Farming will never be a success unless the farmer had more voice in the disposal of his produce—P. Morrel.

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SOME OBSERVATIONS ON VARIETAL RESISTANCE TO 'RUST' OF COFFEE

BY

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The 'Rust' of Coffee caused by the fungus *Hemileia vastatrix* is the most important among Coffee diseases and is known to cause heavy losses to the crop in almost all the Coffee-growing countries of the world. The fungus has been responsible for the abandonment of several thousands of acres of Coffee in South India and Ceylon, and this fact alone has gained for it classic importance in Mycological literature. Of recent years, the Coffee industry in Java has been saved from ruin by the introduction of resistant species and varieties which are gradually replacing the susceptible ones. In India, as in other countries, there is an ever-growing demand among Coffee growers for resistant varieties and strains which combine in them such qualities as good setting of blossom, a high out-turn of parchment, and a bean of good flavour.

The commonest variety of Coffee in cultivation in South India is *Coffea arabica.* This variety is very susceptible to

'Rust' as evinced by the heavy defoliation of the plants caused by the fungus. But its cultivation still continues for the want of a better variety which is at once resistant to the disease and produces the quality of bean which commands a ready market. The cultivation of other varieties is comparatively rare, but some strains which are in any degree superior to Arabica are rapidly gaining popularity.

The following table summarises the prominent qualities of the several varieties studied, as judged by their growth in Coorg plantations under practically identical conditions of culture.

TABLE I

Variety or species.	Extent of cultivation	Setting qualities of blossom and quality of bean as judged by markets.	Degree of Resistance to 'Rust'
1 *Coffea arabica*	Universally cultivated.	Good. Yields dependent on good soil and manuring.	Very susceptible to Rust. Bushes heavily defoliated during the period between June to February
2. *Coffea robusta*	Comparatively rare	Very good setting in some years, but poor in other years. Bean inferior to Arabica. Good out-turn of cherry.	Practically immune to Rust. Rust spots very rarely met with. Bushes show heavy foliage throughout the year.
3. *Coffea liberica. Var.*	Very rare. Never cultivated on a plantation scale. Stray bushes met with on many plantations.	Very poor bearer. Beans very inferior. Poor out-turn of cherry.	Very resistant to Rust, though stray spots are met with on the old leaves during bad seasons. Bushes show heavy foliage throughout the year.
4. Kent's Arabica	Of recent introduction, but increasing in popularity.	Good.	Fairly resistant to Rust Stray spots appear on leaves particularly after heavy cropping
5. Jackson's Hybrid.	Of recent introduction and still in the experimental stage.	Good. Yields dependent on soil and manuring	Susceptible to Rust and practically indistinguishable from Coffea Arabica. Heavy defoliation as in Arabica.

The obviously wide range of variation in Rust resistance among the varieties mentioned in the above table suggested a comparative study of their leaf structure in the hope that it will lead to the discovery of one or more factors which determine the resistance to the fungus. The observations and inferences recorded in this paper are the results of a study made on the leaf structure of a few species and varieties of Coffee found cultivated in Coorg, during the years 1923 and 1924 when the writer had occasion to stay in Coorg in connection with spraying experiments carried out on the Control of Coffee leaf disease.

A comparison of the leaves showed that excepting in *C. robusta*, there is a general uniformity in their shape, size and texture, while in Robusta, the leaves are several times larger in size and possess a leathery texture. As resistance to the diseases did not bear any correlation to the size, shape or texture, it was decided to make a comparative study of the leaf anatomy. This study was made on the following particulars :

(1) The structure of the Parenchyma cells.

(2) The structure of stomata—their size and distribution.

(3) The structure of the lower epidermis.

(1) *Structure of Parenchyma cells.* Sections were prepared from the leaves of all the varieties in different stages of growth. A few measurements were made of the thickness of the epidermis and the mesophyll, but here again there was nothing abnormal which suggested relationship to Rust resistance ; nor was there any peculiarity in the structure of the cells which tended to create variation in resistance. It was however observed that in all the varieties the epidermis as well as the Parenchyma contained numerous globules which were distributed indiscriminately. As there was no means of gauging the amount of these globules quantitatively, it is not possible to say whether one variety possesses more of them than another within the Parenchyma.

(2) *Structure, size and distribution of stomata.* Since the fungus is known to make its entry into the leaf through the stomata [1] it was expected that a study of the structure, size and distribution of the stomata would explain why some varieties are distinctly more susceptible than others. The examination of the stomata was rendered easy by the fact that in all the varieties studied, bits of the lower epidermis measuring up to 1 or 2 sq. c.m. and containing

[1] Butler—*Fungi and disease in plants*, page 472

several hundreds of stomata could be easily peeled off the leaves, by making a small incision in the leaf with a scalpel and pulling off a bit of the leaf obliquely. By this means it was possible to observe and sketch a number of stomata with the aid of an Abbe drawing apparatus. It was found that the structure of the stomata (vide plates I, II, III and IV) was the same in all the varieties. The length of the stomatal opening was measured, but as variations in their measurements occurred among the stomata of the same leaf and which was inevitable due to variations in the distension of the guard cells, it was thought advisable to measure the maximum length and breadth of the area occupied by the guard cells as a surer basis of the measurements of the stomata. The following table (Table II) summarises the results of these measurements and each figure represents the average of 10 measurements :

TABLE II

Measurements of stomata in microns

Variety.	1st pair of developed leaves from growing point.		2nd pair of leaves from growing point.		3rd pair of leaves from growing point.	
	Length	Breadth	Length	Breadth	Length	Breadth
1. *Coffea arabica* ...	27·0	18·8	26 6	16 8	25 5	16·2
2, *C robusta*	23 4	14 9	22 1	15 3	22·2	14·1
3. *C. liberica* ...	26 3	16 5	28 1	17·4	27·3	16·8
4. Kent's Arabica ...	26 9	18 2	27 5	17·4	27 0	18·2
5. Jackson's Hybrid	27 2	17·4	28 7	17 0	29·6	18·0

From the above table it is evident that excepting in the case of *Coffea robusta*, the stomata are practically of the same dimensions. The size of stomata in Robusta is distinctly smaller, but here again size does not give any indication of the degree of resistance, since two of the resistant varieties and the two susceptible ones do not show any appreciable difference.

Counts were made of the number of stomata per unit area with the aid of an Ocular Micrometer disc divided into 100 equal squares. The following table (Table III) summarises the results

of the counts and each figure represents the average of three readings from different portions of the same leaf.

TABLE III

Frequency of stomata (number per unit area)

Variety.	Degree of resistance to Rust	1st pair of leaves (from growing point)	2nd pair of leaves	3rd pair of leaves.	4th pair of leaves	5th pair of leaves
1. *Coffea arabica* ..	Nil ...	188	169	159	153	87
2. *Coffea robusta* .	Very good ...	367	234	220	203	246
3. *Coffea liberica*	Very good ...	144	157	160	169	157
4. Kent's Arabica	Fairly good	161	136	127	135	80
5. Jackson's Hybrid	poor	171	121	132	126	113
6. Hall's Coffee .	good	172	160	160	147	152

NOTE—In the above table a sixth variety—Hall's coffee—of which a few young plants were available at the Coffee experiment station, Sidapur, has been included. This variety (as far as it could be judged from three year old plants) was very resistant to Rust.

(3) *Structure of the lower epidermis.* A critical examination of bits of the epidermis peeled off from the leaves of all the varieties and mounted in distilled water or 10 per cent glycerine invariably showed the presence of a number of globules which varied in number and size according to the age of the leaf. A series of micro-chemical tests showed that these globules were of an oily or waxy nature as the following tests indicate.

(i) Solubility in ether.

(ii) Solubility in Benzine.

(iii) Staining yellow with iodine.

Detailed observations on the occurrence and behaviour of these globules revealed the following interesting facts:

(1) The gloubles are present in all the varieties of Coffee and the bigger ones are identical in appearance to those detected in the Parenchyma.

(2) In young leaves the globules are small and are found in large numbers evenly distributed on the epidermis.

(3) With the maturity of the leaves, a number of small globules fuse together to form bigger globules two of which, as a rule, are found one on each guard cell or secondary cell of a stoma.

(4) In the resistant varieties, namely, Robusta, Liberica, Kent's and Hall's, the small globules are far more numerous than in the susceptible varieties.

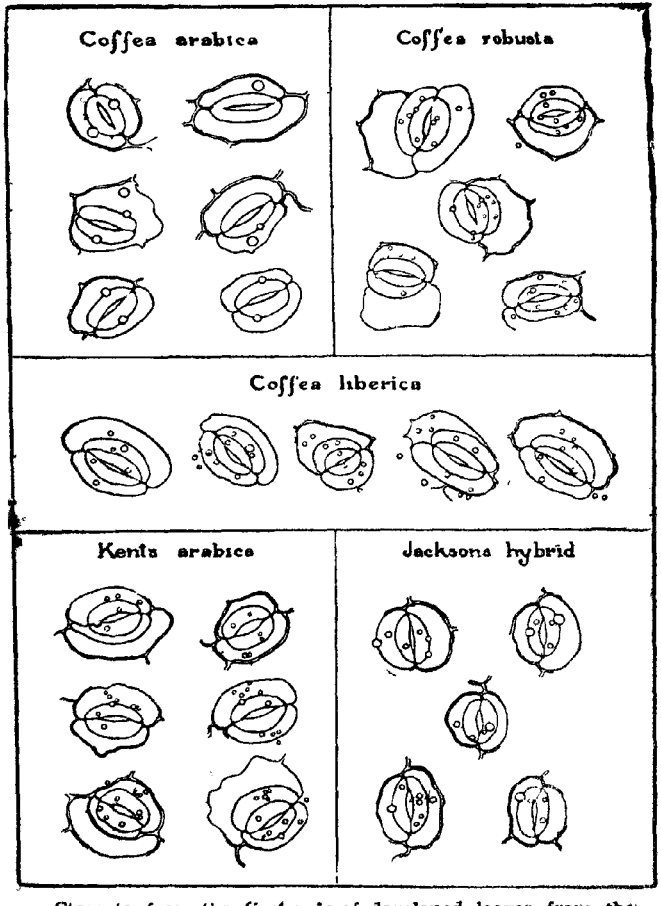
(5) In the resistant varieties, the fusion of small globules is observed in the fourth and the fifth pair of leaves (counted from the distal end of a twig), that is, they fuse at a very late stage in the growth of the leaf, while in the susceptible varieties fusion is observed as early as in the second pair. In other words, fusion of the globules takes place at a very early stage in the development of the leaves of the susceptible varieties, while the small globules remain as such for a longer period and fusion begins at a comparatively later period in the resistant varieties.

Conclusions. From the study of the leaf anatomy of five varieties of Coffee, it is apparent that a correlation exists between Rust resistance and the number, distribution and period of fusion of the oil globules found on the lower epidermis. The fact that these globules are present also in the mesophyll of the leaves suggest that the amount of oil or wax on the epidermis bears a direct relation to the amount present in the Parenchyma cells. Even if this contention cannot be proved, the amount of oil or wax on the lower epidermis appears to be a determining factor in the extent of resistance to 'Rust.' How it is brought about, it is at present impossible to say, but it is possible that the wax or oil on the leaf renders it water-proof and perhaps functions as a toxin on the promycelium in its efforts to make an entry, particularly during the early stages in the development of the leaf when it is otherwise susceptible to infection.

The investigations recorded in this paper do not lay claim to completeness, and more work has to be done before other factors governing Rust-resistance are accounted. However, the results of the studies are presented with the hope that other workers on Coffee, and on disease-resistance of crops in general, may make helpful criticisms which would help further progress in this line of work.

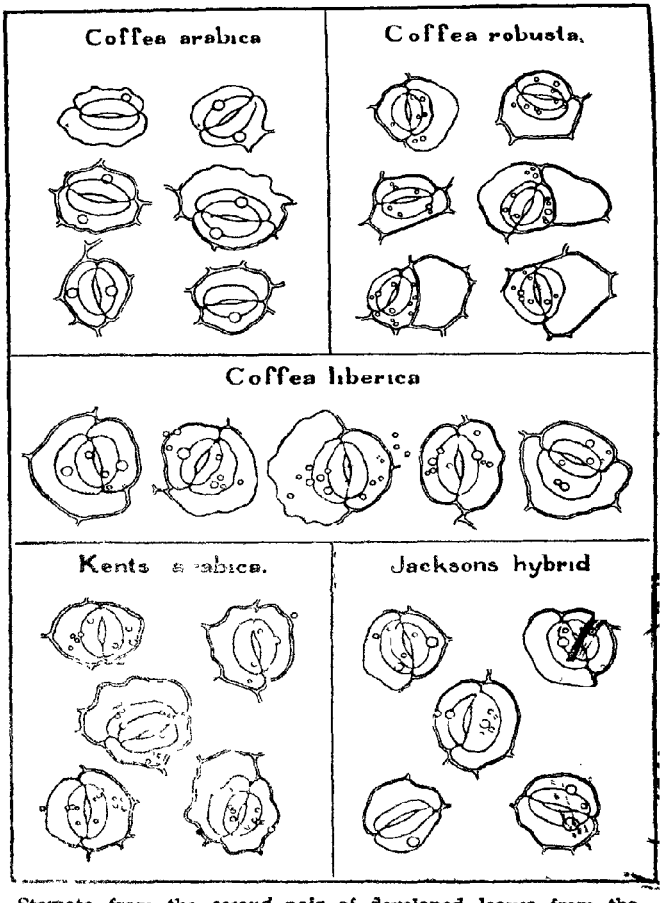
From what has been observed, a study of the number, distribution and period of fusion of the oil globules on the lower epidermis of four successive pairs of developed leaves constitute a

PLATE I

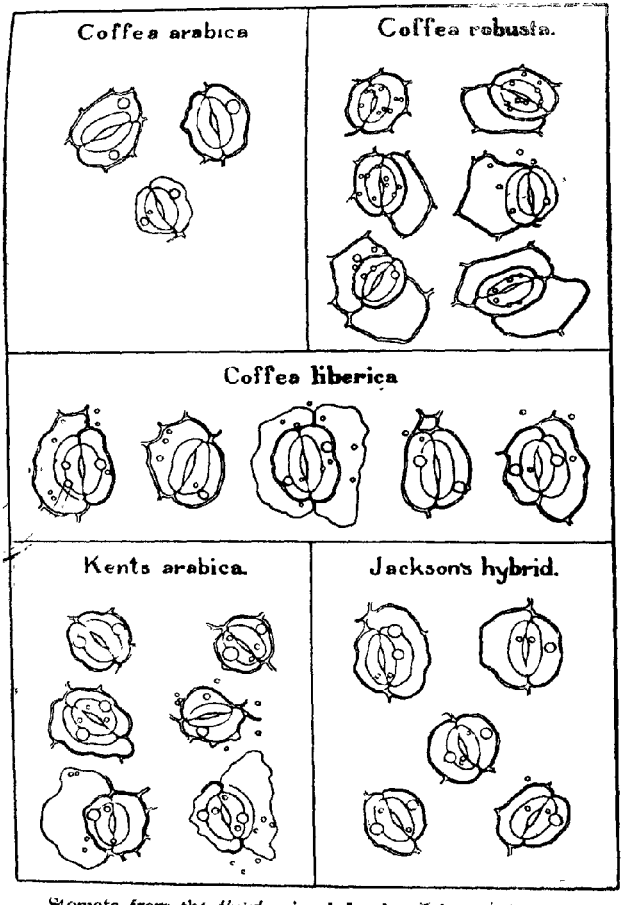


Stomata from the *first* pair of developed leaves from the growing point. × 300. Note the globules.

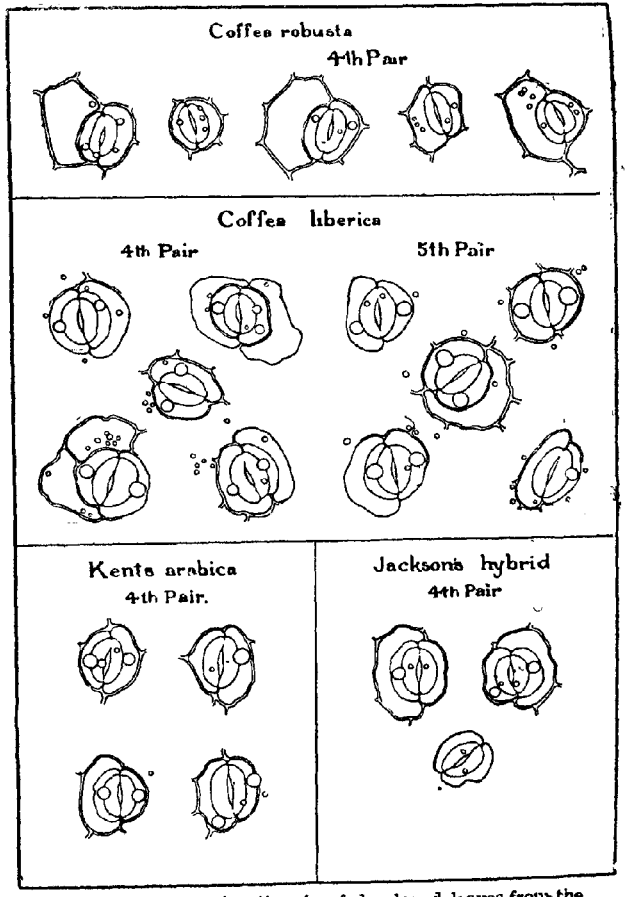
PLATE II



Stomata from the *second* pair of developed leaves from the growing point. × 300. Note the fusion of globules



Stomata from the *third* pair of developed leaves from the growing point. × 300



Stomata from the *fourth* pair of developed leaves from the growing point. × 300.

simple test by which Rust-resistance of individual plants could be gauged with a certain amount of precision; and this fact may be utilized in the laboratory to test new selections and strains of Coffee for Rust-resistance, before resorting to elaborate field tests. To the breeder, it may prove valuable for preliminary comparative tests when the material available is scanty.

I have pleasure in acknowledging my indebtedness to Mr. S. Sundararaman, M.A., Government Mycologist and to Mr. D. G. Munro, B.Sc., General Scientific Officer, United Planters' Association of Southern India, for their encouragement and valuable criticisms during the progress of this work.

THE STORY OF TWO DECADES OF CHEMICAL RESEARCH ON PADDY AND PADDY SOILS IN THE MADRAS PRESIDENCY

BY

B. VISWA NATH

Paddy or Rice (*Oryza Sativa*) being one of the principal food crops of Southern India occupying the largest portion of the cultivated area, was the first to receive the attention of the Department of Agriculture since the commencement of Agricultural Research in this Presidency.

This article deals in popular language, with the investigations bearing on the study of the soil, the crop, the interrelations that exist between soil conditions and crop growth, the mode of action of manures and the influence of manuring on the crop.

The practice of Agriculture in its early days was based almost entirely on the results of accumulated experience. The cultivator had but little idea of the changes taking place in the soil or of the processes controlling the fertility of the land. In consequence, he was often unable to circumvent adverse influences. In course of time, however, it was recognized that the factors involved in crop production were many and varied and the aid of science was invoked with the result that modern agriculture is a fabric built on a scientific foundation based on the labours of an army of investigators in a number of sciences all working in close collaboration with the practical farmer.

It is obvious that plants require food material for their growth and that as they thrive only in the soil, the food must come mainly from that source. The most important of these food constituents, from the point of their absorption by the plant in large quantities, are Nitrogen, Phosphoric acid and Potash. Investigation has shown that all the plant food present in the soil is not in a form capable of being utilized by the growing crop. Plants can take in their food only when it is dissolved in water, and that portion of the plant food in the soil which is not soluble in water, is of little *immediate* benefit to the crop. It is therefore, customary to speak of the '*total*' and '*available*' plant food in the soil, the latter being that portion which is soluble in soil water and which can be at once taken up by the crop. It is thus clear that the '*available*'

plant food in a soil is the factor of chief interest to the cultivator as, other conditions being satisfactory, its amount will within certain limits determine the yield of crops. The *total* plant food is not without interest to the ryot It is in fact an item of reserve deposit from which small quantities are drawn from time to time. There is, in other words, a slow conversion of insoluble material into soluble plant food for the gradual use of the crop and it is this change which enables soils to go on producing crops for very long periods even though no plant food is added in the form of manure. But if land is continually cropped, there must be a constant drain on the food supply present in the soil, till it reaches a stage of minimum availability.

The yield from an acre of normal paddy crop (3000 lbs. grain and 3000 lbs. of straw) has been found to contain 48 lbs. of nitrogen, 23 lbs. of phosphoric acid and 41 lbs. of potash and these constituents must have come from the soil. If we visualise the soil as a bank, it is obvious that, unless what is withdrawn is returned, the account will soon be overdrawn. But wise Nature has foreseen man's greed and in her infinite wisdom has provided against his sins of commission and omission by setting up in the soil a mechanism for the indefinite supply of the bare minimum requirements, for what is ordinarily termed *the minimum crop production*. So that, if the few pounds of the manurial constituents taken off from the soil are not returned, there will not be a complete cessation of crop growth but there will result crops poor in quality and quantity which means an inferior and insufficient food which in consequence produces a devitalised population falling an easy prey to all sorts of diseases.

It is a matter of great practical importance to ascertain to what extent the loss of plant food has proceeded, what reserves are available, and whether the soil is producing the maximum crop which it is capable of producing under proper management. To this end soil surveys of the more important paddy tracts throughout the Presidency were carried out. Many hundreds of samples, typical of the soils of each tract have been collected and analysed. These surveys have yielded very striking results and show in a very marked manner how very deficient our soils are in certain ways and the large areas which demand immediate manurial treatment. The following tabular statement explains the nature and extent of the deficiency.

No	Name of tract	Percentage of the soils deficient in	
		Nitrogen	Phosphate
1	Godavari	40	23
2	Kistna	33	55
3	Guntur	80	33
4	Tanjore	87	80
5	Periyar	0	90
6	Malabar	0	90

The surveys have therefore indicated in a very definite manner, the enormous loss in crop production which is taking place throughout the Presidency, owing to the exhausted condition into which the soils have been allowed to fall, either through the ryot failing to appreciate the importance of manures or more usually through his inability to afford the cost of manures. Loss in yield, however, is not the only injury which results from the wide-spread deficiency of phosphoric acid. The results of experiments at Coimbatore have shown very clearly that in cases where phosphoric acid was deficient, not only was the yield reduced, but the composition of the crop was affected. Both grain and straw contained much less phosphoric acid than the crop from properly manured plots and hence the food value of the crop was much diminished.

The practical utility of the investigations mentioned above is obvious. With the aid of these soil analyses it has been found possible to ascertain the manurial needs of the areas and that of the paddy crop with the result that the nature of action of manures began to be investigated. The results of a large number of experiments in the field and in the pot-culture house spread over a number of years have shown that all the natural and artificial nitrogenous manures are more or less beneficial to paddy but that they are more economical when applied in conjunction with bulky organic manures. Of the latter class of manures, green manures are preeminently suited to paddy crop. The results of the manurial experiments may be briefly described in numerical values comparing the relative merits of the different systems of manuring with that of green manure, taking the value of green manure as the unit of standard.

No.	Manure applied	Relative efficiency
1	No manure	0 33
2	Phosphate alone	0 50
3	Nitrogen alone	0 70
4	Nitrogen + phosphate	0·90
5	*Green Manure*	1 00
6	Green manure + Phosphate	1 20
7	Green manure + Nitrogen	1 33
8	Green manure + phosphate + Nitrogen	1 60

Potash is not included in the investigations as our soils are generally well supplied with this constituent.

The numerical values mentioned above refer to the results of pot cultures. The results of field trials are of a similar order.

These experiments show that of the three most important manurial constituents, namely, nitrogen, phosphoric acid and potash, the last named does not appear to be necessary except perhaps in rare cases or where it is indicated to counteract disease. Nitrogenous and phosphatic manures are in general need and are responded to by the crop when applied singly or together, but their effect when combined is better. Phosphatic manures have been found to stimulate the assimilation of nitrogen which would otherwise not be utilized and also to enrich the composition of the crop in this constituent thus enhancing the *nutritive* and *seed* value of the grain.

It is seen that artificial manures are not as efficient as green manure for paddy and that the efficiency of either class of manure can be considerably improved by combining them. This raises the question as to the proportion in which artificials and green manures should be used. In so far as the Coimbatore soils are concerned, it would appear that a mixture of two-fifths of artificial nitrogen and three-fifths of organic nitrogen make a suitable combination for paddy. Larger dressings of green manure appear to render supplements of artificial nitrogen like sulphate of ammonia ineffective.

The study of the soil conditions and the nutrition of the paddy plant with special reference to the practice of green manuring marks a distinct advance in our knowledge of the nature of action of green manure under puddled and swampy conditions.

Paddy in this Presidency is generally grown under swampy conditions and in a puddled soil throughout the growing season, and yet no general system of cultivation holds good for all tracts, so that it cannot be said that the system adopted in one locality holds good in another. In South Malabar, the general practice is to plough the lands in the dry season with excellent results, but this practice introduced into the deltaic tracts resulted in failure. Green manuring is found beneficial in one area, but when tried in another the crop fails. In some places water may be run on to fields and puddling and manuring done weeks before the crop is planted, but in other districts the custom is to put in the green manure just before transplanting. These and other mutually opposed facts make it essential that the conditions governing the growth of paddy should be closely studied in order to obtain, if possible, some common basis capable of explaining them before any improvements in paddy cultivation can be considered.

Since green manure undergoes putrefactive fermentation when buried under water, it was considered that an examination of the soil gases would make an opening to the problem. The first investigation showed that the normal fermentation of green manure in swamp paddy soils leads to the production of different gases and that the introduction of a crop into the field modifies the proportion in which some of the gases are produced and inhibits the production of others. The soil conditions are found to be anaerobic in character and therefore, nitrification is impossible and the nitrates produced during the period when the soil was dry are quickly denitrified. Under these conditions, therefore, the nitrogen required by the crop is obtained in the form of ammonia and probably form other nitrogenous organic compounds produced by the anaerobic decomposition of the proteins in the green manure.

Certain substances formed as a result of this decomposition are toxic to the crop and should be removed in the drainage water or should be destroyed by prolonged decomposition before seedlings are transplanted.

A more detailed study of the soil gases has revealed the fact that the gases escaping through and at the surface of the water in the paddy fields, are different from those that are present in the

soils themselves and consist mostly of oxygen and nitrogen as against marsh gas, hydrogen, and carbon dioxide that are formed *in* the soil. A certain relationship was also noticed between the evolution of oxygen and the presence or absence of crop, and pot experiments have clearly shown that the effect of the crop is to diminish the evolution of oxygen. This means that the evolved oxygen is absorbed by the crop for its growth. A careful examination of paddy roots of different types has shown that the roots of paddy do not resemble those of typical aquatic plants, but are similar to those of ordinary dry-land crops and as such require oxygen to be healthy and strong. The supposition is, therefore, correct that the oxygen is used up by the crop for aerating its roots.

The evolution of oxygen has been traced to a film of algae commonly seen on the surface of paddy fields and this film is found to contain bacteria which oxidise hydrogen and marsh gas with production of carbon-dioxide. The carbon of this gas is utilized by the algae for their food liberating oxygen which dissolves in the soil water and aerates the roots.

If the oxygen dissolved in the surface water is to aerate the roots, the water charged with oxygen should be capable of reaching the root zone, and this is possible only if there is drainage ; so that drainage is an important factor. If the soil is badly drained, the oxygenated water cannot enter the soil and consequently aeration would be restricted to the surface layers.

On the other hand, in well drained soils, the aerated water would penetrate deeper into the soil. Consequently it appears reasonable to presume that the better the drainage, the deeper would be the aeration and therefore a proportionately increased cropping. If this is the case aeration can be promoted by a thorough periodical draining of the soil.

Actual experiments have shown that this is not the case. The mere draining of the soil is inadequate for the purpose. The simple system of slow movement of water through the soil and therefore, through the root range has been found to be most beneficial for the crop. The reason for this has been found to be that the water percolating through the soil is strongly charged with oxygen and therefore supplies plenty of it to the roots ; whereas, the simple admission of air into the soil by thorough draining would yield only a weak solution of oxygen.

The best results are obtained with a moderate amount of drainage and too slow or too rapid drainage would result in decreased cropping. The reason for this has been traced to the fact that the development of the film which is responsible for the supply of oxygen occurs best under moderate drainage conditions. Thus the most efficient drainage in paddy soils is not the quickest but one that permits the surface film to maintain its full activity.

The practical aspect of these investigations from the point of view of the South Indian ryot is that the relationship of green manure to the aeration of roots is of the greatest importance and that, apart from all other considerations of manurial value or its influence on the texture of the soil, one of the most important functions of green manuring with reference to paddy soils lies in promoting the activity of the surface film which is responsible for the proper aeration of the roots. We have also learnt that green manuring does not always give good results on all soils and that when drainage is deficient the toxins produced during the decomposition of the green manure affect the growth of the crop adversely and that, therefore, green manuring should not be adopted as a universal practice but should be undertaken after careful consideration. The universal practice of puddling paddy soils has been understood and this knowledge has led to the conclusion that drainage can be controlled by means of puddling and that this is easily at the command of the ryot.

Another very important practical indication of these investigations is that growing a green manure crop in a field to which it has to be subsequently applied as green manure, is not advantageous as the nitrogen is largely dissipated as gas and as the crop had taken its nitrogen originally from the soil, it involves a distinct loss of nitrogen.

The work on paddy soils and the nutrition of the paddy plant has so far been considered. The work on the dietetic value of rice which forms the main food of a large section of the people of South India will now be considered. This investigation had its origin in a collaborative work of the Chemical section with the Deficiency Diseases Inquiry into the relationship existing between rice and *Beri-beri* in India.

The problem of the relationship of rice to *Beri-beri* will not be specifically discussed here but certain aspects of the defects of polished white rice will be briefly considered.

Fashion is so contageous that even the poorest man is anxious to use highly polished spotless white rice if he could only secure it. It is no exaggeration to state that the opulence and the extent of refinement of a man is partly measured by the quality of the rice he uses. Little do we know what valuable nutrient materials are lost in the polishing. The greater the polish, the greater is the loss. The fats, proteins, mineral salts and vitamins are stored in the outer, dirty brown or red coating of the rice grain, and during the process of polishing these nutritive constituents are lost and all that remains is mostly starch.

Analyses in the laboratory and feeding trials with pigeons have shown that raw, milled, unpolished rice is the most nutritious while raw, milled, highly polished rice is the least nutritious. Parboiled rice comes midway between these two extremes. Parboiled and milled rice, in the unpolished stage is not so nutritious as raw, milled and unpolished rice; but even when it is polished, boiled rice possesses a higher nutritive value than the corresponding raw polished rice.

Washing of rice just before cooking has also been found to deprive rice of a good deal of its most nutritious ingredients. The effect of draining rice after cooking should also be similar.

AGRICULTURE IN AUSTRALIA

BY

R. D. ANSTEAD

i. FARMING CONDITIONS

Australia is in marked contrast to India as regards her agricultural problems and practices. One of Australia's great farming disadvantages is drought and insufficient rainfall. There has not been a satisfactory general rain for five years. Wing Commander L. J. Wackett who flew across the Continent recently, lecturing before the Sydney branch of the Royal Empire Society said : We hear much from time to time about the great open spaces of Australia. Having seen them from the air I regret to say they left an impression of despair. Such country can never support modern civilisation and most of it is useless waste.'

Despite this gloomy opinion scientific methods of dry farming have enabled wheat to be grown successfully in regions where cropping would have been considered impossible thirty years ago. Now wheat is one of the most important agricultural products of the country, and it is produced at a profit despite high wages. The fields are very large, some in the west are as much as a thousand acres, and a furrow has been known three miles long. The roads are straight and wide and large implements are therefore possible, and the usual sized team for one man to manage is seven horses and in some there are ten. A considerable amount of work can therefore be done : in one day a man is expected to plough 5 to 6 acres, to cultivate 20 acres, to harrow 40 acres, to drill 25 to 30 acres, and to harvest 8 to 12 acres. Much use is made of tractors and power implements of all kinds, especially combined implements. A favourite machine for instance cultivates and drills seed and superphosphate all in one operation. The harvest weather is normally fine and dry so that one implement takes off the heads and threshes and bags the wheat. Great economy of labour is thus possible, and one man can manage 800 acres of wheat with a little extra labour at harvest time only.

* * * * *

The Commonwealth of Australia has a Council for Scientific and Industrial Research. This Council appoints State Commitees on which are representatives of the science sections of the State Agricultural Departments, and provision is made for the co-option of additional members enabling each Committee to be so constituted that all the major industrial activities followed in each individual State may be given a voice on the local body. These Committees correspond to the Provincial Agricultural Advisory Committees recommended by the Royal Commission on Agriculture in India, one of which has been established in Madras, while the Commonwealth Council corresponds to the Central Research Committee established recently at Simla.

The Committees provide the Council with a facile and rapid means of obtaining complete information on different aspects of particular problems.

They ensure that any important information obtained from State sources is a well balanced statement of the position viewed from all aspects, and not a coloured version of one particular body or individual. The Committees, especially those far distant from the headquarters of the Council, also serve on occasion to draw attention to problems previously little known, or whose importance and potentialities have not been fully realised.

One of the duties of the Commonwealth Council is to co-operate with State organisations with a view to the prevention of unnecessary overlapping, and the utilisation of facilities and staffs available in the States, and this side of its work has been developed to a remarkable degree, and a large and wide number of subjects have been dealt with.

Another important function of the Council is to act as a means of *liaison* between the Commonwealth and other countries in matters of scientific research. A movement for the establishment of team work in matters of scientific research is becoming evident throughout the world and Australia is fully alive to the desirability of its forming one of a team in an Empire-wide attack on the various problems that are now confronting the Empire as a whole.

These are also the broad lines along which the Royal Commission on Agriculture in India advised that the Imperial Committee of Agricultural Research in India should be conducted. But the Commonwealth Council have gone a step further and have divided themselves into sections, termed Divisions, each of which is in charge of a Chief. And here comes a very important point, a point raised by the way at the last meeting of the Indian Central Cotton Committee at Bombay. The Council has definitely adopted the policy of refusing to carry out extensive investigations in any particular field until it has obtained the services of a really competent authority in the science involved to direct the work in the capacity of Chief of a Division, and a similar policy has also been adopted in the case of minor or more or less independent researches. This policy may cause delay in some cases, but it is considered far better to wait and get the very best man possible than to run the risk of having the investigation misdirected.

At present the Council has four main Divisions, each in charge of a Chief, viz. animal nutrition, economic entomology, economic botany, and forest products, while a Division of animal health is contemplated. The Council itself has control over a fund voted by the Commonwealth Government which amounted to £500,000.

ii. Agricultural Education

In Australia the State Agricultural Colleges are under the Agricultural Departments but independent of the Universities, which have chairs of agriculture of their own, and provide a really practical training for would-be farmers. They grant a diploma in both agriculture and dairying, and successful graduates are eligible for posts in the Agricultural Departments and receive concessions at the University, but the majority of the students actually take up farming. In this respect these Colleges differ from ours at Coimbatore where a University course leading to a degree is taught, and the majority of the graduates look to Government Service for a career. This being so, the

Australian Colleges are specially equipped to teach a practical course, and the research and laboratory sides are somewhat neglected as compared with the field work.

The author had an opportunity of inspecting the Hawkesbury Agricultural College at Richmond not far from Sydney in New South Wales, which is one of the largest and the best of the colleges in Australia. The primary object that the Department of Agriculture had in view in establishing this institution was to teach the science of agriculture and its practical application. The chief aim is to turn out men who will take up farming as a vocation. Various courses are provided and they cover not only general farming of all kinds, but also instruction in the handling of poultry and pigs, including bacon making, orcharding, vineyarding, and agriculture. There is also a dairy course teaching the most modern methods of handling milk, butter, and cheese. Connected with the farm itself are sections devoted to carpentry, black-smith-craft, saddlery, and engineering, in all of which subjects is given a systematic course of work suitable for farm requirements. Every section is provided for down to jam making, fruit preserving and drying in connexion with the orchard.

The buildings are excellent, each student has his own room in a two-storied hostel, and all mess together in a big hall, and there is a fine swimming bath and gymnasium as well as playing fields and a rifle range.

A portion of the farm which has over a thousand acres under cultivation is devoted to experimental work. The comparative values of different fertilisers are being tested, various systems of rotation of crops and methods of cultivation are being tried with regard to their suitability to the district. New varieties of crops and pure line seed are also being produced. With the object of improving the stock of the State, pigs, poultry, dairy cattle, and sheep are bred. Selected animals of the best blood strains are purchased and imported from time to time and the progeny with pedigrees are sold to farmers at 'reasonable rates.' Farmers will pay as much £50 for good young stud bulls which may be contrasted with Madras where ryots grumble at paying Rs. 250 for pedigree stud bulls from Hosur.

The College handles about 150 students a year. They must be over 16 years of age and must pass an entrance examination. The course costs about £22 per annum. As compared with Coimbatore the buildings strike one as small and the class rooms and laboratories are cramped; but the farm itself is a marvel of efficiency and equipment. The pure Jersey dairy herd is one of the finest pedigree herds in the world. A number of the best cows give over 500 lbs. of butter fat in a year of 365 days.

The College also provides short courses at the slack period of the year for busy farmers and stock owners who can devote only a limited time for study and intensive practical instruction. Designed specially to teach improved methods these courses discuss theory only to explain practice and the discussions are made as simple and as free from technical language as possible. The courses embrace a variety of subjects including dairying and poultry keeping, Entomology, and Veterinary Science. Thus all classes are provided for and it is easy for both prospective and actual farmers to obtain education in the latest developments of agricultural science.

Madras Mail.

THE GIFT OF WATER FINDING

BY

B TOMPKINS

Many people are apt to look upon water finding as a very simple thing and only suitable for, say, a small cottage or country residence; but I have discovered springs of water capable of yielding 40,000 gallons per hour, and this supply has been obtained in several cases.

Almost at the beginning of my official career, I carried out numerous experiments for the late Sir William Barrett, Professor of Physics at the Royal College of Science, Dublin. Sir William at the time was preparing a lecture on the so-called 'Divining-Rod' for delivery at the Royal Albert Hall in connexion with the Physical Research Society.

At that time many theories held the field as to why only one person among thousands should possess such a unique gift, or even why such a gift existed at all. One of these theories was called the 'Psycho-Physical' involving a power unconsciously conveyed to the brain of the water finder, he, being a shrewd, cunning sort of a man, would keep a sharp eye on the ground as he was walking over it, would notice a low place where the grass was greener than in any other part of the field, and when approaching this spot his twig would turn in answer to this unconscious power from his brain.

What about the finding of water in cities and towns like Birmingham, Wakefield and Barnsley? There are no green spots there or low places in streets and works. Another explanation was 'thought transference'. I went to Cheltenham to prove if this theory was correct or not. As a matter of fact the power of water finding does not affect the head in the least. It comes up through the feet, legs and back, over the shoulders, down the arms on to the twig; and the negative and the positive meeting at the apex of the twig cause it to rise in the hands and revolve over and over, when over the head of the spring. If rubber shoes are worn, or even if the twig is split through the apex and securely bound with twine, the rod ceases to act, which seems to prove that the power is natural electricity.

No one has yet been able to overthrow my theory or replace it with anything better. Facts are stubborn things and one ounce of practice is worth a ton of theory; and so long as abundant supplies of pure spring water are produced by this method, the theory is of but secondary importance. I have discovered hundreds of springs of water in places most unlikely from outside observation, and in districts where nothing but impure land soakage and surface water existed, and where duckweed had to be swept back on ponds before dipping in pails, no other water being available. During the extreme drought in the year 1887, I discovered a spring in the middle of a large arable field at only 6 feet depth from the surface; now there are three feet of water in a reservoir of 12 feet diameter, and this spring supplied the need of the neighbourhood during the drought.

Great anxiety is felt in time of drought throughout England generally. It is a problem that becomes more acute every year. Springs of water underground have often connected with each other by subterranean water courses, and it is obvious that the more springs are tapped and drawn from, the more supplies tend to weaken, unless supplemented by snow or rainfall. A very curious incident happened recently at one of the English towns situated in a valley.

The streets had been flooded for a considerable time. Previous to this I had an engagement in the suburbs of this town to discover a water supply for a country residence and an open-air swimming bath 15 yards long, 6 yards wide and 9 feet deep. I was successful in finding a very strong spring which I estimated at 40 feet deep and yielding 5,000 gallons per day, at the foot of a plantation near a high hill. A well was sunk and water obtained at 30 feet deep, and to obtain the full supply the sinking was continued to 40 feet deep. The swimming bath had been constructed previously and everything was in perfect order, when quite suddenly, to the surprise of everyone, the water disappeared.

Having a second engagement to advise for a water supply at an adjoining village some little time afterwards, I visited and made a second test to ascertain the cause of this sudden disappearance of water and to my astonishment my rod was absolutely motionless where it had previously turned with such vigour and speed. I was dumbfounded. I determined if possible to find out the cause of this catastrophe. After a very careful search of the neighbourhood I found that several other supplies had vanished, and that Nature in one of her less kindly moods had allowed various springs to have their liberty by diverting the watercourses.

There are interesting points in connection with the subject of water finding that it may be useful to mention. This art is apparently confined to only a few though I believe the number is by no means as limited as is supposed. I have tested hundreds of persons of various ages and positions in life, but only in two instances have I found anyone who possessed the gift with sufficient confidence to be able to utilise it with any degree of success. It is true that water finders are born, not made. It is not a gift that can be acquired, or a profession that can be taught.

A very common feature in connection with this gift is the discomfiture experienced when close to a dynamo or electric light station, unless one is properly insulated. The body is like a battery, easily becoming charged with the current; then the only thing to do is to take a long brisk walk for relief. It is also advisable to have some occupation consisting of both physical and mental exercise to counteract the exhausting effects of being overwrought.

There is no magic or suggestion of charlatanism in the method of water finding. The operator is the instrument or receiver that responds or accepts the force generated in the earth by the underground springs. A portion of the power present in the running water underground is converted into a form of energy that has hitherto been unknown, but which possesses some of the properties of the other physical forces and responds to some of their laws. The principal property it possesses is that of stimulating

the nerves controlling the vital parts of the body in similar fashion to the tuning up and tautening of the strings of a harp or violin ; this causes certain movements, which a e rendered visible by the V-shaped forked twig that has become so closely associated with the operations of water finding.

Thus the white thorn and hazel are chosen because of their reliability as an indicator, showing clearly and unmistakably the presence of the energy transformed by the working of the forces it is obeying, from the running water underneath. Some waterfinders in the past have used steel clock and watch springs in their operations, but I consider that these springs, being highly magnetic, tend to give incorrect estimates as to the depth and yield of water. I remember in one of my experiments using a long piece of copper wire, so long as the apex of the wire touched the ground at the head of the spring, and whilst the two ends of the wire were in my hands in the same way as I hold the Divining Rod my hand became hot and blistered badly ; so I ceased further experimenting on these lines.

In the *Madras Forest College Magazine* from the *Statesman.*

BORE-HOLE LATRINES

The *Madras Panchayat Bulletin* for October 1929 contains a note, on the relative merits of the different types of latrines and disposal of night-soil, which will be of interest to agriculturists and the general public :

The Registrar-General of Panchayats paid a visit to Madura and inspected the various types of latrines which have been constructed at Usilampatti and also the ' bore-hole ' and ' trench ' latrines in eight other places. The following types of latrines have been experimented with at Usilampatti :

(1) Septic tank costing about Rs 2,000 ;

(2) Sanded or dry-earth latrines ;

(3) Deep trench latrines ; and

(4) Bore-hole latrines.

In other villages, bore-hole and trench latrines have been experimented with.

2. A septic tank latrine with an impermeable cemented tank and a man-hole outside through which the fæcal matter can be removed was found very satisfactory as regards cleanliness and freedom from odour. But it is costly and requires a permanent staff of *thotties* of a class who will handle night-soil to attend to it at regular intervals. It would be suitable for large unions and municipalities who can afford the initial cost and procure the necessary staff.

3. The dry-earth latrines which have been experimented with in the market are better than the ordinary open latrines so prevalent in unions and municipalities but require practically as much attention as removable bucket latrines and have the disadvantage that fæcal matter lies exposed to flies.

4. The deep trench latrines with specially prepared slabs over them, if excavated to a sufficient depth, were found fairly satisfactory, but to excavate them to a sufficient depth, they have to be constructed much wider than is really necessary in order to give the men working room when digging. It was also found that, for some reason or other, they were generally inclined to be rather objectionable as regards smell, though nothing compared with prickly-pear outskirts of many a village visited by the Registrar-General.

5. The bore-hole latrine consisting of a bore 14 inches diameter and from 8 to 15 feet depth, was found very satisfactory and astonishingly free from offensive odour even when nearly filled up. The deeper ones were practically odourless. They can be arranged single with a light wall around them or in groups with a rear wall, a screen wall and partitions. They last from six months to a year according to depth and amount of use. When filled up, fresh holes have to be bored, the concrete slabs being removed and placed over the new bores.

In the case of latrines with more than one seat, with a screen wall, this can be generally done within the existing wall and merely the partitions and the slabs have to be shifted, the old screen walls remaining. The cost of these latrines is from about Rs 10 to Rs 12 per 'seat'; and the boring instrument so far found most suitable costs about Rs 100 complete with extension rods. Once a village has seen how to work the borer and place the slabs, there is no reason why each village should not have its own borer and maintain its own recurring series of latrines. The fæcal matter in the bore-holes takes longer to decompose than was expected and probably, at any rate, in dry areas, it will be two years before it can be removed and the bores used again. The President of the Madura District Board informed the Registrar-General that they have already been having application from ryots for the stuff as manure. The reinforced concrete slabs can be made in almost any district and the pattern can be obtained from Madura. The pattern used there could be improved slightly by sloping the top towards the edges of the hole more.

6. These bore-hole latrines have been constructed in thirty-six villages of the Madura district and the President of the District Board informed the Registrar-General that a spontaneous demand for them was growing up and he could not cope with it and the reconstruction of the used-up boreholes with the special staff he had at his disposal. The latrines provided for women are used most as they provide privacy at a convenient distance but the latrines for males, notwithstanding the remarks of some of the older village 'hodges' about the open fields being good enough for them were found to have been largely used. The latrines are best put down in those parts of the village which have been resorted to before at nights and polluted. It is the pollution of the soil immediately round about the village that must be combated in any sanitary campaign. Where the population really goes forth some distance into the village fields, the sun does the work of disinfection and the danger to health is not so great.

7. Experience in Madura shows that along the construction of latrines, propaganda is necessary at first in order to teach the people how to use them properly. And a staff of toties, say one to every four villages, is required to go round and clean the squatting slabs and the neighbourhood occasionally.

There is as little space as possible provided for in the latrines, but experience shows that especially in the women's latrines, young children taken along with their mothers squat in the passage way and adults also are not always careful to sit properly over the hole provided in the slab.

8. With this system of latrines, however, all that the toti has to do is to brush fæcal matter into the hole and sluice the slab. This obviates the removal in receptacles of fæcal matter elsewhere which is so objectionable a part of what attempts at sanitation are made now-a-days.

Notes

We note with pleasure from the *Agricultural Journal of India* for September 1929, that Co 221 cane has headed the list of cane varieties in the Leeward Islands of the West Indies, yielding 31·85 tons per acre on calcareous soils and 24·35 tons as a ratoon crop in clay soils. Co 221 was one of the several Coimbatore seedlings introduced in these islands in 1923.

Valcano Soils

It is interesting to learn through the *Planter and Sugar Manufacturer* of September 1928 that lava belched from the volcano *Makuaweoweo* in Hawaii island forms very fertile soil in a short time and supports very good crops of cane. Within living memory thousands of acres of land have been added on the shore side, layer after layer to a thickness of about 50 feet. There are two sugar companies working in that district, raising large areas of canes in soils that can be taken to have formed ' yesterday '.

Preservation of Potatoes

Storing of potatoes for domestic consumption or for feeding stock has always been a difficult problem. The following methods of preserving potatoes, noted in *Nature* of September, 7, 1929 will therefore be read with interest. ' The potatoes are first washed and then steamed in as little water as possible. After pouring off the liquid, the tubers are packed closely and firmly into a pit about three feet deep in the ground. Old jute bags are laid over the potatoes which are then covered with a foot of soil. In wet climates the pit is thatched over with straw. With proper packing all air is excluded and the potatoes keep in good condition for years.'

Corn Stalks as Fuel

The practical possibility of the conversion of corn stalks into gaseous fuel for lighting and heating of farm homes has been examined in a paper read before the American Chemical Society recently. It is very interesting to note that the fermentation of corn stalks encouraged by the admixture of ordinary ' household wastes ' results in the production of sufficient volume of a mixture of carbon-dioxide and methane, to be utilised for all ordinary purposes of heating and lighting. A family of 4 or 5 can have enough supply from a tank 8 feet in diameter and 8 feet in depth, as 50 per cent of the corn stalks are reported to be converted into gas. It is also stated that the fibrous residue in the tank can be used in paper manufacture.

The Licorice Root in Industry

This is the title of an interesting article published in the October issue of the *Industrial and Engineering Chemistry*. The licorice root has been

known in India and China for a very long time. It is now a great industry in U. S. A. The sweet principle in the root, glycyrrhizin, when pure is 50 times more sweet than sucrose. The uses of licorice in medicine are said to be as follows: general tonic and blood purifier, gives relief for internal inflammations, externally applied for wounds with honey, and also effective in cases of catarrh, hoarseness and sore throat. In industry, 90 per cent of the licorice mass produced in America is used up in the tobacco industry, as a flavouring and sweetening agent, to keep the tobacco moist making it more mild in flavour; the remaining 10 per cent mass of licorice is utilised in the pharmaceutical and confectionary industries. The byproducts of the manufacture of licorice extract are used in preparing a fire-extinguishing agent and the resulting fibrous material serves as a good raw material for making card board boxes and for building construction.

An Interesting Plant Hybrid

Rao Bahadur T. S. Venkatraman, Sugarcane Expert, Imperial Cane Breeding Station, Coimbatore, has just succeeded in raising hybrids between sugarcane and *cholam* (*Andropogon sorghum*). As an intergeneric hybrid—by no means too common in the vegetable kingdom—this should prove of considerable scientific interest. Two such hybrids of possible economic value known at present are the 'Maize-teosinte' and the 'Wheat-rye'. The F_1 generation of sugarcane being noted for diversity among the progeny and sugarcane, as a crop, being propagated vegetatively, it is not impossible that important economic results might come out from a 'cane-cholam' hybrid.

Extracts

Giant Earthworms

Nature of September 7, 1929 briefly describes how a species of giant earthworms live in South Gippsland, full details of which have been published in the July number of the *Victorian Naturalist.* 'The burrows, vertical or horizontal, are always slimy and damp and the approach of an investigator is heralded by a loud gurgling noise made by the worms as they contract in the burrows. The eggs may lie free in loose soil or may be fixed among grass rootlets. They are tough and horny, greenish and translucent, oval and about two to three inches in length. The average size of the worms is from six to nine feet.'

New Guinea not Habitat of Sugarcane in Wild State

Jared G. Smith writes as follows in the *Planter and Sugar Manufacturer* of September 28, 1929. He says 'Although New Guinea has long been considered the native habitat of *Saccharum officinale*, the sugarcane of commerce, no proof supporting this contention was discovered during the recent scientific survey of that field, according to Mr. C. E. Pemberton. All of the 175 different varieties of sugarcane collected by the members of the New Guinea Expedition were secured in the gardens surrounding native villages.

Inquiry as to the source of the separate varieties was invariably answered in vague fashion, that the original seed came from some other village, river-basin or district, brought by some man or family. No plants of the true sugarcane were observed by Mr. Pemberton during the twelve months he spent in New Guinea, growing in the jungles or anywhere except under cultivation, nor did he find 'wild' sugarcane during the four months that he devoted to field surveys on the island of New Britain, in the New Hebrides, and the Solomon Islands. The tall grasses found along the margins of rivers and lakes were found to be a new species of Saccharum, named by Dr. Jacob Jeswiet—*S. Robustum.* But this 'robustum' cane contains no sugar.

Sugar-cane is one of the principal food plants of the New Guinea natives. The varieties cultivated by them are all soft canes, a number of them as easily munched as an apple. Pemberton does not think that any of them will become commercial varieties, being too soft and brittle. They have probably undergone century-old selection, undoubtedly, for sugar content and eating qualities. It is believed that tens of thousands of new cultural forms of sugarcane will be discovered in the native gardens of the cannibals and headhunters, but they would all prove to be 'tame' rather than 'wild' cane varieties. Every native garden, according to Pemberton, supplied at least one new variety. Sugarcanes were noted by other explorers on villages as high as 7,000 feet above sea-level.

College News

The Students' Club: There were three meetings during November. In the first, David of Class II spoke on 'The Task before us' when Mr. T. V. Rajagopalacharya presided. In the second Mr. Devendranath Misra of the Brahmo Samaj delivered a lecture on 'The Problem of Human Life' under the presidentship of Dr. T. V. Ramakrishna Ayyar. On the 26th Mr. S. N. Chandrasekhara Ayyar gave an interesting discourse on 'Eugenics' when Mr. G. N. Rangaswami Ayyangar presided.

Diwan Bahadur Sir T. Vijayaraghavachariar, the Vice-Chairman of the Imperial Council of Agricultural Research visited the Imperial Sugarcane Station on the 19th November. He evinced keen interest in studying the cane improvement work carried on at the Station. He was entertained at Dinner by Rao Bahadur T. S. Venkatraman, the Sugarcane Expert, when many of the officials of the Department were present. Sir T. Vijayaraghavachariar is expected to visit the Agricultural College and Research Institute in January next.

The Agricultural College Officers' Club Day: The Club Day was celebrated with great *eclat* on the 23rd November. There were the usual sports and Tournaments which were keenly contested. In the evening there was a grand dinner followed by an entertainment of a very novel character which was thoroughly enjoyed. The entertainment consisted of a Muhammadan nautch party and a Harikatha Kalakshepam on the genesis and growth of the Officers' Club in the most interesting and original way.

Weather Notes

OCTOBER 1929

Rainfall Data

Station	Rainfall	Departure from normal
Gopalpore	25·7	+17·7
Vizagapatam	10·1	+ 3·1
Cocanada	7·0	— 0·9
Masulipatam	4·8	— 3·3
Kurnul	3·8	+ 0·3
Bellary	5·5	+ 1·6
Anantapur	2·9	— 0·2
Cuddapah	4·2	— 0·9
Nellore	7·2	— 1·2
Madras	6·7	— 5·0
Cuddalore	8·6	— 1·8
Vellore	5·9	— 0·5
Salem	3·2	— 3·5
Coimbatore Town	3·6	— 2·9
Coimbatore Lawley Road	3·1	...
Trichinopoly	8·9	+ 2·0
Negapatam	6·1	— 4·4
Madura	6·7	— 1·2
Pamban	9·0	...
Palamkotah	8·1	+ 1·2
Trivandrum	10·5	...
Cochin	23·3	+10·2
Calicut	7·4	— 2·8
Mangalore	16·5	+ 8·9
Bangalore	5·5	— 0·4
Mercara	7·1	— 1·7
Kodaikanal	9·1	— 0·6
Coonoor	12·9	— 0·7

The weather during the month of October was abnormal following an abnormal September. The month began with an area of low pressure lying off the Coromondel coast which developed into a depression near 14° N and 84° E on the 3rd and into a storm on the 4th which crossed during the day near Cocanada. It occasioned heavy rain on the Circars coast between the 3rd and 5th. Gopalpore reporting 5·4″ on the 4th, Vizagapatam, Cocanada and Kalingapatam 3″ each on the same day. The storm weakened rapidly and disappeared by the 7th. Between the 7th and 11th sporadic showers occurred in the Presidency. On the 11th conditions again became unsettled in

the Andaman sea and remained so till the 16th when a depression formed in the centre of the Bay, and which intensified into a storm on the 17th about 17° N 85° E. and moving first North West recurved along the coast and crossed the Orissa coast on the 19th. It caused very heavy rain on the North Madras Coast. Gopalpore receiving 14·9″ in the 72 hours ending 8 a.m. on the 18th with 7·6″ on the 17th and Kalingapatam 9″ in 48 hours ending 17th. During this period distribution was of the South West monsoon type and rainfall had practically disappeared from the Carnatic and South Madras. The pressure distribution changed over to the North East monsoon type on the 24th, but general rain did not appear on the Madras coast till after the 26th. Extensive Thunder showers occurred in South Madras and the North East monsoon had established itself about the 30th in the Carnatic 15 days later than usual. Rainfall was markedly above normal in parts of the Circars and Malabar in moderate to large defect elsewhere. Gopalpore was 17·7″ above normal and Cochin 10·5″. Temperature was above normal in the South almost throughout the month and in large defect in the Circars during the rainy period. Humidity was very high in the Circars during the rainy period and in defect in the South.

Report from the Research Institute Observatory

The barometer rose and fell with the movements of the depressions in the Bay and fell to the lowest point on 3–10–29 to 28·461″ (unreduced to sea level) on the day before the first storm crossed at Cocanada and again to 28·502″ on the 16th, when the second Bay depression was forming. Barometer rose thereafter and reached the highest point on the 27th and with that the seasonal trough of low pressure shifted southwards. Winds had a southerly component during the period when the disturbances were in the Bay, and steady North East winds began after the North East monsoon conditions set in. Velocities were however low and calm was reported on 10 days at 8 a.m.

There being no appreciable rain during the first half of the month, temperatures were high and the maximum was 91°F. on the 21st. Rainfall was frequent during the period from 22nd to the 31st and a total rainfall of 3·17″ was recorded.

Summary of Weather Records

Absolute Maximum in shade	91°· 0
Do Minimum ,,	67°· 5
Mean Maximum ,,	87· 2°
Do Minimum ,,	70· 9°
Mean daily wind velocity	3· 9° Miles per Hour
Do 8·00 a.m. ,,	2· 9 ,,
Total Rainfall	3·17 inches
Heaviest fall in 24 hours	1·07 ,,
Total number of rainy days	8
Total Hours of bright sunshine	213·8 hours
Mean hours of bright sunshine	6·9 ,,

Prospect for November

The late setting in of the North East monsoon and the frequency of rainfall in October does not give much hope for a regular season in November. The two previous months being abnormal November is also likely to be abnormal.

P. V. R.
B. S. N.
