification. Mr. R. Swami Rao, Assistant Director of Agriculture and Officiating Superintendent, Central Farm, Coimbatore, to be Lecturer in Agriculture (permanent), Agricultural College, Coimbatore, with effect from the date of the notification. He will continue to officiate as Superintendent, Central Farm, Coimbatore in the temporary post created. Mr. R. Chockalingam Pillai, Superintendent, Cotton Breeding Station, Coimbatore, and Officiating Assistant Director of Agriculture, Tinnevelly (on leave), to be Superintendent, Agricultural Research Station, Koilpatti (permanent with effect from the date of the notification, vice No. 5. He will continue to officiate as Assistant Director of Agriculture, vice Mr. M. C. Cherian on other duty. **I Circle.** M. Chinnaswami Naidu, A. D. Peddapuram, extension of l. a. p. for one month from 24—10—32. N. Ramdass, A. D. Cocanada, will continue to be in charge of Peddapuram. **II Circle.** D. Panakal Rao, A. D. Gurazala, l. a. p. for 6 days with 2 Sundays. **III Circle.** Bagirathi Padhy, A. D. Nandyal, l. a. p. for 2 months and 13 days from 11—10—32 and permitted to avail the Xmas and New Year Holidays. **IV Circle.** S. Rama Rao A. D., compulsorily recalled to duty from 12th forenoon to 19th afternoon to join duty at Chittoor. S. Madhava Rao, A. D. on special duty, l. a. p. for 4 days from 10—10—32 with permission to prefix 8th and on 9th. M. A. Balakrishna Iyer, A. D., extension of l. a. p. for 2 days on 24th and 25th Oct. in continuation of one month's leave already granted. S. Ramachandran, A. D., l. a. p. for 15 days from 3—11—32, on expiry of leave he will join duty at Tirupathur. M. A. Balakrishna Iyer, A. D., will be in charge of the Van from 3—11—32 to 6—11—32. C. Annamalai, A. D., Palmaneir will be in charge of the Van from 7—11—32. B. Shiva Rao, A. D., Madanapalle will be in charge of the District work in Palmaneir. K. B. Vaideeswara Iyer, F. M. on expiry of leave to join duty at Cuddalore to assist the A. D., Cuddalore. V. Suryanarayana, F. M., Kalahasti, extension of l. a. p. on M. C. for 23 days from 5—11—32. S. Rama Rao, rejoined duty at Chittoor on 26—10—32. After the training in Eri culture and Seri culture at the textile institute K. Varadachari will proceed to A. R. S. Palur as F. M. **V Circle.** M. P. Gourisankara Iyer, A. D., Papanasam, l. a. p. for 2 months and 10 days from 13—10—32 with permission to affix Xmas holidays. T. G Muthuswamy Iyer, A. D. Tiruturaipundi, extension of l. a. p. on M. C. for 2 months from 18-10-32. **VI Circle.** G. J. Balraj, A. F. M., Koilpatti, extension of l. a. p. on M. C. for one month in continuation of leave already granted. V. G. Dhanakoti Raju, A. D. Ambasamudram, l. a. p. on M. C. for 4 months from 9—10—32. **VII Circle.** K. M. Jacob, A. D., Cannanore, l. a. p. for 3 days from 3—11—32. **VIII Circle.** T. A. Rangaswamy Iyengar, A. A. D. Rasipuram, to be A. A. D. Krishnagiri. A. A. D. Namakkal will be in additional charge of Rasipuram. **G. A. C's Section.** C. Raghavendrachar, Asst. l. a. p. for one month and 15 days from 3—10—32. **G. E.'s Section.** J. A. Mulyil extension of l. a. p. for 10 days from 16—10—32. K. P. Anantanarayana Iyer, l. a. p. for 10 days from 27—10—32. **P. S's. Section.** P. Uthaman, Asst., Pattambi, l. a. p. for 2 days on 14 and 15th Oct. 1932. **D. A's. Office Orders.** K. Govindan Nair, Chemistry Assistant, extension of l. a. p. 3 weeks from 3—11—32 and half average pay for 3 weeks in continuation. N. K. Thomas, F. M., C. B. S., Coimbatore, transferred to VIII Circle. P. K. Krishnan Nambiar, A. A. D., Live Stock, Madras, l. a. p. for one month and 16 days from 7—11—32 with permission to prefix Sunday the 6th November and to suffix the Xmas holidays. M. V. Narasimha Sastri, A. F. M., Buffalo Breeding Station, Guntur is temporarily transferred to Madras as A. A. D., Live Stock, Madras.

ADDITIONS TO THE LIBRARY DURING AUGUST & SEPTEMBER 1932.

A. Books.

(1) *Cultivation of Bulbous Plants in India*, K. S. Rajagopala Ayyangar. (1932). (2) *Farm Managemet in South Africa*, E S. Dawson, (1931). (3) *Agricultural Policy in South Africa*, H. D. Leppan, (1931). (4) *Cost accounting applied to Agriculture as an aid to more Productive Farming*, J. S. King. (1927). (5) *Co-operation in Marketing Dairy Products. Part I. Aims and Agencies. Part II. Price Plans.* R. W. Bartlett, (1931). (6) *Marketing Principles; Organisation and Policies.* J. F. Pyle, (1931). (7) *An Introduction to the Marketing of Farm Products.* A. H. Benton. (1926): (8) *More about How to Draw in Pen and Ink.* H. Furniss. (1915). (9) *The Genius of Louis Pasteur.* P. Compton. (10) *The Madras Financial and Account Code. Vol. I. 2nd Edition.* (1932). (11) *The Madras Services Manual. Vol. II. Subordinate Services. Corrected up to 1st March 1932.* (1932). (12) *Some Materials for the Study of Agriculture and Agriculturists in Ancient India.* R. Gangopadhyay, (1932). (13) *Tomato and Cucumber Growing for Profit.* J. W. Morton, (1931). (14) *Apple Culture in Victoria.* J. Farrell, (1919). (15) *Bee-keeping in Victoria.* F. R. Beuhne, (1925). (16) *The Evolution of Continuity in the Natural World.* D. Russell, (1922). (17) *Coleoptera-Staphylinidae. Vol. III.* M. Cameron, (1932). (18) *Handbook and Directory of the Concrete Industry in India.* (1929). (19) *India in 1930-31.* (1932). (20) *Audit Code, Vol. I. Corrected up to 30th November 1928.* (1929). (21) *Do. Vol. II. Do. (Appendices and forms).* (1929).

B. Reports & C. Bulletins.

(1) Administration Report of the Madras Co-operative Societies, 1930-31. (2) Census of 1931—Village Statistics. Chingleput District. (3) „ Salem District. (4) Annual Report of the Indian Central Cotton Committee, Bombay for 1931. (5) Interim Report of the Committee appointed to Enquire into the Rice and Paddy Trade of Burma, 1931. (6) Annual Report of the Agricultural Department Tanganyika Territory, 1930. (7) „ Jamaica, 1931. (8) Report of the Botanical and Forestry Department in Honkong, 1931. (9) Madras University Convocation Address by S. Kumaraswami Reddiar 4—8—1932. (10 to 12) Punjab Irrigation Research Institute Memores. Vol. IV. No. 1, 2 & 3. An Examination of Some of the Factors Determining the H-ion Concentration of Suspensions of Punjab Soils. Part I. The Effect of Concentration of the Soil Water Suspension. „ Part II. The Variation of the H-ion Concentration of the Soil Suspensions with Time. The Conductometric Method of Analysis as Applied to Soil Survey work. (13 to 15) E. M. B. Nos. 55 to 57. Canned and Dried Fruit Supplies in 1931. The Demand for Canned Vegetables. Wool Survey. (16 to 50) Min. Agri. & Fish Bull No. 1 to 50. Some Diseases of Farm Animals. Fruit Production: Tree Fruits. The Improvement of Grass Land. Fruit Production: Soft Fruits and Nuts. Commercial Fruit Tree Spraying and What it Costs. Scientific Principles of Poultry Feeding. Poultry Keeping on the General Farm. Calf Rearing. The Culture of Fish in Ponds. Home Grown Feeding Stuffs, Some Diseases of Rabbits. Fruit Growing Areas on the Old Red Sand Stone in the West Midlands. Variations in the Composition of Milk. Country Egg Laying Trials in England. Inbreeding Poultry for Egg Production. Investigations into Certain Methods. Some Beneficial Insects Domestic Preservation of Fruit and Vegetables. Practical Soil Sterilisation. Cereal Smuts and their Control. Investigations on Celery Diseases and Their Control. Johne's Disease in Cattle. Agricultural Machinery in Canada and the United States of America. Insect Pests and Fungus Diseases of Basket Willows. Rats and How to Exterminate Them. Mushroom

Growing. The Sex-linked Method in Poultry Breeding. Fertility and Animal Breeding. The Construction of Cow Houses. Cheese making. Narcissi Culture. Fruit and Vegetable Production for Commercial Canning. Celery Growing. Rations for Livestock. Intensive Systems of Apple Production. Rabbit-Keeping. (51 to 59) Econ, Ser. 8 to 35. Report on Agricultural Credit. Report on Markets and Fairs in England and Wales—Part I. General Review. Report on Fruit Marketing in England and Wales. The Fluid Milk Market in England and Wales. Markets and Fairs in England and Wales. Part III. Northern Markets. Do. Part IV. Eastern and Southern Markets. Report on Preparation of Fruit for Market Part II Gooseberries, Currants, Cherries, Raspberries, Loganberries, Tomatoes, Cucumbers and Grapes. Markets and Fairs, in England and Wales. Part V. Welsh Markets. Part VI. London Markets. Part VII. Final Review. Report on the Marketing of Honey and Beeswax in England and Wales. Report on the Organization of Wool Marketing (60) E. M. B Pub, Memoranda on Russian Agriculture. (61) Imp. Bur. Doil Sc. Pub. Catalogue of Journals and Periodicals in the Library of Rothamstead Experimental Station. (62) University of Cambridge, Mem. No. 4. A Brief Summary of the Papers Published by the Staff of the School of Agriculture, Cambridge. (63) Compagne Belge De Fertilizants. Pub. La Fertilisation Du Sol. (64) Nyasaland Protectorate Dept. of Agri. Bull No. 1 (New Series). Tea Research in Nyasaland Report on Advertising of Empire Tea in the United Kingdom. Statistics of Tea Import into South Africa and the Rhodesias. 65 to 68. Tasmania Dept. of Agri. Bulletins No. 107. Common Diseases of Dairy Cattle and Their Treatment. Feed the Land. „ 1 (N. S) Reworking of Fruit Trees. „ 3 „ Pruning of Fruit Trees. „ 5 „ 69. Union of S. Africa Dept of Agri. Bull. 112. The Date. 70. U. S. A. Chamber of Commerce Publication. Marginal Agricultural Land. 71 to 73. Cornell Bull. No. 529, 535, 536. The Social and Economic Areas of Yates Country, New York. The Control of Bottom Rot of Lettuce. Soil Acidity studies with Potatoes Cauliflower and other Vegetables on Long Island. 74. Arkansas Bull, 273. The Relation of Nitrogen, Phosphorus and Potassium to the Fruiting of Cotton. 75 and 76. Wisconsin Res. Bull. 112 and 113. Relation of Nutrition to the Contagious Cattle abortion. An Economic Study of the Milwaukee Milk Market. 77 to 82. Michigan Teach, Bull. Investigations in the Mosaic Disease of Bean. Successful Farm Practices in the Upper Peninsula. Marketing Michigan Beans. Spray Injury Studies. I. Injuries from Summer Applications on Apples. II. Secondary Effects of Spray Injuries to Apple Foliage. Home Production of the Family's Food Supply. 83. Madras Leaflet No. 37. Mildew on Grapes and How to Prevent it. 83 a to 104. Min. Agri. and Fish Leaflet No. 320. Manuring of Vegetable Crops. Standards recommended for Certain Insecticides and Fungicides. Mole Draining. Potash Fertilisers. Naval III and Joint III in Newly Born Animals. Preservation of Eggs. Apple Canker. Flea Beetles. The Frit Fly. Chicken Rearing. Control of Fruit Pests in Gardens and Small Orchards. Suggestions for Allotment Holders for Autumn Treatment of Land. Winter Pruning Bush and Half Standard Apple Trees. Stack Thatching. Broom Rape. Oats. Sugar-Beet Growing. Seeds Mixtures for Grasslands and Some Directions for Laying down to Grass. Pruning of Stone Fruit Trees. Duck Keeping for Egg Production and Table. Cultivation of Cucumbers. Turkeys. (105) E. M. B C/1. Dairy Produce. (106) Grain Crops (107) Newzealand Agri. Pub. Certified Grass and Clover Seeds. (108) Cyprus Gazette No. 2231. Agricultural Supplement No. 49. (109 to 115) Tasmania Agri, Dept. Cir. No. 1, Farm With Clovers. Healthy Stock. Mammitis. Its Treatment and Prevention. Choice Cream. Contagious Abortion. Liver Fluke. Plan of Milking Shed. (116) Wisconsin Uni. Pub. Every day uses for Cherries. (117 and 118) U. S. A. Food and Drug Admn. Pub. Notices of Judgment under the Food and Drugs Act. (119) Villagers' Calendar 1932—33. (Malayalam Edition).

Mad. Agri. Dept. 1932. (120) Census of India—Village Statistics. Ganjam District. 1932. (121) Do. Ramnad District. 1932. (122) Do Vizagapatam District. 1932. (123) Report of the Mysore Agricultural Department for the Year ending 30th June 1931. 1932. (124) Report of the Botanical Survey of India for 1930—31. 1932. (125) Annual Report of the Department of Agriculture, Burma for 1931—32. 1932. (126) Report of the Rothamsted Experiment Station, Harpenden for 1931. 1932. (127) Report of the Agricultural Department, St. Lucia for 1931. 1932 (128) Do. Do. Cyprus for 1931. 1932. (129) Calendar for 1932—33 of the Agricultural College, Coimbatore 1932. (130) Calendar for 1932—33 of the College of Engineering, (Guindy) Madras. 1932. (131) *Mad. Agri Dept. Bull No. 30.* The Cultivation of Coimbatore Seedling Sugarcanes in South India. (132 to 136) Min. Agri. & Fish Bull. Some Diseases of Poultry. Mushroom-Growing. Guide to the Conduct of Clean Milk Competitions. Narcissus Pests. Modern Milk Production. (137) 24th Report of the Imp. Econ. Committee. Hemp Fibres. (138) Imp. Bur. An. Nut. Tech. Comm No 1. A. I. V. Silage. (139 to 141) E. M. B. Report on Cattle-Breeding in Jamaica and Trinidad. Preliminary Report on the Vitamin Content of the Mango. Coir or Coconut Fibre—A Report on its Extraction and Properties. (142 to 145) Emp. Cotton Gr. Corp. Memorandum by the Mechanical Transport Sub-Committee. Report on the Characteristics of several Crops that may be suitable as Rotation Crops with Cotton in East Africa and the Possibilities of Marketing them in this Country. Review of the Situation in the Principal Cotton Growing Territories of the Empire and a Summary of the Main Activities of the Corporation since their Formation. Report on Cotton Breeding and Seed Supply in Nigeria. (146 to 149) Mem. Cotton Res. Stn. Trinidad Series A. Genetics. Studies on the Inheritance of (a) Petal Spot, (b) Pollen Colour and (c) Corolla Colour in the Cotton Plant. Studies on the Inheritance of Corolla Colour and Petal Size in Asiatic Cottons. (a) Reversal of Dominance in the Inter specific Cross G. barbadense Linn. G. hirsutum Linn. and its Bearing on Fisher's Theory of Dominance. (b) The Inheritance of Chlorophyl Deficiancy in New World Cottons. (c) "Crumpled" A New Dominant in Asiatic Cottons produced by Complimentary Factors. (150 & 151) Series B. Physiology. Studies of the Transport of Nitrogen in the Cotton Plant. Parts I, II & III, IV and V. No. 3. (152) Cyprus Bull No. 1. Horticul. Series. Some Observations on the Citrus Industry of Palestine, with reference to Application of Improved Methods to the Citrus Industry of Cyprus (153) Sultanic Agri. Soc. Tech. Bull. (Egypt). The Effect of Water on the Cotton Plant. (154 & 155) Roy. Agri. Soc. Egypt. Pub. Maarad Cotton. Natural Crossing in Cotton. (156) Colorado Bull No. 390. A Comparison of Soil Plaque Method with the Naubauer and Hoffer Cornstalk Methods for Determining Mineral Soil Deficiencies. (157 & 158) Massauchusetts Bull Experiments with Permanent Pastures. Questions and Answers Concerning Pullorum Disease.

D. Leaflets, Circulars Etc.

(1) Mad. Agri. Dept. Leaf. 45. Early Sowing of Cambodia Cotton. (2 to 6) E. M. B./T. P. 20, 21, 22, 23. E. M. B./C/3. Production and Trade of the Falkland Islands. Production and Trade of Fiji. Production and Trade of Malta. Production and Trade of British Malaya. Meat, (7 to 15) Min. of Agri. & Fish Ad. Leaf. Management of Milch Goats. Pea and Bean Beetles. Loganberry Cultivation. Production of Mutton and Lamb. Ringworm in Cattle. Small-Holder Cheese. Improvement of Poor Upland Pasture. Hints on the Feeding of Dairy Cows. Lancashire Cheese. (16 to 32) Board of Agri. Scotland Leaflet Pig Keeping for Small Holders. Wart Disease of Potatoes. Potash Manures and Potash Manuring. Liquid Manure. The Importance of Lime. The Manuring of Grain Crops. Substitutes for Superphosphate of Lime. Bottling of Fruit.

Waste Lime, The Manuring of Gardens and Allotments. Vegetable Growing in Gardens and Allotments. The Scandinavian Method of Haymaking. Grain-drying Sheds. Destruction of Rats. 51. The Making and Use of Silage. Pit and Trench Silos. Virus Diseases of the Potato. Their Control. (33 and 34) Cyprus Agri. Leaf. 16. Downy Mildew of the Vine. The Production of Silage. (35) Agri. Suppl. No. 50. Cyprus Gazette No. 2235 dated 26—8—32. (36) Uni. Philippines Cir. 23. Curing Pork and Making Sausage for Home Use. (37) U. S. A. S. R. A. F. D, No. 2. Definitions and Standards for Food Products. (38) 18926—18975 Notices of Judgment under the Food and Drugs Act. (39) Reprint from the Bull. Imp. Instt. Vol. XXX No. 2. Sisal Hemp and New Zealand Hemp. Report of Investigations, conducted by the Imperial Institute.

E. Reprints.

Cream Flavours and Defects: Their cause and prevention. Reprint from Tasmania Journal of Agri. 1st November 1930.