BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.

Director of Public Gardens and Plantations.

Vol. III.

HOPE GARDENS, JAMAICA:

1905

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COTTON CONFERENCE IN JAMAICA.

The Conference arranged by the Board of Agriculture to meet Messrs. E. L. Oliver and R. Stancliffe, the deputation from the British Cotton Growing Association, took place at the Institute of Jamaica on 29th November, 1904.

Among those present were His Excellency Sir J. Alexander Swettenham, the Hon. H. C. Bourne, His Grace the Archbishop, Hon. Lieut.-Col. Pinnock, Mr. H. H. Cousins, Hon. Dr. J. Pringle, C.M.G., Hon. W. Fawcett, Hon. T. H. Sharp, Mr. James Allwood, C.M.G., Mr. L. F. McKinnon, Mr. Upton, Mr. C. A. T. Fursdon, Mr. Warmington, Hon. H. Cork, Captain Egerton Eves, Hon. H. T. Ronaldson, Mr. A. W. Farquharson, Mr. R. A. Walcott, Mr. Broderick, Mr. J. Barclay, Mr. W. H. Johnson, and several other gentlemen interested in the cotton industry.

The Hon. H. Clarence Bourne, Chairman of the Board of Agriculture, occupied the chair.

Mr. Oliver said that was the first meeting which he had had in the West Indies without the presence of Sir Daniel Morris. He wished to convey to them Sir Daniel Morris' regret that owing to his long stay in England, his work in the West Indies had fallen into such arrears that it was impossible for him to accompany the members of the deputation to Jamaica.

The cotton industry of the West Indies had passed the experimental stage. It was undoubtedly a commercial success; more so, perhaps, in the other West Indian Islands than in Jamaica, where it was, comparatively speaking, in its infancy. Perhaps they in Jamaica could scarcely be said to be out of the experimental stage, but the progress which had been made in the other islands was simply phenomenal, and very great credit was due to Sir Daniel Morris and his staff on the one hand, and to Mr. Charles Wolstenholme, of the British Cotton Growing Association, on the other hand. The people of Jamaica had made more progress in this industry in two years than they might naturally have been expected to do in a life time. They had had the benefit of very sound advice and every word of that advice had been founded on the best possible experience of the United States.

Cotton was no stranger to these parts of the world, although it was a stranger perhaps to the present generation. During the American war there was a movement started here to resuscitate cotton growing, but it was given up. He did not think that that movement was so well organised as the present movement, and the circumstances were entirely different. At that time they had to deal with a state of affairs which was unusual and temporary. The present time was altogether different in this respect that the demand had been gradually overtaking the supply for some time and, therefore, there was much more hope of the present movement not proving merely a temporary one as the movement of 1862 1863, and 1864.

He believed that the firm which he represented in England was the first firm to use Sea Island cotton grown in the West Indies—at any rate during the present movement. That cotton possessed very good qualities and very bad ones, and he intended to be perfectly frank with them and to tell them how they found it from the consumer's point of view. Sir Daniel Morris met him in Manchester on the 4th of July and he and Sir Gerald Strickland asked him (Mr. Oliver) to come out to the West Indies and speak to the planters, telling them how the English people found their cotton, and what they wanted and what they did not want. After a great deal of consideration he consented to come to the West Indies, and he was exceedingly glad that he had come. If he was only able to teach as much as he had learnt, then he thought he would have done a little good by coming out.

The chief difficulty they had with the West Indian cotton was its mixed character—long and short, coarse and fine, strong and weak cotton, all in the same bag and, if it had not been for the interest taken in the West Indian cotton by Mr. Charles Wolstenholme in assorting them, it was doubtful whether they would have been used at all. Mixed cotton was very unpopular, and if it had not been that the last year was a time of phenomenal scarcity of cotton it was probable that this kind of cotton would not have been tried—at any rate by the general market.

He had been greatly interested in cotton experiments, and he had used Sea Island cotton grown in Fiji, Tahiti, Solomon Islands and other places, and he had also used Sea Island cotton, grown in Egypt; and he and others had found that there was a considerably larger amount of waste in the West Indian cotton than in cotton grown in the American Sea Islands and the other places mentioned. The percentage of waste in the West Indian cotton was 11 per cent. greater in some instances. Instead of getting 60 lbs. of cotton yarn out of 100 lbs. of cotton they got less than 50 per cent. This was caused almost entirely by the presence of unripe fibre, and they should be careful not to pick the cotton until it was properly ripe.

In Barbados, St. Vincent, St. Kitts, and Nevis, they had been examining cotton which had been ratooned and they had come to the definite conclusion that if they wanted to make a success of cotton growing they must not allow it to ratoon. They must not attempt to grow together two crops from the same seed. They must plant fresh seeds every year.

Another point he wanted to call to their attention was that in other islands they would not grow cotton in the same ground two crops in succession. They grew cotton on certain lands in one year and something else in the next year. He thought that was a wise decision.

He had been asked whether Egyptian cotton was the best to grow here. For Egyptian cotton there was an absolutely unlimited demand but whether it would pay them to grow it he did not know. What they would receive for Egyptian cotton would not be more than one half, if as much, as what they would receive for good cotton grown from such seeds as the Imperial Department of Agriculture secured from Mr. E. L. River's estate of last year. He should be sorry to discourage experiments made with Egyptian cotton. They were discouraging them in the smaller islands because of the risk of mixing the seed, but Jamaica was big enough to try the experiments with regard to Egyptian cotton. An important point which he desired to bring home to them was that if they were growing Egyptian cotton then it should be confined to a certain area.

They must most carefully avoid mixing the seed of long staple and short staple cotton, and if through any cause whatever after selecting the cotton seed, that grown on one patch should be inferior to that grown on another patch, then keep them separate; for, if you mix them you will only obtain a price equal to the worst cotton in each bag; and even then you will find it difficult to find a market for it, as a spinner will avoid buying mixed cotton if there is a plentiful supply on the market. Just as the strength of a chain is its weakest link, so is cotton only worth the value of the poorest cotton in the bag. If necessary the crops should be divided into three grades, and if that is done full market prices will be realized for each grade.

He had been asked to say if it was necessary to obtain fresh seed for the next season. Sir Daniel Morris and the Department were now engaged in making experiments to find out if it was necessary to import seed every year from the States. Personally, he did not think so. They, however, would have to await the result of the experiments.

He had also been asked whether it was not wiser to cross the native with the Sea Island variety to avoid insects and other pests. All he would tell them was if they gave up the idea of ratooning then they need fear no ravages from pests.

It was very essential to pick the cotton as clean as could possibly be done, and only to pick when the cotton was ripe. Pickers who picked clean ought to receive a higher scale of pay than those who brought in the cotton with chips and scale. The result of the chips and scale being left in was to spoil the cotton when it went into the gin.

With regard to baling it would be well if the cotton was baled so that it would arrive in the best possible condition. Some of the cotton from the West Indies was sent out in bales bound round with iron bands like Florida and Georgia Sea Island cotton, but he understood in some cases presses had been obtained for making up the cotton in bags without bands which will give the bales the same appearance as the cotton from Edisto and James Island. He did not think that a single planter in Edisto or James Island puts bands round his cotton, and to see bales with iron bands round them might lead some spinners to be suspicious lest they were buying Florida and Georgia Sea Island and not real Sea Island grown upon the islands.

Mr. Oliver then passed round samples of waste as it came from the cotton spinning factory in England, taken from Barbados, also samples of ladies gloves manufactured from cotton that contained cotton grown in the West Indies.

SOME QUESTIONS.

The Chairman said that if any one desired to ask any questions Mr. Oliver would be pleased to answer them.

Mr. Ronaldson said he would like to understand whether ratoon cotton was of no use and whether they were not to grow ratoons ?

Mr. Oliver replied that his advice was not to have anything to do with ratoons. The cotton yielded from them was weak and poor and would not find a market. As soon as the first crop was reaped the trees should be destroyed and fresh seed planted.

Mr. Ronaldson said if that was the case he did not see how it could pay. He had recently put in 25 acres and it had cost £4 10s. an acre. He did not think it could pay if they were not to use the ratoons.

Mr. Walcott said he would like to know if Mr. Ronaldson had taken into consideration the yield from the seed and other bye-products.

Mr. Oliver said that he knew two men in Barbados who made £10 an acre from their yield. He, however, repeated his advice against ratoons and pointed out that to establish a reputation, a regular standard quality will have to be maintained which can not be got from the cotton produced from ratoons.

Mr. Sharp said that with regard to the matter of ratooning he would like to say what was called a ratoon here was really not a ratoon. He knew of cases where two crops were grown in ten months. Except they were able to ratoon it would be a serious matter as far as Jamaica is concerned. Here the soil was different to most other places, as Mr. Cousins could tell them. He knew that as soon as the crop was ready all that was necessary was to gather the fruit and cut off the branches that had borne and get the next crop. He would like to know whether the tree was to be treated as an annual or whether the tree was to be destroyed after the first crop.

Mr. Oliver said of course the ratoon cotton could be grown and shipped but it would fetch a very much lower price, and in some cases remain unsold.

Mr. Oliver was asked what was the cost of picking, ginning and baling?

Picking, he said, was done in Barbados at ½ cent per lb., and ginning and baling, three half-pence a lb.

Mr. Oliver was also asked whether it was better to have a big ginning district or that each man should have a gin of his own?

A large place, he replied, was worked more economically than a small one. He did not think it would pay a man to have a gin of his own unless he had 500 acres under cultivation. In his opinion a Central Factory would pay best such as at Barbados.

The Chairman said he thought they had all the information they wanted from Mr. Oliver and there was nothing left but to thank him for his advice. He also thought they ought to place on record a vote of thanks to the British Cotton Growing Association for taking the interest they did in this matter. He desired in thanking Mr. Oliver to thank Mr. Stancliffe too. He took it that the Meeting agreed to pass both votes of thanks.

This was unanimously agreed to.

Mr. Stancliffe, in reply, said he was very pleased to be there that morning, and he desired to thank them all for the kindness shown to both Mr. Oliver and himself. Everywhere they had been to, they had received proverbial West Indian hospitality for which he desired to return his sincere thanks. He wished them all prosperity in cotton growing and assured them that if they treated it with the same kindness that they had treated them then it must be a success. He hoped their visit would result in a new era for cotton growing in the West Indies.

COTTON FROM RATOON PLANTS.

Mr. Oliver, the cotton expert, stated that cotton from ratoon plants grown in various places all over the world, showed great deterioration, the plants very soon reverting to the condition of wild cotton.

After seeing the plants growing in Jamaica, he allowed that what was called here first ratoons did not correspond exactly to proper ratoons, but appeared to be rather a continuation of the original growth.

In Barbados he stated the planters went on picking their crop during 3 months, but here the crop matured on the first branches at much the same time, and then a second series of branches grow from below the original set: these second branches were known here as first ratoons.

Judging from the small sample that he had seen, he was inclined to think that there was no deterioration in the lint for the so-called first ratoons, but this was a question which could not be decisively answered until he had seen a much larger quantity.

NOTES ON GRAPE VINE CULTURE.

By W. J. THOMPSON, F.R.H.S. Travelling Instructor and Superintendent Parade Garden.

On account of the unusual rains grape vines have made more growth than is good for them. To counteract the late excessive growth, people who possess only one vine, and wish it to give a good crop of fruit this year, should see that it is kept as dry as possible till about the middle of January, and also that it gets as much sunlight and air as can be given it. The reason for this is, that the past season's main growth of the vine may become quite ripe; for it is the good ripe wood of the grape vine that determines the amount of fruit, and not the pruning. If the wood is thick, enough and ripe, fruit will come in the spring, even if the pruning is not of the best description.

The above applies to vines that were not pruned late last year. Vines that have been ill-used by being pruned twice in the year should not be pruned again till late in the spring.

Grape vines should only get one general pruning each year, more than this is injurious to them.

People who have several vines with quite ripe wood, should have begun to prune in December and should prune one or two vines every fortnight so as to get a succession of fruit. With enough vines and proper treatment, grapes can be had most of the year through.

From the time water is withheld from the vines, so as to ripen the wood, it should not be again given to the roots until about a week after the plants have been pruned, then the vines should be given an abundant supply of water so as to start them into growth. When the young growths are a few inches long, the vines should receive a supply of water at the roots like the other plants in the garden. It must be distinctly understood that while old vines will stand any amount of water at their roots, great care has to be taken in watering newly planted young vines, as they will die from being over-watered. When the fruit is beginning to ripen, water should be withheld from the roots. After the fruit is gathered, and if a second small crop should be coming on the lateral growths, the usual supply of water can be given. But care must be taken to see that the vines are not kept growing and fruiting for too many months in the year.

If a vine is restricted so as to have only one crop of fruit each year, it would be better for it and better for the owner.

When the vine has been pruned and started into growth care should be taken to see that as soon as the young growths are about four to six inches long that too many are not allowed to remain on the vine. This can be remedied by rubbing off the smallest growths with the thumb and fingers, and only allowing one good growth to grow from one section of the vine instead of three or four weak ones.

In pruning care should be taken that too many main growths are not left, so as not to get the vine overcrowded; and when the cut is made, see that it is close to one of the main stems.

I find that in some gardens when the plants have had plenty of soil and manure about the roots, that the vines have begun to fruit on the lateral branches. In such cases, it will be the wisest plan to dry the vines off for about a month by exposing the base of the plants and withholding water, then they should be pruned. If this fruit is allowed to remain on and ripen the vines will not be able to form good new wood for another year.

NITROGEN IN AGRICULTURE.

Extract from an Address by DR. SOMERVILLE, at the British Association.

The Chemical Fixation of Atmospheric Nitrogen.

It has for long been the dream of chemists to discover, or welcome the discovery of, a chemical process, capable of industrial application, by which the nitrogen of the air could be made available to replace or to supplement our rather limited supplies of nitrogenous manures. In his Presidental Address, Sir William Crookes had something to say on this fascinating subject, and looked hopefully to electricity to solve the problem. He pointed out that with current costing one-third of a penny per Board of Trade unit a ton of nitrate of soda could be produced for £26; while at a cost of one-seventeenth of a penny per unit, a rate possible when large natural sources of power, like Niagara, are available, the cost of such artificial nitrate of soda need not be more than £5 per ton.*

Dr. von Lepel, in giving an account of recent work on this subject to the winter meeting of the German Agricultural Society in February of this year,† puts the cost of electric nitrate, as compared with Chili nitrate, in the proportion of 24 to 39, which is in close agreement with Sir William Crookes's estimate. Lepel points out that the material obtained, neutralised by some alkali, consists of a mixture of nitrate and nitrite. When used in potculture experiments it has given results closely agreeing with those furnished by Chili nitrate.

Good progress would also appear to have been made in another direction in the commercial fixation of atmospheric nitrogen, and a short account of the results was communicated by Prof. Gerlach, of Posen, to the meeting of the German Agricultural Society already referred to, and is published in the same issue of the *Mittheilungen.*

When air which has been freed of oxygen is conducted through finely disintegrated calcium carbide at a high temperature, one

* Crookes, "The Wheat Problem." p. 47,

† Dr. von Lepel, Neuere Versuche zur Nutzbarmachung des atmosphärischen Stick. stoffs durch Elektrische Flammenbogen," *Mitteil de Deut. Land. Gesell., 1904, Stuck 8*

atom of carbon is displaced by two atoms of nitrogen, and calcium cyanamide ($CaCN_2$) is formed. This substance is also produced when a mixture of lime or chalk and charcoal is heated to a temperature of 2,000° C. in a current of air.* When pure, this substance holds 35 per cent. of nitrogen, but in its crude commercial form it contains only about 20 per cent. Treated with acids, calcium cyanamide is changed into dicyandiamide, a substance holding nearly 67 per cent. of nitrogen, but directly poisonous to plants. Or, if heated in superheated steam, calcium cyanamide parts with all its nitrogen as ammonia, which, of course, is easily brought into a portable form.

But experiments conducted at Posen and Darmstadt during the past three years, both in pots and in the open field, have shown that calcium cyanamide itself is a useful nitrogenous manure, field experiments giving results about 20 per cent. below those obtained by the use of an equal amount of nitrogen in the form of sulphate of ammonia. In prepared soil in pots the results fully surpassed those obtained both with nitrate of soda and sulphate of ammonia, the less satisfactory yields obtained in the field being perhaps due to the organic acids inducing the formation of a certain amount of the poisonous dicyandiamide.

So far as one may judge from the information available, it would appear that agriculture will not have long to wait until it is placed in the possession of new supplies of that most powerful agent of production, nitrogen, and Sir William Crookes will see the fulfilment of his prediction that "the future can take care of itself."

Nitragin.

A few years ago much interest was excited in this and other countries by the announcement that the scientific discoveries of Hellriegel and Wilfarth had received commercial application, and that the organisms of the nodules of the roots of Leguminosæ could be purchased in a form convenient for artificial inoculation. The specific cultures placed upon the market were largely tested practically and experimentally, but the results were such as to convince even the patentees, Nobbe and Hiltner, that the problem which promised so much for agriculture had not been satisfactorily solved. Since that time however, investigators have not been idle, and the present position of the subject is to be found in a recent report by Hiltner and Störmer.†

It was early recognised that the organisms (bacteria) which inhabited the root-nodules of the various species of Leguminosæ were not all alike, and that, in fact, they showed marked physiological if not morphological distinctions. Any particular species of leguminous plant is found to resist more or less successfully the attempt of these various organisms to effect an entrance into its

* Bull. *Imp. Inst.* June 30th, 1904.

† "Bericht über neue Untersuchungen über die Wurzelknölichen der Leguminosen and deren Erreger," *Arbeiten aus der Biol. Abteil. für Land-und Forstwirtschaft am K. Gesundheitsamte,* Band iii. Heft 3.

root-hairs, and according to the power of the organism to gain access, and to establish colonies, so is the particular plant benefitted and the stock of fixed nitrogen increased. This power of the adaptability of the organism is designated its " virulence," a term, however, which is perhaps hardly suited to our English mode of expression, though it may for the present be retained. It has been found that organisms of what is called "high-virulence" are capable of entering with ease the root-hairs of vigorous plants at an early stage of their growth, and of inducing the formation of nodules that are large, numerous and placed high up on the roots. Organisms of low virulence, on the other hand, can only enter plants of feebier growth, or plants that have passed the most vigorous stage of youth, so that the nodules, in this case, are small and scarce, and distributed, for the most part, near the ends of the roots. The practical object, therefore, would appear to be the breeding of strains or varieties of organisms of high virulence, adapted to the symbiotic requirements of the various important species of farm and garden leguminous crops.

The nitragin put on the market a few years ago was used in two ways, being either applied directly to the fields, or mixed with water and brought into contact with the seed before sowing. Under the former method of procedure an increase of crop was obtained only when the nitrogin was used on land containing much humus. The explanation given for failure under other conditions was that the bacteria artificially introduced perished for want of food before the leguminous seed germinated and produced plants.

Failure of the nitrogin to effect an improvement in the crop when it was sprinkled on the seed is now believed to be due to the action of secretions produced by the seed in the early stages of germination. These secretions are found to be rich in salts of potash, and when brought into contact with the bacteria in question they induce changes allied to plasmolysis, and these changes are subsequently followed by death. This difficulty was found to be got over by moistening the seed and allowing it to sprout before the nitrogin was applied; but manifestly such a procedure would always be difficult, and often impossible, to carry out in practice. The object, however, would appear to have been gained in another way, namely, by cultivating the bacteria in a medium that imparts to them the necessary power of resistance. Such nourishment may take various forms, but that which gave the best results consisted of a mixture of skim milk, grape sugar and pepton, and it is in this medium that the organisms of the nitrogen now distributed are cultivated.

Early in the present year the new nitragin was being offered free of cost to all members of the German Agricultural Society on the condition that it was used in accordance with the directions that accompany it. In consequence of the large demand the free offer was in April withdrawn, but the substance may be purchased from Prof. Hiltner, of Munich, in quantities sufficient to treat the seed of a half to one acre at the price of one shilling. The United States Department of Agriculture are so convinced of the practical utility of the improved nitragin that they are distributing large quantitles to American farmers. In this way the material will be thoroughly tried in two hemispheres under practical conditions, and abundant evidence should soon be forthcoming as regards its effects. It is to be hoped that British investigators will not be deterred by past disappointments from putting the new form of nitragin to the test.

THE AGRICULTURAL EDUCATION CONFERENCE AT GLOUCESTER.*

Under the auspices of the Gloucestershire County Councll, a conference on agricultural education was held at the Shire Hall, Gloucester, on October 15. There was a large attendance not only of those locally interested in either education or agriculture, but also of delegates from many of the other counties. After a few preliminary remarks from the Chairman, Sir John Dorrington, Lord Onslow opened the proceedings, and explained the work his department was charged with in regard to education. He justified the retention of that work by the Board of Agriculture ihstead of allowing it to be merged in the general educational system administered by the Board of Education, on the plea that agriculture in England was so far from being the leading industry that the specialised education it required would get scant attention were there not his own department peculiarly interested in fostering it. He claimed that the constant and sympathetic communication between the two departments secured more favourable results than could be acquired under the Board of Education exclusively. The work of the Board of Agriculture was confined to assisting the collegiate centres under which the greater part of the country was now grouped; there was, however, a large blank on the educational map, for the whole of the west country, including Gloucestershire itself, had no centre of university rank from which agricultural instruction emanated. He trusted that the present conference would pave the way towards remedying the need he had indicated.

Sir William Hart-Dyke, to whom the first paper, on higher agricultural education, had been entrusted, was unable to be present; his paper, of which an abstract was read, warned the meeting of the difficulty that now confronted all countries in the matter of higher education because of the great draft on their funds for the future training of elementary schoolmasters.

A paper by Prof. Middleton, of Cambridge University, next dealt with the proper function of experimental plots in local agricultural education; Prof. Percival, of Reading, who followed, dealt with the ideal course of instruction in an agricultural college. The

*From "*Nature*," *October 20, 1904.*

current courses, he maintained, were far too scientific; chemistry, botany and kindred sciences should be reduced to a minimum in favour of work on the farm, a thoroughly popular programme which appealed to the "practical men" in the room.

Lord Monteagle then opened the second part of the proceedings, on the education of the small farmer, with an account of the way the Irish Board of Agriculture had gone to work.

In Ireland the central authority administered the larger part of the fund, contributing five-ninths of the cost of any work, and securing four ninths from the local authority; thus the organisation proceeded more evenly over the whole country than in England, where the initiative rests with the local authority. Next, they had proceeded in Ireland on the principle of establishing no institution until they had created a demand for it by means of pioneer lecturing and demonstrations. Lastly, in Ireland they believed that the industrial organisation of the farmers must go hand in hand with their education.

Prof. Wallace, of Edinburgh, who followed dwelt on the necessity of beginning an agricultural training at an early age, so far as practical work on the farm went, leaving the true technical instruction to come when the lad had matured. Mr. Frederick Verney also dwelt on the harm that was being done to country children by keeping them at unsuitable school subjects until they had lost all taste for farming pursuits; the present system of elementary education contributed both to the depopulation of the country and the overcrowding of the towns.

Mr. H. Hobhouse, M.P., spoke on the value of attaching agricultural sides to the ordinary country grammar schools the training would not be technical, but scientific with an agricutural bias.

After lunch Mr. Morant expressed his pleasure at the opportunity the conference afforded him of learning the feelings of the great agricultural community towards the educational system of the country. He assured the meeting that the Board of Education was wholly anxious to assist, provided the men who represented agriculture on such occasions would make their views precise, and, instead of grumbling at large, would indicate exactly what worked harshly or harmfully in the present arrangements controlled by the Board of Education.

A paper by Sir C. Dyke Acland was then read in his absence; it dealt with the education of the labourer, and was, like so many that followed, a plea for more intelligent teaching in our elementary schools, and for a more flexible system which would partially liberate boys at an earlier age for light work on the farm. Mr. G. Lambert, M.P., and Mr. Martin F. Sutton emphasized this point of view, and, like Mr. Acland, they agreed that in the main rural labour difficulties had been caused by keeping the rate of wages too low, with consequent loss of efficiency.

The last section of the conference, on the education of the teacher and expert, was opened by Mr. A D Hall, who pleaded for a more rigorous training which should include some experience in farming for the teacher of agriculture, and some work at research for the man who dealt with agricultural science. Canon Steward, principal of the Salisbury Training College, discussed more generally the education of the elementary schoolmaster and mistress in country districts, and finally Mr. R. P. Ward gave an account of the way the teachers were being trained in Cheshire.

In the discussion which followed most of the speakers urged the substitution of winter schools or of evening continuation schools for the compulsory attendance of country boys at school up to the age of fourteen ; for farm purposes a boy ought to begin light work on the farm at the age of twelve at latest, though his education should go on much later than it does now.

The conference was noteworthy not only for the quality of the papers read, but for the advance they showed in the direction of organisation on those submitted to previous conferences. It was made clear that there are several different classes to be provided for ; the large farmer's son or future land agent wants a different equipment from that of the small holder ; the farmer himself must be reached by an entirely different method ; the labourer, again, has to be treated separately. At Gloucester the various speakers defined clearly their aim and their method ; in former gatherings of the same nature the speakers seemed to consider there was only one kind of worker engaged in agriculture.

THE HEATING OR FERMENTATION OF HAY.*

It is well known that when hay which is not quite dry is placed in a shed or stack, spontaneous generation of heat takes place. It has generally been held that this action is entirely due to the work and activity of bacteria, but recent investigations by Boekhout and Vries at the Agricultural Experiment Station of Hoorn, in Holland, appear to prove that the fermentation of hay is a purely chemical process, and is quite independent of the work of living organisms. They ascertained the temperature of haystacks in which heating was manifestly taking place, and found that it might considerably exceed 200 degrees F. As compared with ordinary hay which had not undergone much fermentafion, heated hay was found to contain a larger percentage of albumenoids, woody fibre, and fat, but a smaller quantity of sugar and starch. Furthermore, the heated hay was markedly sour, owing to the presence of considerable quantities of formic acid.

The investigators then proceeded to construct an apparatus which enabled them, through the agency of steam and air, to reproduce very closely in the laboratory the changes that take place in the haystack. The hay was kept under treatment for twenty days, at the end of which time the material smelt exactly like hay

* From *Centralblatt fur Bakteriologie. Parasitenkunde u. Infektionskrankheiten.* September, 1904. *Journal of Board of Agriculture*, London.

that had fermented in a stack, and when subjected to chemical analysis it showed precisely the same changes as were found to have taken place in hay which had heated naturally. The temperature of the receptacle in which the artificially heated hay was kept was never less than 203 degrees F., so that the conditions were such as to preclude the activity of living organisms. In order, however, to verify the result, hay was sterilised at a temperature of 248 degrees F., and this material also, when put through laboratory treatment, attained the same condition and composition as heated hay from a stack.

The investigators are therefore perfectly confident that they have proved satisfactorily that the fermentation of a hay stack is in no way associated with the activity of living organisms, though they do not yet feel justified in attempting to offer an explanation of the causes that induce the high temperatures which are met with in the interior of a mass of fermenting hay. As they consider that they have shown that this form of so-called fermentation is purely chemical, they are disposed to cast doubts on the necessity of any bacterial action in the case of many other similar processes, as, for example, in the maturing or fermentation of tobacco.*

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, VI.†

(*Continued from Bulletin for December, 1904.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

THE CULTURE OF CASTILLOA.

In attempting to plan a rational culture for Castilloa it will be worse than useless to insist upon all or any of the cultural measures which have been found desirable with coffee, cacao, or other tropical crops. Castilloa is not cultivated for the leaves like coca, for the flowers like cloves, for the fruits like oranges, nor for the seeds like coffee. The increase of the size of the trunk and of the amount of milk contained in its inner bark are objects of cultural solicitude.

SHADE IN THE CULTURE OF CASTILLOA.

SHADE NOT A NECESSITY.

Much of the preceding discussions of the habits of Castilloa and of the climatic conditions suitable to its culture may also serve as preliminary to the consideration of the question whether planta-

* Dr. Loew, under the direction of Prof. B. T. Galloway, chief of the Division of Vegetable Physiology & Pathology, U. States Department of Agriculture has investigated the curing and fermentation of cigar leaf tobacco. The result of his work is to show that the principal changes that take place are due to the action of soluble ferments or enzymes, not bacteria; and that the development of colour and aroma is due principally to the action of oxidizing enzymes. (*Misc. Publications*, No. 52, 1899.) [Editor.]

† Extract from U. S. Department of Agriculture. Bull. No. 49, Bureau of Plant Industry.

tations of Castilloa require the shade of larger trees or may be exposed to full sunlight. The argument that Castilloa always grows in shady locations in nature is by no means conclusive, since it is well known that many forest trees thrive better when they have the opportunity of standing alone and are free from the close competition for food and sunlight implied by forest conditions. It is also certain that Castilloa is not only able to obtain an existence in the open, but that it makes much more rapid growth quite without shade than it does in the forest. If the problem were merely to secure the quick growth of Castilloa there would be no hesitation between these two methods of planting; but there are many stages between dense forest and clean culture, and the question may well be raised whether the conditions most favourable for rubber production are not to be found in some of these. Advocates of both extremes and all intermediate conditions are not lacking, so that the question of shade with Castilloa bids fair to become as complicated and as extensively debated as with coffee and cacao. Moreover, as with those crops, it may be found to have no general solution, but to depend upon local conditions of soil and climate.

That rubber can be grown under forest conditions there can be no doubt, since all the natural supplies are to be credited to this method of production, but the desirability of forest planting does not necessarily follow, since it is equally certain that under the deep shade the trees grow with an extreme slowness, which would exhaust the patience of any investor. Moreover, as previously shown, it may well be doubted whether a plantation of Castilloa would ever grow to normal maturity in the undisturbed forest; the indications are that only those trees survive which are able to profit by accidents to their larger neighbours and thus receive more sunlight than usually reaches the undergrowth of a dense tropical forest. In other words, regular forest planting does not mean the placing of Castilloa under conditions most favorable to its growth in nature; these are more nearly attained when the forest is thinned out or partly cut away.

Koschny, who distinguishes four kinds of Castilloa in Costa Rica, says that the "hule blanco," or white Castilloa, is the only one adapted for cultivation, and that this is never found in the deep forest, but in more open places, where the foliage has access to the sunlight.

Experiments with forest planting were studied in eastern Guatemala and in Southern Mexico, and in both instances the young trees were at an obvious disadvantage in comparison with others planted at the same time in more open situations. Many individuals had hardly grown at all in six months and many had died. On the other hand, it should be explained that the trees, while they had no shade overhead were not exposed to the extent which might be implied by the term "open culture," since they stood in a clearing only a few acres in extent. The neighbouring forest gave shade in the morning and afternoon, and the atmosphere was undoubtedly kept far more humid throughout the day than would be the case in a large tract of unshaded land baked by the tropical sun. They were also undoubtedly assisted by a mulch of dead leaves and brush. Trees 12 feet high were said to be only 1 year old.

It would seem, then, that one of the extreme suggestions—the planting of rubber in the undisturbed forest—is clearly inadvisable and may be dismissed from further consideration. The other extreme—clean culture—is not so readily condemned as impracticable, since observations in southern Mexico establish the fact that even single trees, standing in the open sun and with little other vegetation near them, are not only able to survive six months of dry weather, but actually remain more leafy at the end of the dry season and thus appear to suffer less from drought than those on land covered with weeds and bushes. The reason for this apparent anomaly may not be difficult to conjecture, since it is plain that a tree standing in cleared ground has a monopoly of all the moisture which rises in the soil, and may thus have a distinct advantage over one obliged to share a similar supply of water with a tangled mass of other plants which expose to the atmosphere a total leaf surface many times that of the young rubber tree. Moreover, it is also clear that the water required to supply the needs of this large amount of vegetation would greatly exceed that which escaped from the exposed surface of the soil. It is even doubtful whether a covering of low vegetation greatly checks the evaporation from the soil; it may be as great or greater than where the surface of exposed soil is loosened by stirring and thus forms a layer which hinders the access of dry air and is a nonconductor of heat. In previous discussions of shade in the culture of Castilloa this distinction between open culture and clean culture seems to have been overlooked, and the question of shade has continued to be confused with that of water supply. The statements of various writers that the leaves are unable to withstand exposure to the full sun because of their delicate texture are quite erroneous. The tree needs sunlight, and it is benefited by it as long as the water supply is sufficient, but when this becomes deficient the leaves shrivel. The light is no brighter and the temperature no higher in the dry season, which in Mexico occurs in the winter months; but the dry atmosphere demands more water, while the soil supplies less.

The rapidity with which dry atmosphere takes water from a plant may be judged by the promptness with which the leaves of a broken branch wilt and shrivel, and this happens very promptly with Castilloa. Many plants have developed no expedients for resisting evaporation and are accordingly confined to continuously humid regions, but Castilloa, as has already been seen, is adapted in several ways for resisting drought. The leaves themselves are, it is true, of rather loose texture and have only the slight assistance of the hairs of the lower surface as a protection against excessive transpiration. The leaves suffer when they are obliged to part with more water than they can obtain, and their falling off is then an advantage because it decreases the demand for water. Thus, although Castilloa is not a desert plant, the falling of its leaves in the dry season is the same physiological phenomenon which appears so conspicuously in deserts, viz., the loss of the leaves as a protection against drought. Many desert plants such as Parkinsonia, Fouquieria, Peireskia, and species of Euphorbia put out leaves for the wet season only, while most of the Cactaceæ and many Euphorbias have discarded leaves entirely and expose as little surface as possible to the air.

This digression may help to make it apparent that the planter who desires to give intelligent consideration to the agricultural question of shade should dismiss the notion that the rubber tree derives a direct advantage from standing in the shadow of another tree, on the contrary, it is probable that interference with the sunlight is always a direct disadvantage. Shade, if used at all, is to be applied and justified on the ground that it will preserve the moisture of the soil or of the atmosphere or serve some other cultural purpose. By conserving the soil moisture, clean culture may produce some of the desirable effects commonly ascribed to shade. Open culture may be, and probably is, less advisable than either clean culture or a moderate shade culture.

Open culture with relatively little cleaning at first would be more practicable if the weeds and undergrowth cut down in the dry season could be left spread over the ground. This would do more to conserve the moisture of the soil than the same vegetation alive, but the danger of fire will in moist localities forbid the use of this method of culture.

If the present question could be settled by deciding whether or not Castilloa needs to be protected from the sun, it would be easy to establish the negative view; but with shade recognized as a means of influencing natural conditions of soil or climate it becomes evident that each planterwill need to use his best judgment in determining what local conditions require. In Costa Rica, Koschny advises the thinning of the forest by the removal of two or three trees out of every five. At La Zacualpa more are cut out. Some of the planters on the Isthmus of Tehuantepec practice clean culture. No general principles will determine which is best, because no one method is applicable everywhere.

RELATIVE COST OF SHADE CULTURE.

It must be remembered, in addition, that the planter finds himself compelled to decide not what will be the best for the rubber trees, but what is the best he can afford to do for them. Is it, for example, good policy to use labour and capital in keeping a tract of planted land clean, or will more be gained ultimately if one contents himself with somewhat slower growth and improves the opportunity of planting additional tracts with trees that can also be growing? Careful comparative experiments might be necessary for an answer, and this might differ for different localities.

EFFECT OF SHADE ON FORM OF TREE

There are great and persistent differences of shape or "habit" among trees. The Lombardy poplar and the weeping willow are not distant relatives. It is a general fact, however, that forest trees are taller and more slender than those of the same species grown in the open. The low spreading habit, which is desired and encouraged among fruit trees, is not desirable in rubber-producing species, where a large expanse of trunk is needed to supply the milk and to give opportunity for tapping without the necessity of wounding the same place too often. Castilloa trees growing alone in the open often send out permanent branches 8 or 10 feet from the ground, while those in the forest may have from 20 to 40 feet of smooth trunk before the permanent branches are reached. Open-grown trees may have large spreading branches, while in the forest or under close planting the main axis of the tree continues to grow upward and the lateral branches are relatively small.

The problems of rubber culture may prove in this respect to be directly opposite to those of coffee, where the formation of much wood in proportion to leafage is a sign of unfavourable conditions or of bad plantation management. It does not follow, however, as some have seemed to suppose, that forest shade is necessary to grow long-trunked trees. In coffee culture it is plain that the most wood is formed not by shade culture, but by planting close in the open, and the older-planted trees of Castilloa at La Zacualpa, if not as slender and as smooth-trunked as those of the forest, are certainly tall and slender enough to furnish ample evidence that open culture does not cause a low, spreading growth, if the trees stand close enough together. The Zacualpa experiment is of further significance in this connection, because it shows that a harmful degree of crowding was by no means reached. In numerous instances where from three to five trees grew in a cluster their trunks were each equal in size to those of many of their neighbours which stood alone.*

Coffee trees which stand too close together lose the use of their lower branches, which become interlaced and shade one another, and ultimately only the top of each tree continues to grow and produce fruit. The planter must choose a middle course between the injury of his bearing trees by crowding and the waste of capital and labour in keeping clean unused land between trees planted too far apart. With the rubber tree the seed is a consideration entirely secondary to the growth of the trunk. In comparison with coffee it may be said that the crowding of rubber trees is desirable, and that it finds its limit, not in the discourage-

* Planting in clusters might be advisable on some accounts, since the trees would better shade their trunks and the ground under them, but the difficulty of properly tapping such trees would seem to exclude this method of culture.

ment of lateral branches, nor even in the lessening of the size of the individual trees, but in the decrease in the amount of rubber which can be produced on a given area of land.

SHADE AND RUBBER PRODUCTION.

The general question of shade can not, however, be treated as closed until its influence on the yield of rubber has been tested by careful experiment. From the facts given on previous pages it appears very improbable that less rubber will be formed in the open than under shade; the difficulty, if any, is likely to arise in connection with the extraction of the rubber. The desirability of tall trunks to afford a large tapping surface has been noted already, but there may be other disturbing factors. The pressure of the liquids inside a tall columnar trunk may be greater than if it were thicker and shorter, so that more milk would be forced out on tapping. The bark of trees more exposed to wind and sunlight becomes thicker and there may be differences in texture which would affect the flow of milk. The air is much dryer outside than inside the forest, and this might soon impede the flow of milk, though this suggestion seems to be negatived by the fact that milk flows more freely from wild Castilloa on the dry Pacific slope of Mexico and Central America than in the more humid districts of the Atlantic side.

A recent writer on the shade question claims to have discovered that, while planting under partial shade hinders the growth of the trees, it greatly increases the yield of rubber. The managing director of a rubber plantation operating in Mexico writes as follows to the India Rubber World:

> We are planting in the partial shade; a great many planters are planting in open sunlight. My honest opinion is that every one who has planted in open sunlight will get a tree 50 per cent larger in five or six years than we in the partial shade. On the other hand, we will get from 60 to 75 per cent. more rubber from a small tree than they do from a large one. About three months' careful study was made of this proposition; the trees were tapped both in the shade, partial shade, and open sunlight, and the results carefully tabulated by a committee of which I was not a member.

It is easy, however, to understand how such an opinion could be formed if the experiments in tapping were made at a time when the trees planted in the open were drier than those in the shade, and such a difference would be especially pronounced in young trees. This observer did not find that the milk was richer in rubber in the shade, but merely that at a certain time more milk flowed from the shaded tree than from the unshaded tree. This would not, however, be an argument for shade planting unless it were shown that the unshaded trees would not at any other time yield more milk. It is quite probable that shaded and unshaded trees might need to be tapped at different times to secure a maximum flow, or it might be found that unshaded trees could be tapped with impunity more frequently than the others, and thus afford a larger annual yield. The flow of milk does not depend so much upon the amount in the tree as upon the pressure existing at the time the tree is tapped. The indications are that pressure attains its greatest intensity in trees which are exposed for a part of the time to a relatively dry atmosphere and which are accustomed, as it were, to pump water rapidly to supply the leaves. Such trees may, on the contrary, yield no milk at all when the water supply is deficient. It may be expected, therefore that open culture will require much more careful attention to the time of tapping. This may prove a disadvantage if it requires all the trees of a large plantation to be tapped on the same day or in the same week, but this is not likely. On the other hand, tapping at the right time would mean the drawing of a larger amount of milk from a smaller cut, a saving of labour, and a lessening of injury to the trees.

The above considerations make it easy to understand also that writers acquainted with humid districts commonly refer to the rubber harvest as occurring in the dry season, while in the drier regions, as in Soconusco, the beginning of the rainy season is the recognized time, when the tree's demand for water is largest and the internal pressure highest.

LEGUMINOUS SHADE TREES TO BE PREFERRED.

Where the policy of thinning out the forest is followed the question arises as to which trees are to be left and which cut down. A study of coffee and cacao culture has revealed the probability that much of the benefit ascribed to shade is due in reality to the nitrogen furnished by the bacteria of the root tubercles of the leguminous trees which are preferred in all countries where the shade culture of coffee has become popular. If shade trees are to be planted with rubber, they must be different from the species of Inga which are preferred for coffee shade in Mexico and Central America, for the reason that Castilloa grows faster than Inga. Some leguminous trees, however, grow with great rapidity and may be able to outstrip the rubber. No comparative experiments seem to have been made. If, as suggested above, shade trees are more useful as windbreaks than for the shadow they cast on the rubber, the planting of fruit trees like the mango or other useful species in rows or hedges would be preferable to scattering them amongst the rubber.

DISTANCE BETWEEN TREES.

As yet there have been no experiments yielding any definite information on the above point, but the recent trend of opinion among planters seems to be distinctly in the direction of closer planting. There has been a gradual decline from 20 feet and upward between trees to 12 feet and under.

The questions of shade and of distance between trees are closely related and need to be considered together because several of the arguments for shade can be met, wholly or partially, by close planting. The first of these is that of the greater expense incidental to open culture. The frequency with which the land requires to be cleaned and the period of years during which it would be necessary to continue such cleaning depends largely upon the amount of overhead shade present to discourage the undergrowth. Some planters on the Isthmus of Tehuantepec are evidently taking advantage of this fact and are setting close, with the intention of removing alternate trees before they are large enough to injure their neighbours by crowding; and it is expected that if they are "tapped to death" they can be made to yield enough rubber to more than cover the expense of planting. At least there seems to be no reason why, if the land is to be cleared, it should not be made to produce as much rubber as possible instead of being planted with useless trees for a purpose which can be attained quite as fully by setting the rubber trees closer together.

There is danger, however, that any suggestion which promises earlier returns from rubber culture will be overdone. The rubber of very young trees is of low grade and expensive to collect; also it would be very poor policy to risk permanent injury from weak spindling growth, which overcrowding would undoubtedly cause. More is likely to be lost than gained by trees standing at less than 8 feet for even a few years. Better than uniform close planting would be to set the north and south rows farther apart than the trees in the rows. With a given number of trees this would secure the maximum of shade on the ground, because the morning and afternoon sun would not shine down the rows. The cleaning of the land or the cultivation of a catch crop or a shade crop between the rows would also be facilitated. The distances would depend on the size which the Castilloa trees were expected to attain in any given locality, the rows from 12 to 20 feet apart, the trees from 8 to 12 feet in the rows being fair average estimates.

(*To be continued.*)

BOARD OF AGRICULTURE.

A Special Meeting called to consider the matter of the Locked Still at Denbigh Estate was held on 1st November, 1904. Present: the Hon. Colonial Secretary, Chairman; the Director Public Gardens, the Chemist, His Grace the Archbishop, the Hons. T. Capper, J. V. Calder and H. Cork, and the Secretary, John Barclay.

Resignation of Mr. Sharp.—Mr. Cousins asked if he might put forward a special matter, as it was urgent. This was the resignation of Mr. T. H. Sharp, jr., Superintendent of Manurial Experiments, who asked permission to leave on November 15th. To fill the vacancy, the name was suggested of Mr. P. W. Murray, son of Dr. Clark Murray of Brown's Town, who had been through a five years' course at an Agricultural Institute in Virginia. The Chemist was directed to bring the name of Mr. Murray before the Government with a view to asking him to act temporarily as Superintendent of Manurial Experiments at a salary of £100 a year.

Sugar Grant.—The Chairman said that he had satisfied himself that the disposal of the sugar grant was in the hands of the Board and that he ruled that the mere fact of the Board sanctioning the expenditure of £1,000 for new machinery was not sufficient to take out of their hands the power of allocating the details of the expenditure. It was in the power of the Board to determine that the money charged to the Sugar Grant for the Locked Still matter, on the responsibility of the former Chairman of the Board, should not be met from the Grant. In that case the Government could only ask the Legislative Council for a special vote for the purpose, and if the Council refused then Mr. Olivier would be personally responsible for the payment of the amount.

Locked Still.—The Secretary read a letter from Mr. Shore stating that he did not think the Meeting was in order in being called specially to consider a motion that would have come on the Agenda of the next Meeting, and that he was authorised by the planters of St. James and Trelawny to protest against the expenditure for the proposed Locked Still at Denbigh being paid from the funds of the Sugar Grant.

Mr. Cousins then gave full particulars as to the proposed Locked Still and submitted detailed plans and specifications, also estimates.

Mr. Calder protested against the manner in which the whole thing had been carried through and held that the experiment would be of no use whatever in checking the stealing of rum and he moved:

"That the Board acting under the powers conferred on it by Law 45, 1903 section 2, refuse to sanction any expenditure (for the purpose of erecting a Locked Still at Denbigh) of the funds placed under its disposal, until the plans and specifications have been submitted and approved by the Board."

And he further moved the addition—"That the Board do not approve of the plans and specifications now submitted."

Mr. Cork seconded.

The Archbishop said that there might be a way out of the difficulty if the expenditure could be shared equally between the Estate, General Revenue and the Sugar Grant.

The Chairman said that he could not agree to any charge on General Revenue.

The Chemist moved the following amendment:—

"That while this Board regrets that the full details of the installation of the Locked Still at Denbigh were not placed before them before the matter was put in hand, it is desirable, considering the expendtture already incurred, to proceed with the Locked Still at Denbigh and that the expenditure of £300 be authorised upon the estimates of the Sugar Fund for appliances and new apparatus for estates."

On being put to the vote the Chairman, the Director of Public Gardens, the Chemist, and the Superintending Inspector of Schools voted for the amendment, and Hons. J. V. Calder and H. Cork for the motion. The Archbishop abstained from voting. The amendment was therefore carried, by four votes against two.

The Chemist asked for authority for the expenditure of £120 from the Sugar Industry Fund, for the Sugar Laboratory Buildings; £66 8s. for apparatus and gas box and for the experimental distillery; £104 2s. for a Chattanooga Cane Mill, a pair of Cuban steers, 36 puncheons, 36 Racking Cocks, Barrel on wheels and Hose; also £120 for alterations and new plant for Estate Distilleries in connection with the Locked Still at Denbigh. This was granted.

The usual Monthly Meeting of the Board of Agriculture was held on 15th November, 1904, Present: the Hon the Colonial Secretary, Chairman, the Director of Public Gardens, the Island Chemist, His Grace the Archbishop, the Hons. T. Capper, and H. Cork, Mr. C. A. T. Fursdon, and the Secretary, John Barclay.

Cattle Disease—The Secretary read a letter from the Colonial Secretary that His Excellency was considering the question of legislating with a view to the prevention of the spread of epidemic diseases amongst cattle in Jamaica.

Importation of Cattle—A letter from Mr. Fursdon was submitted with regard to the prohibition of the importation of cattle from South America. It was stated that there is a law providing for regulating importation and that a proclamation prohibiting the importation of cattle from Central and South America is in force, dated 5th August, 1896.

Cotton Conference—A letter was read from the Colonial Secretary enclosing copy of a letter from Sir D. Morris announcing a visit to Jamaica of Messrs. E. L. Oliver and R. Stancliffe, a deputation from the British Cotton Growing Association, and asking that any facts and figures available in reference to the Cotton Industry together with samples of cotton should be collected to be put before them.

It was resolved to hold a Cotton Conference at the Institute of Jamaica on 29th November, and the Secretary was asked to issue circulars to all who were interested in cotton, to notify the Agricultural Society and local Agricultural Societies, and to get notices inserted in the newspapers calling attention to this Conference. He was also asked to endeavour to get the particulars and samples desired.

Agricultural Conference at Trinidad—The Secretary read a letter from the Colonial Secretary enclosing copy of a letter from Sir D. Morris, asking the Government to send representatives to Trinadad to take part in the Agricultural Conference in January.

The Colonial Secretary stated that His Excellency proposed to send Mr. H. H. Cousins, and the Board was asked to nominate a practical agriculturist on behalf of the Board of Agriculture.

Mr. Cousins asked if he could be excused because his work in connection with the Sugar Experiment Station would be most important in January. The Chairman said he would refer the matter to the Governor.

The Secretary was instructed to ask Mr. Shore first if he would act as the representative of the Board, and failing him Mr. Calder, Dr. Pringle or Mr. Cork. Mr. Cork promised to act if none of the three gentlemen named did so.

Tobacco—The Secretary submitted a report from the tobacco expert, Mr. F. V. Chalmers.

Water Buffalos—The Secretary read replies to his enquiries regarding the Water Buffalos—1 from the Department of Agriculture, U.S.A., with the information that the Water Buffalos were not in use in the United States, but were being used in the Hawaiian Islands on account of their value for work in wet and mud, in the cultivation of the rice fields; 2. from Mr. Meaden, Manager of the Government Stock Farm, Trinidad, giving particulars as to their use there and their cost, and giving reference to Mr. S. Henderson, Chaquanas, Trinidad, and Mr. B. de Lemarre, Orange Grove, Trinidad, who had herds of Buffalos. The Secretary was instructed to write these gentlemen for full information as to these animals and as to whether they could be procured in Trinidad and their cost.

Tourist Advertising Service—The Secretary submitted a letter from the Superintendent D. W. I. Cable Company, asking for a subscription to the Tourist Advertising Service. He was instructed to reply that the Board had no funds available for the purpose.

Chemist's Estimates—The Chemist submitted revised estimates of expenditure from the Sugar Industry Fund during the current financial year as follows:—

Authorised estimate 1904-5 ...		£1,400	0	0
Revised estimate for 1904-5 ...		1,055	16	8
Saving estimated	...	£344	3	4

He also submitted a Statement showing that the Public Works having executed the Laboratory and Distillery buildings as one operation, it was not possible for the Treasury to keep the account, as originally authorised under two separate heads. He therefore asked for authority for a re-casting of the original items to meet this difficulty without affecting the total sum involved. The Archbishop proposed and it was agreed, Mr. Cork alone objecting, that the proposal be adopted. The estimate of capital expenditure under the Sugar Industry Fund now read

1. *Buildings*—Sugar Laboratory, Fermentation Laboratory and Experimental Distillery £1,000.
2. *Fittings and appliances*—Sugar Laboratory, Fermentation Laboratory and Experimental Distillery £1,000.

Of these sums the Director of Public Works was authorised to expend a sum not exceeding £1,000 on the construction account, while the £1,000 for fittings and appliances is authorised subject to the authority of the Chairman.

The Chemist also submitted the Estimates of expenditure for

1905-1906 showing a total of £1,400 as authorised in the Scheme approved by the Governor in Privy Council.

The Estimates of the Director of Public Gardens and of the Government Laboratory were submitted.

Reports from Mr. W. J. Thompson and Mr. E. Arnett with reference to School Gardens were submitted.

Cotton.—The Secretary read a report on the Cotton Experiments and asked that the balance of eight out of ten grants be authorised to be paid. This was approved of.

Agricultural Instructor—A minute from Mr. Cradwick was submitted asking if he would be allowed to accompany the Cotton Experts if they visited St. Elizabeth where he could show them the various cotton cultivations. This was approved.

A letter from the Sav.-la-Mar Agricultural Society was submitted asking that Mr. Cradwick be permitted to act as Secretary of their Show under the special circumstances that no other experienced person was available this year. A minute was also submitted from Mr. Cradwick with reference to his acting as Secretary of a new Show to be held at Montpelier. It was agreed that Mr. Cradwick might act for this year, but that in future he is to consult the Board before undertaking such duties.

A letter from Mr. Cradwick was also submitted asking that he be allowed to change his residence from Ramble to Southfield so that he may give more attention to the cotton industry. It was pointed out that Southfield would be a most inconvenient centre for other parts of his district, and that it was 26 miles from the Railway. The proposed change was not therefore allowed.

Agricultural Education in Secondary Schools—The Archbishop reported that the Standing Committee on Agricultural Education in Secondary Schools had met and that he would submit a report later.

Teachers' Course—As regards the Teachers' Course at Hope Gardens and Mico College which was to commence on the 2nd January and last for four weeks, the Archbishop suggested that Mr. Fawcett form a Committee with Mr. McFarlane and Mr. Capper for carrying through the arrangements in connection with the Course. He asked that Mr. Fawcett would report at next Meeting. This was approved.

The following reports from the Chemist were submitted and directed to be circulated.

1. Progress Report—Field Experiments,
2. Arrangements with Estates for Sugar Laboratory.

The following reports from the Director of Public Gardens were submitted and directed to be circulated.

1. Mr. Cradwick's itinerary to the 23rd December and his visits for the month of October.
2. Hope Experiment Station.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

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EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

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Hope Gardens.

1905.

JAMAICA.

BULLETIN

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Vol. III. FEBRUARY. 1905. Part 2.

WITHER-TIP AND OTHER DISEASES OF CITRUS TREES AND FRUITS CAUSED BY COLLETOTRICHUM GLŒOSPORIOIDES.*

By P. H. ROLFS, *Pathologist in charge of Sub-tropical Laboratory.*

INTRODUCTION.

The group of diseases discussed in this bulletin was unknown in Florida until a comparatively recent time. ** At first recorded as of merely passing interest, the attacks of the fungus *Colletotrichum glœosporioides* have since increased in severity until they are now assuming serious proportions in various citrus crops. The amount of damage done by lemon-spot is often sufficient to eliminate the profits of the shipments in which the disease occurs. As wither-tip it repeatedly kills back the new growth of young trees until their vitality is exhausted. On large trees the small twigs are cut off, thus preventing the tree from producing the bloom necessary to set a heavy crop. As anthracnose and canker of lime it has caused an almost total destruction of the crop where the disease has gained a foothold.

The fact that the attack of this fungus manifests itself in various diseases has greatly complicated the work and added immensely to the labour of demonstrating its identity. The results of the microscopic work indicated that these various diseases—wither-tip, leaf-spot, lemon-spot, canker, and anthracnose—were produced by one species of fungus. It remained for cross inoculation with pure cultures to confirm this supposition. In most cases these cross inoculations took readily, while in others it was difficult to induce the fungus to make an attack. This was especially the case in attempting to produce lemon-spot. Infection at the stigma of lime blossoms is one of the inoculations most easily accomplished.

Leaf-spot is easily produced artificially on foliage infested with purple mites. To produce such an infection a leaf must be washed carefully to free it from danger of natural infection, and then

* Bn. 52, B. of Pl. Ind. U. S. Dept. of Agri.

** I have lately found this disease in Jamaica on limes. Editor, *Bulletin of the Department of Agriculture.*

spores from a pure culture should be applied to the epidermis, after which a moist atmosphere is necessary.

DISTRIBUTION OF THE DISEASES.

The diseases known as wither-tip, anthracnose, leaf-spot, and canker extend through a large portion of Florida, the West Indies, South America, Australia, and Malta, and it seems probable that they occur in all parts of the world where the orange is cultivated, especially in the more humid regions. The drier regions are more exempt from leaf and branch inhabiting fungi.

GENERAL METHOD OF ATTACK.

The initial lesion is usually at the tip or an edge of a leaf. More rarely is a leaf attacked at the midrib or some other interior portion. The part attacked becomes light green, then turns brown. Then the acervuli form; at first light brown, then dark brown or nearly black. They may develop on either surface and in various arrangements.

EXTENT OF INJURY.

All sizes of trees, from those located in the nursery (even seedlings in the seedling beds) to the oldest trees in a grove, are subject to attack. Budded trees less than a year old are rarely attacked except in the leaves. Where such infections are allowed to remain on the trees the diseased area extends into the growing twigs and causes the typical "wither-tip." In such cases the tip dies back for a distance, or the disease may go as far as the trunk and then stop. A bud below the diseased portion then pushes forward, but unless preventive measures are used the second sprout withers back like the first. In this way the disease may prevent the tree from making any growth, and even kill it in four or five years.

The initial attack in older trees is the same as in trees in the nursery rows. The fungus gains entrance to the tissues of the leaf and from this grows down into the fruiting twigs. This cuts off much of the younger growth in severe cases and thus prevents blooming to a large extent. Such cases are frequently mistaken for blight, but a more common error is to attribute the injury to die-back. It may be readily distinguished from blight by the fact that only small twigs die off, and these do so without any wilting of leaves. Even the leaves that are so badly diseased that they fall do not wilt, while in the case of blight the leaves wilt with no visible sign of injury. It may be distinguished from die-back by the absence of multiple buds, of gum pockets, or of dark excrescences. One or more of these characters always accompany die-back. Die-back twigs may be attacked by this fungus, but in such cases wither-tip must be regarded as the secondary disease.

This disease may be also present in a blighted tree. Any agency that lowers the vitality of a tree, whether fertilizer, weather, or condition of soil, predisposes it to an attack of wither-tip, but trees that are in the most healthy condition possible are also attacked when exposed to infection. The damage caused by this disease is very largely overlooked from the fact that it occurs upon the smaller twigs and is often attributed to other diseases, as previously stated. Wherever pruning is practised the infected branches are usually cut off before the nature of the disease becomes fully apparent.

VARIETIES ATTACKED.

All varieties and species of citrus trees and fruits cultivated in Florida are more or less subject to attack. Since the parts attacked and the parts most greatly damaged differ considerably, the measures adopted for relief must be varied according to the different diseased conditions.

LIME.

ANTHRACNOSE.

The lime is the most severely attacked of the citrus species. It sustains its greatest loss during the time of most rapid growth, which is usually during the spring and early summer. The effect of the fungus in the young growing shoots is somewhat peculiar, as it resembles the result of an attack from biting insects, and by many persons it is attributed to this cause.

The infection usually takes place at the axil of a leaf or some other place where the spores may find lodgment, and the fungus then cuts off the stem, causing the upper part to fall over and hang lifeless beside the other portion, or it may fall away; in this manner simulating the effects of insect depredations. In such cases gum quickly forms at the wound and prevents the fungus from forcing its way down the twig.

Besides the young growing twigs and leaves, the blossoms, the unopened buds, and the young fruit are attacked. When the fungus attacks an unopened bud the latter fails to develop and the entire outer portion becomes covered with spores. In the opened blossom the common point of attack is the stigmatic surface of the pistil. The fungus grows in the stigma and finally destroys the entire fruit; this, however, usually falls off before the fungus has time to penetrate below the calyx. By attacking the blossoms the fungus may render the whole tree entirely fruitless, the calyxes remaining until the normal time of ripening, giving the branch a very peculiar appearance.

In addition to attacking the open bud, the spores frequently find a place for infection in the nectaries. The development of the fungus here causes the fruit to fall, and the resulting appearance is much the same as when the infection took place in the stigma.

WITHER-TIP.

When the fungus gains entrance from the terminal bud or from leaf infection the formation of the gum previously mentioned does not take place, and the disease may extend down the twig, resulting in a case of wither-tip similar to that encountered in other species of citrus.

FRUIT CANKER.

If the bloom escapes, the young fruit may be attacked at almost any subsequent period. The attack on the young fruit frequently causes a portion to be taken out as though bitten by a grasshopper or some other gnawing insect. This causes a large percentage of the young fruit to fall. Fruits after they are about half developed are not usually attacked. When the fruit has reached considerable size before it has been attacked, corky tissues form and a development takes place resembling scab or verrucosis.

LEMON.

LEAF-SPOT AND WITHER-TIP.

Lemon leaves are attacked in the typical way, causing leaf-spot, and from these the disease extends into the twigs, causing the wither-tip. For a discription of the characteristics of this attack see page 26.

LEMON-SPOT.

The disease causes the most serious damage to the mature fruit. The fungus finds entrance through some slight bruise or abrasion of the skin, or it may be that infection takes place through the uninjured skin under conditions not known at present. Attempts at artificial inoculation through the uninjured skin of the lemon failed uniformly. Even so slight an abrasion as rubbing the fruit together in a packing crate or handling it roughly gives sufficient opening for the fungus to enter. The results of applying spores from pure cultures to the epidermis confirmed this conclusion. When the fungus has once found its way into the epidermis a dark spot is produced. This continues to enlarge until a definite brown spot is made. The development then continues until the entire rind of the lemon is browned. Ordinarily the diseased skin hardens, so that the actual usefulness of the lemon has not been materially impaired by the attack, but since it is not saleable its value has been destroyed.

The injury from this disease is the greater because of the fact that infection to a large extent occurs during the handling of the fruit, especially during the colouring period, so that the fruit is sent off to market before the disease is visible. The diseased spots continue to enlarge. This of course makes the fruit unsaleable, and it becomes necessary for the merchant to repack, discarding all fruit that shows infection. Spores are rarely produced on such lemons except when the fruit is kept in a moist place, in which case they are produced in great profusion.

The peculiar way in which lemons have to be handled for market makes them especially liable to attack, The fruit is picked from the tree when still green. The growers allow the lemons to mature sufficiently to develop in them a certain amount of citric acid. When they have attained the proper size (and this must be learned by experience) so that they will shrink in the course of curing to the size demanded by the market, they are picked and placed in a colouring house, or they may be placed in a large heap, which is then covered with hay or similar material to keep out the light and to keep them at a uniform temperature. It therefore happens that the lemon groves must be picked over several times during the ripening season, the largest and most fully developed specimens being taken off usually in August or September, according as experience dictates. In handling these it is almost impossible to keep them from being bruised or slightly scratched or even pricked by thorns. Such abrasions in the epidermis, however slight, are sufficient to permit the entrance of the fungus.

THE COLOURING HOUSE.

The colouring houses for the lemons are small structures, usually about 12 feet wide by 14 feet long and 10 or 12 feet high. They are double walled and built with a steel roof. The sun shining on this roof causes the temperature of the building to rise. By means of ventilation at the bottom and top the cool air is allowed to enter at the floor and the hot air to pass out at the ridge of the roof. By means of these ventilators the temperature is kept from reaching too high a degree. At night the openings which permit ths cold air to enter are closed, and if the outdoor temperature happens to be quite cool the ventilators in the roof are also closed. In this way the temperature of the colouring house causes a very rapid ripening of the lemons, the fruit turning yellow in a few days. The evaporation from the lemons causes the air to become humid, creating a most admirable condition for germinating any *Colletotrichum* spores that may be adhering to the fruit. Spores that happen to be near an abrased place in the epidermis of the lemon will find an entrance and produce the disease in the fruit. The drying of the fruit which occurs at the latter end of the colouring period causes the affected portions to become depressed brown areas when the disease has progressed sufficiently.

When the lemons have been permitted to mature rather fully the process in the drying house is of short duration. No matter how short it is, however, it is always sufficiently long to permit fungus infection. When the period between infection and removal of the fruit from the colouring house is of short duration, the spots have not had time to collapse and become brown, making it impossible to detect the disease when the fruit is being graded and put into crates; consequently a considerable percentage of lemons infected with *Colletotrichum* is packed and shipped to the markets and the diseased spots develop in transit.

Experiments with infected lemons show that the fungus continues to develop, even if they are placed in the dry atmosphere of a living room, and that a spot is produced. These spots when examined under a microscope showed no fungus spores, and only a few mycelia were found in the tissues of the lemon rind adjoining the blackened area. On lemons under normal conditions, such as those in a crate on the way to market or in a storeroom, these spots develop very rapidly. Freight cars or the holds of vessels usually superheated, bringing the temperature up to that needed for the most rapid development of the fungus. Crates of lemons that were started out from the packing house during August, 1902, without the slightest visible speck, were found to have from 5 to 25 per cent, of specked fruit when they arrived in the Boston market. Specimens taken to the laboratory and kept under conditions similar to those of lemons packed in a crate developed spots varying in size up to three-fourths of an inch in diameter. Every lemon thus spotted is rendered worthless for commercial purposes, nor is the entire loss represented by the percentage of specked lemons, since a crate of lemons containing even a small percentage of specked fruit can not be sold except at a liberal discount or after the additional expense of repacking.

When specked lemons are placed in a moist chamber the fungus develops very rapidly and produces a great quantity of spores; The lemons under these conditions give out a peculiar mouldy citric odour. It not infrequently happens that sufficient moisture is produced in transit to market to permit a very full development of spores. In storage especially this is true.

THE COLOURING BED.

The very considerable loss sustained as the result of curing lemons in a house caused it to be suspected that the curing house was at fault in this matter, Curing beds were therefore prepared. These are made by selecting a position that is high and dry, clearing off the land, and smoothing its surface. This is then covered with hay or some other soft material. The picked lemons are placed upon this bed to a depth of a foot or more, and are covered with hay or similar material to a sufficient depth to keep out the light, In this bed the lemons go through a curing process very similar to that of the curing house. The temperature being much lower and the possibility of regulating it being removed, the process is much less certain and less satisfactory than in the curing house, the lemons not curing uniformly. In these curing beds the spotting of the lemons goes on in very much the same way as in the curing house. The time elapsing between placing the lemons in the curing bed and removing them from it is considerably longer than in the curing house; consequently a greater percentage of the lemons infected with *Colletotrichum* show spots, and the fungus has time to develop larger spots, which makes it less difficult to detect the diseased lemons. As a consequence fewer lemons infected with the fungus pass the graders and packers, and a smaller percentage is lost after being shipped.

ORANGE AND GRAPE FRUIT.

LEAF-SPOT.

The first point of attack is in the leaf. The development of the fungus takes various peculiar forms. At times the acervuli are distributed in a more or less regular way from a centre resembling " fairy rings." At other times the infection takes place in the tip of the leaf, which gradually withers back to the stem. Small trees may be defoliated and the fungus continue to develop in the twigs.

WITHER-TIP.

The smaller twigs of the sweet orange and grape fruit are very frequently and severely attacked. In a great many cases the death of twigs from an attack of wither-tip is supposed to be the result of die-back. This may, however, be easily distinguished from die-back, as indicated on page 26. It not infrequently happens that die-back and wither-tip occur on the same twig. Any material weakening of the health of the tree is very likely to induce an infection; this, however, is not a necessary antecedent to infection. The fruits of these two varieties appear to be exempt from attack.

PREVENTIVE AND REMEDIAL MEASURES.

TREATMENT TO PREVENT LEMON-SPOT.

The loss from spotting of lemons may be greatly reduced, if not entirely prevented, by spraying with fungicides, such as potassium sulphid, ammoniacal solution of copper carbonate, and Bordeaux mixture.

The particular fungicide to be used will depend on the specific form in which the disease manifests itself. For lemon-spot sulphur spray* may be used after the lemons have been picked.

The spraying may be done by first placing a layer of lemons one or two deep on the curing bed, then spray this thoroughly, place upon these another layer of lemons one or two deep and again spray, continuing the placing of lemons and spraying until the amount of fruit needed to fill the bed has been supplied. After this the lemons should be allowed to dry thoroughly before the cover is placed upon the bed. It is quite probable that the sulphur spray or the potassium sulphid† will also be helpful in the progress ofcolouringthelemons. Sulphur spray and potassium sulphid being mild fungicides, there is no danger of producing rot by their use.

Ammoniacal solution of copper carbonate‡ may also be used to

* *Preparation of sulphur spray.*—Place 30 pounds of flowers of sulphur in a wooden tub large enough to hold 25 gallons. Wet the sulphur with 3 gallons of water; stir it to form a paste. Then add 20 pounds of 98 per cent. caustic soda (28 pounds should be used if the caustic soda is 70 per cent.) and mix it with the sulphur paste. In a few minutes it becomes very hot, turns brown, and becomes a liquid. Stir thoroughly and add enough water to make 20 gallons. Pour off from the sediment and keep the liquid as a stock solution in a tight barrel or keg. Of this solution use 4 quarts to 50 gallons of water.

† Use 1 ounce of potassium sulphid to 2 gallons of water.

‡ *To prepare ammoniacal solution of copper carbonate.*— Put 3 gallons of water in a wooden or an earthen vessel, pour 3 pints of ammonia (26° B.) in this, and stir it to mix the two evenly. Take 8 ounces of copper carbonate and shake it into the ammonia water, stirring the liquid for a while. If a considerable part of the copper carbonate remains undissolved, the liquid may be left to settle; if, however, all or nearly all of the copper carbonate is dissolved, more of it should be added in the manner previously described until a considerable amount remains undissolved; then it is set aside as stated before. After the precipitate has settled, use the clear blue liquid. The undissolved copper carbonate may then be treated with more ammonia and water, fresh copper carbonate being added whenever the residue becomes less than an ounce. The solution should not be kept for more than a day or two, and when used 1 gallon should be diluted with 15 or 20 gallons of water.

prevent spotting, but the solution should be applied to the fruit a week or ten days before picking. The spraying should be done thoroughly and care should be exercised to get the mixture on the fruit. The amount, if at all apparent, will be so small that it will not interfere with its selling quality. Bordeaux mixture can not be used to good advantage on lemons, because it adheres very tenaciously to the fruit, and so reduces its selling value.

TREATMENT OF LIME TREES.

During the past year experiments performed by Mr. M. S. Burbank, of Cocoanut Grove, Fla., at the Red Mill fruit farm, with a view to protecting lime trees from the attacks of this fungus, brought out some interesting results. One tree under observation had been producing limes for a number of years in a most prolific manner, but during the three years preceding 1902 the crop had been a total failure, owing to the attacks of *Colletotrichum glœosporioides.* Spraying with Bordeaux mixture* was begun in September, 1902, and was continued at intervals as thought advisable, and in less than a year the disease had been almost entirely subdued and the tree bore a heavy crop of fruit. Other trees were also treated, as well as trees in other groves, with good results.

THE EFFECT OF PRUNING.

In a small orchard, or in the case of an isolated tree, especially in a young orchard, much good can be done by cutting out diseased twigs and picking off the diseased leaves. Where this is practiced with thoroughness the disease can be reduced to a point where it does only a small amount of damage, or it may be eradicated; but pruning and picking must be done at frequent intervals and very thoroughly. This would probably be an effective method of keeping the fungus under control in the case of small orange and pomelo orchards.

Where pruning is practised the weak limbs are taken out. The spurs that have dropped their leaves are also cut out, and in this way much of the hold-over wither-tip is removed. All wood that has withered is also taken away. This pruning reduces in a large measure the number of spores left in the grove and hence greatly diminishes the extent of the infection.

CULTIVATION AND FERTILIZATION.

Thorough cultivation and fertilization are among the effective ways of keeping the fungus from becoming established in an orchard. A properly cultivated and well-fertilized tree will produce

* Bordeaux mixture may be prepared by dissolving 6 pounds of copper sulphate (blue stone) in 25 gallons of water. If the powdered copper sulphate be used, it may be dissolved in an hour or so by suspending it in a feed sack just under the surface of the water. In another vessel, slake 4 or 5 pounds of lime in a small quantity of water. When slaked, dilute to 25 gallons. Strain through coarse sacking into a 50-gallon barrel, to remove all the matter that might clog the nozzle of the spraying machine. Pour the copper-sulphate solution into the lime solution, stirring the mixture vigorously during the process and for two or three minutes afterward. During the stirring the paddle should be made to go back and forth. Use the mixture at once.

new growth so rapidly and in such quantity that the amount of wood that is killed by the fungus and the number of leaves destroyed will form only a small percentage of the total number of leaves and twigs present. The same number of leaves and the same quantity of twigs destroyed on a tree of only indifferent growth would form a much larger percentage and, consequently, weaken the constitution of the tree to such an extent that it would actually die before the atmospheric conditions would become adverse to the disease. Seedlings and nursery trees not carefully attended are frequently killed in this manner. It is thus possible for a tree that has been properly fertilized and cultivated to withstand an attack that would prove fatal to one not in the best physical condition. While it does not seem possible to render a tree proof against attack excepting by the use of fungicides, the probability of infection and the damage to the tree can be greatly reduced by putting it in the most healthy condition possible.

FERTILIZERS.

In choosing fertilizers to aid in warding off these diseases a large percentage of potash should be used in the compound. The source of potash does not seem to be important, but sulphate of potash has proved a general favourite among growers of citrus fruits.

Sulphate of ammonia is somewhat slower in acting than nitrate of soda, but gives a firmer leaf. Nitrate of soda will produce a very quick growth and a large leaf, but it is especially subject to attack from the fungus unless well balanced by a generous supply of potash. Organic ammonia in the form of dried blood, cotton-seed meal, and bone meal should not be used in combating this trouble, as it is very likely to produce die-back in addition to the softening of the wood, and so lay the tree doubly open to attack.

SUMMARY.

(1) Wither-tip was not known to exist in Florida until 1886. In 1891 it was recorded as only of passing interest but it is now present in every citrus-growing region of the State, as well as in many citrus-growing countries. Such is the severity of the disease that many requests for advice as to remedies have come to the Department of Agriculture from extensive growers.

(2) The diseases caused by the fungus *Colletotrichum glœosporioides* Penz. manifest themselves as wither-tip on orange, pomelo, and lemon twigs; as leaf-spot on leaves of various citrus species; as anthracnose on lime-blossoms, recently-set limes, lime twigs, and lemon twigs; as lemon-spot on ripe lemons, and as canker of limes.

(3) On the orange and pomelo the fungus causes the most severe damage by defoliating young twigs and causing these to die, thus reducing the amount of wood that may produce bloom in the bearing trees and cutting back seriously the growth of young trees. In lemon groves the most severe damage is done to matured fruit, while in lime groves the greatest loss occurs during the blooming season, the disease often causing all the bloom to fall. Trees less

severely attacked often have over 80 per cent. of the fruit cankered, and consequently its market value is much reduced.

(4) Remedial measures are effective, but these must be varied to suit particular manifestations of the fungus. Wither-tip and leaf-spot are best controlled by pruning out diseased twigs and then by spraying with Bordeaux mixture. The spotting of lemon may be controlled by spraying the fruit before picking with ammoniacal solution of copper carbonate and with sulphur spray while in the colouring bed or colouring house. Canker of limes may be prevented by cutting out wither-tip before the blooming period and then by spraying with Bordeaux mixture.

EVOLUTION OF WEEVIL-RESISTANCE IN COTTON.*

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U.S. Department of Agriculture.

The complexity of biological problems finds another excellent illustration in the evolutionary history of the relations between the cotton plant and the so-called Mexican boll-weevil. The present indications are that both the cotton and the weevil originated in Central America. The parasitism of the beetle is certainly very ancient, if, as seems to be the case, it has no other breeding-place than the young buds and fruits of the cotton plant. Of the severity of the parasitism there is ample evidence in Texas, the weevils being able to totally destroy the crop when the climatic conditions admit of their normal increase.

It was to have been expected, therefore, that in humid tropical localities where all seasons of the year are alike favourable, the cotton would have been exterminated long since, or at least that its cultivation as a field crop would be utterly impracticable unless there were means of protection against the ravages of the insect. A definite intimation of the existence of protective adaptations was incidentally gained in eastern Guatemala in 1902 when no weevils were found in a field of the dwarf cotton cultivated by the Indians, although they were extremely abundant on a perennial 'tree' cotton a short distance away. The opportunity of making a detailed study of the subject during the second quarter of the present year has revealed an interesting series of protective adaptations resulting from the long evolutionary struggle for existence between the cotton and the weevil.

Reference has been made in another place† to the extensive system of extra-floral nectaries by which the cotton of eastern Guatemala has secured the active cooperation of the kelep or weevil-eating ant, but the Central American cottons and the Indians who have been cultivating them for thousands of years have developed many other expedients of structure, habits and

* From Science N.S., Vol. XX. No. 516, Pages 666-670. November 18th, 1904.

† Report No. 78 U. S. Dept. Agri., p. 4, 1904; reprinted in Bulletin of Department of Agriculture, Jamaica, II. 7. July, 1904.

culture which are of more or less assistance in resisting or avoiding the weevil.

The large leafy involucre of the cotton may have been at first a protective adaptation, though the weevils later learned to enter it easily. In some of the Guatemalan sorts the bracts are grown together at the base as though the evolution of a closed involucre had begun. The hairy stems assist the ants in climbing, but impede the weevils, and thus increase the chances of capture. Prompt flowering and determinate growth enable an annual variety to ripen more seed. A perennial kidney cotton also escapes extinction by producing nearly all its blossoms at one season. In the central plateau region of Salama and Rabinal another perennial variety is cut back annually to the ground. New shoots spring up and the new crop is set within a short time, while the plants are still small enough to be cared for by the chickens and turkeys.

Another of these protective adaptations proves to be of such potential significance as to call for announcement in advance of a detailed report. The issue is nothing less than that the cotton plant, in some of its varieties, has finally developed a practical means of resisting and destroying the weevil larvæ. The process is in the nature of a varietal characteristic subject to increase by selection. The efficiency of the adaptation is such that a variety in which it appeared uniformly would afford no opportunity for the weevil to breed, and would thus be a means of exterminating it.

The facts are simple and have been thoroughly established during the department's entomological studies of the weevil for the past decade, but they have not been interpreted as a protective adaptation, nor as a character subject to further selective development. Messrs. Hunter and Hinds have reported* that in some instances as high as 41 per cent. of the boll-weevil larvæ fail to develop, as a result of what they have termed a 'gelatinization' of the tissues of the young bud or 'square.'

In the later stages the injured buds often appear as though filled with a structureless exudation, and it was not unnaturally supposed that the abnormality was the result of some disturbance of nutrition, or of bacterial infection. The material failed, however, to yield cultures of bacteria or to respond to experiments with fertilizers. The opportunity of examining the earlier stages of the phenomenon show that the conditions are far less abnormal than have been supposed. and that the 'gelatinization' is simply the result of very active growth or proliferation of the loose tissue of the tube or column, which in the flowers of the mallow family surrounds the style and bears the stamens.

The usual programme would be for the young squares to fall to the ground when the larva has hatched and begun to eat out the pollen of the young bud. Proliferation involves the opposite procedure.

* Bull. 45, Bureau of Entomology, U, S. Dept. Agriculture p. 96, 1904.

Instead of ceasing to develop, the soft tissues of the staminal tube are stimulated in a manner analogous to that by which galls and other vegetable excrescences are formed. The cavity eaten out by the larva is filled and the little miscreant is either smothered in paste or, more likely, starved by the watery tissue which is certainly no equivalent for the highly organized protoplasm of the pollen, the normal infant-food of the young larva. But whatever may be the actual cause of death the practical fact is that the larva is killed, and apparently in every instance in which proliferation occurs.* A very little of the new tissue may be effective. When the cavity eaten out by the larva is small it is often neatly plugged by the new growth, and the flower may develop with no very great distortion, though the corolla generally shrivels up before reaching more than half the normal length. The young boll is not always blasted, though it is often small and irregular in shape, perhaps as a result of deficient pollination. The stigma sometimes projects from the injured flower and might be fertilized normally, but in other instances the withered staminal tube and corolla remain closely wrapped about it, so that pollen could scarcely have entered. It would not be surprising if the more rapid and persistent growth which favours the new protective tissue were also accompanied by a tendency toward parthenogenesis. Or it may be that the irritation resulting from the presence of the larva stimulates the ovary as well. Moreover, proliferation is not confined to the bud ; the same or a closely similar formation of tissue sometimes appears in the bolls, when these have been attacked by the weevils.

It is thus not merely a coincidence that the proliferation is most frequent in the quick-growing early varieties of cotton which are now prized in Texas as the best means of securing a crop. The weevil has conducted, as it were, a selection for rapidity of growth and early fruiting, and a further accentuation of vegetative energy has introduced the new protective habit. The destructive insect has, in effect, over-reached itself, and induced a condition which with man's assistance may accomplish its own destruction.

It is not easy to conjecture any means by which the weevil could survive the general planting of a variety of cotton having proliferation as a constant character. If only the squares would 'gelatinize' the weevil might develop an instinct of postponing the egg-laying period until the young bolls could develop. The advantage might be partly temporary, though it would take many years for the weevil to meet the new demand, and it could never reach its present destructiveness because the delay of the breeding season even for a week or two would be an effective handicap, particularly if the weevils should continue to waste most of their ammunition on the squares, as they probably would.

* In a few cases living weevil larvæ were found in squares which gave evidence of gelatinization, but there was always a second puncture from the outside, indicating that another egg had been deposited.

How long it will take to secure a completely resistant cotton by selection can only be conjectured, since it is not known as yet how constant a character proliferation is in the plants which possess it. To lose no unnecessary time is, of course, of the greatest practical importance, not only for the industry at large but especially for the sake of the growers of the long staple cotton in South Carolina and Georgia. The longer season required by the Sea Island cotton will render entirely ineffective the cultural expedients by which a part of the crop of the upland varieties can be saved from the weevil; if the insect be permitted to reach the Atlantic coast Sea Island cotton will soon become an agricultural tradition.

This change of view regarding the nature of 'gelatinization greatly alters the prospect of finding in tropical America a variety of cotton resistant to the weevil, a hope which seemed to be lessened by the discovery of the kelep or Guatemalan cotton-protecting ant. It is by no means impossible that varieties already exist in which proliferation has become a fixed character, and if not it will still be highly desirable to secure those in which the tendency is most strongly pronounced. In the ant-protected variety of eastern Guatemala, proliferation takes place very frequently, at least in the bolls, and the plant has other desirable features of quick, determinate growth and early bearing which may make it of value in Texas. It has the good qualities of King and other related varieties in accentuated form, though with a longer staple.

The dwarf Guatemalan cotton represents, as it were, the highest known development of the upland type. Even the annual character which has been looked upon as a result of cultivation in temperate climates is a further instance of protective adaptation long ago secured in the tropics by the unconscious selection of the Indians. It was from the Central American region, evidently, that the other upland types came, but they represent an earlier stage of development, or have deteriorated because selection for resistant qualities has been relaxed in regions where the weevil was absent, as in our southern states. Other things being equal, the Indians would undoubtedly prefer the perennial 'tree' cottons, which continue to be cultivated in Mexico and Peru in localities so arid as to exclude the weevils, though it is not certain that they exist in Peru. Possibly there has never been a connected series of agricultural communities along which the weevil could follow into South America; the pest might never have reached the United States if cotton culture had not been extended into southern Texas.

But even if the varieties already known in Texas were to be utilized as the basis of selection, it is by no means beyond the limits of probability that a resistant, regularly proliferating variety could be secured within a decade, or even within five years, since cotton has been found to respond rather promptly to selective influence. The urgency of the matter would certainly justify an extensive campaign of selection, the problem being to find among the millions of plants which will be grown next season, some which possess in the highest degree the tendency to proliferation, and to secure seeds from them. The task, however, is peculiar, and more difficult than such experiments usually are, because there is little or nothing in the way of an external clue to the desired character. It may be necessary to cut open each infested square in succession to make sure that the plant is allowing no weevil larvæ to develop. And after the most promising plants have been located, it may be possible to obtain seed from them only by artificially protecting them from the weevils. Otherwise the best stock might be lost if the weevils were very abundant. Indeed, this suggests a reason why 'gelatinization' has not become a fixed character already. Selection thus far has only been in the direction of proliferation in the bolls, since the proliferation of tissue in the buds would give a particular plant no advantage over its neighbours in the matter of seed production. It would enjoy no immunity from subsequent attack because it had not allowed any weevils to reach maturity. Weevils from other plants would continue to come to it, and the chances of ripening seeds would not be increased. There has been, in other words, no selective inducement for 'gelatinized' buds to become a uniform character except as they might be correlated with 'gelatinized' bolls, in spite of the fact that for killing the weevil proliferation in the buds is more important than that in the bolls.

These considerations reveal still another episode of evolutionary history, and may explain why it is that the variety protected by the ants, and the other 'upland' types which have originated in the same region, have the additional protective adaptations. It was only where the ants protected the cotton and thus perpetuated it as a field crop that these other considerations could have a cumulative effect. The other adaptations by which the tree cottons have maintained a desultory existence are of suggestive interest, but of apparently little practical importance, since no field culture of a perennial cotton seems to be maintained in any weevil-infested district.

In eastern Guatemala the cultivation of cotton as a field crop is strictly limited to localities suited to the ants, where they exist in such numbers as to give practical protection. In Texas, however, cotton is grown under a great variety of conditions. The climatic vicissitudes of heat and cold, drought and flood are many times as great as in Guatemala, so that notwithstanding the unexpectedly great adaptability of the kelep, it can not be expected to thrive equally well in all parts of the state, any more than does the weevil. Even if it be found that the ants can thrive, breed and establish new colonies in Texas, they will probably require many years to take full and effective possession even of the more favourable localities of this vast agricultural empire. Such a mitigation of the weevil's injuries would be, of course, of great practical value, and the work of the ants in destroying the larvæ of boll worms and leaf-worms might be only slightly less important in some districts. If, however, the hope of exterminating the weevil is to be cherished, or that of staying its ravages before it has laid the entire cotton industry of the South under tribute, there would seem at present to be no other alternative than to secure by discovery or development, within the next few years, a variety of cotton in which the larvæ of the boll weevil can not mature.

The present brief outline of the results of our study of cotton in Guatemala may be summarized by saying that the tendency to rapid growth and early fruiting, the large extrafloral nectaries which attract the ants, and the proliferation of the tissues of the young buds and bolls which kills the weevil larvæ, are protective adaptations, developed as a result of long contact between the cotton plant and the boll-weevil. The proliferation is not a mere pathological abnormality, but represents a definite evolutionary tendency, capable of further increase by selection. If this interpretation of the facts be correct it affords an intimation of a successful solution of the weevil problem by means of a resistant variety of cotton.

NOTES ON THE CULTIVATION OF COCONUT, SUGAR CANE, COFFEE AND COCOA.

By W. M. CUNNINGHAM, Asst. Superintendent and Agricultural Instructor at Hope Gardens.

The following notes were prepared for a small cultivator who wrote asking for information, and as they may be useful to others they are now published:—

COCO-NUT PALM—This tree requires a loose soil, its slender horizontal roots often extend to the distance of forty feet; they are formed of a ligneous body, surmounted by a spongy tissue and covered with a reddish epidermis.

Soils.—There are two kinds of soils on which coco-nuts refuse to grow to any profitable purpose, namely, thin washed gravels overlying rocky foundations, and stiff clays, or compact clayey soil, which retains water; not only are the roots prevented from spreading, but they rot. The richer the soil, the quicker they will grow and bear the earlier; the best soils for coco-nuts are deep alluvial loams on the banks of rivers, subject to floods that overflow on the neighbouring lands; all level lands exposed to the sea-breeze where the soil is good, as the valleys between hills, which have been filled up. In such situations the crops are enormous; the next quality of soil is brown loam, but it is only found in certain districts, and seldom extends into the higher uplands. A loamy sand is a good coco-nut soil, and, with careful cultivation, is only slightly inferior to the alluvial and brown loams.

Holes.—Coco-nut holes cannot be made too large, say three feet deep by three feet wide, and they should be filled in for half their depth with soil from the surrounding surface. It is important to give the plant the means of a fair start, and eighteen inches of loose rich soil, below and all around it, is the best available means to that end, indeed a plant so treated, will gain several years on one placed in a one-foot hole.

SUGAR CANE—The sugar cane has no main root, but like all grasses possess a great number of fine rootlets, these spread to a great distance, and to a considerable depth in suitable soil. The results would be of considerable interest and value if planters would make a series of observations on the range of the roots of the sugar cane. In good soil the majority of the rootlets reach a depth of about 2 feet; a smaller number extending even to 4 or 5 feet; in moderately well tilled soil the roots grow downwards until they reach the layer of soil but little disturbed by cultivation, and then spread laterally, so that the depth to which the roots descend in stiff soil depends on the depth of the tillage.

Soil.—The question of the suitability or unsuitability of a soil for prodncing a certain crop resolves itself into two distinct heads, one being the physical character of the soil, the other its chemical composition. It is not too much to say that the first essential in a fertile soil is the capacity for absorbing an abundance of air; at the same time, the friability or porosity of the soil must not be so excessive that no moisture is retained. The sugar cane will grow upon almost any soil; clays, loams, marls, and calcareous soils, as well as vegetable ones, are suitable, more or less, to cane cultivation. Indeed, considering that canes are grown in all the principal West Indian Islands, with their wide diversity of soils, one might feel inclined to come to the conclusion that the nature of the soil was of no account in the cultivation. Rich, porous clays, and alluvial soils on low lands, are the most favourable for cane cultivation, with the exception, perhaps, of loams formed by the decomposition of volcanic rocks, these being well fertilized by a proportion of decayed vegetable matter. Deep black moulds are less suitable for cane culture, tending to produce exuberant growths, rather than a rich and plentiful juice; some of the very best sugar is produced on lime-stone soils, though they do not promise great fertility.

COFFEE—Coffee trees delight in the cool climate of the mountains, up to 4,500 feet, where the rain is abundant all the year round, alternating with bright sunshine; on the lower mountains, especially where they are subject to dry sea breezes, the berries will often be empty, mildewed, or scorched, and the trees short-lived.

Soil.—The best soil is a free, open virgin soil, 3 or 4 feet deep; on steep slopes the soil should be firm, but not clayey, mixed with a proportion of sand, gravel, or small stones through which water may easily pass. Even on white limestone, if the climate is rainy, coffee will flourish where the rocks are mixed with deep soil.

To obtain large returns from each tree, the following should be carefully attended to:

(*a*) Choose a good and fertile soil, containing a tolerable quantity of decayed vegetable matter, and having a generous subsoil, which is naturally well drained.

(*b*) Pick out strong and vigorous young plants, and take them up, if possible, without breaking their roots, and with the earth around them.

(*c*) Let the ground be in a tolerably moist condition.

(*d*) Prepare holes (varying from 18 to 24 inches in diameter) with well rotted vegetable manure, and finely pulverized soil, into which place the young plants, and fill up the holes, so as to leave no hollows wherein water may lodge.

COCOA—The cocoa tree frequently requires the protective shade of another tree to thrive, and the younger it is the more it requires shade, hence the banana suffices at first, but the Immortel tree (*Erythrina*) protects its after-life. This shade tree is planted either as young plants or seeds, in the interval between every third cocoa, or about 36 to 42 feet apart. A warm, moist climate is necessary for the cultivation of cocoa, if large crops are expected; but when the soil is suitable, the trees will grow and give fair returns in a moderately dry place.

Soil.—On account of its long tap root, which attains 7 feet or more, it only thrives advantageously in rich and deep loamy soils, and especially if these are formed by the decomposition of volcanic rocks. The best soil is that covered with a vegetable deposit which has accumulated from the falling leaves and branches of the original forest. If land can be found on the banks of a river where there is a considerable depth of alluvial deposit, such a position, if well drained, is an ideal spot. The tap root of the cocoa tree, being the continuation of its stem, penetrates the soil directly downwards, so that in flat lands, to insure its proper development, the soil must be comparatively deeper than that of both undulating and hilly lands. In flat lands, therefore, both the soil and subsoil must be porous and friable. If the sub-soil is over clayey, stiff or retentive, the growth, after a few years, either deteriorates or becomes stunted, and the tree perishes, while during the rainy season, the water instead of draining off, becomes stagnant, thus gradually rotting the roots. As a rule, a fertile cocoa soil must be rich in nitrogen, with a high percentage of potash, and a fair proportion of lime, and phosphoric acid.

Hard dry, rocky soils, stiff clays, a shallow soil resting on rock, mountain sides, where great detrition frequently takes place, shallow lands, and boggy land should be avoided.

NOTES ON WATERING PLANTS IN GARDENS.

By W. J. THOMPSON, F.R.H.S.,

Travelling Instructor & Superintendent of Parade Gardens.

In travelling about the Island one not only sees time being wasted in unnecessary watering of plants in gardens, but the plants themselves are actually injured by too liberal supplies of water, and I know of cases where the owners give themselves a great deal of trouble in seeing that the gardens get their watering twice each day of the week, Sundays included.

I am often asked the question, how often should the plants in a garden be watered? It is impossible to give an answer to this question that will suit all cases. The owners of gardens should know when their plants need watering, and when water is needed they should see that sufficient is given.

More than one-half the water that is given to gardens is wasted, either because the plants do not need it, or the ground is not in a fit condition to receive it; it is just of as great importance that the ground is in a fit condition to receive the water if the plants are to be kept in a healthy, growing condition, as that the water should be applied.

All owners of gardens who wish to see their plants looking healthy, and to get satisfactory returns for the money they spend on them, should see that the soil between the plants is dug about three times a year to a depth of from twelve to fifteen inches. When digging is being done, leave the surface of the soil rather rough, that is, do not have the surface raked smooth as is done in most gardens. My reason for recommending this is that when the surface is in a broken condition, water and air can enter the ground more freely, and half the water that is usually given will be sufficient to keep the plants in a growing condition.

The plants in any well managed garden should not need watering more than three times a week. I am speaking now of the gardens about Kingston and suburbs. If a copious watering every other day does not keep the plants in good condition, then the soil is either too hard or too full of roots. If the former, it should either be forked or dug to a depth of about 15 inches; and if the latter, judicious root pruning should be carried out when the ground is being forked or dug.

In the case of pot plants, for every one that dies through want of water, probably two die through being over-watered. No plant should need watering more than once a day, or three waterings a week should be sufficient for most plants, unless the pots are filled with roots, or the soil is too sandy. If the plants have filled the pots or tubs with roots, they should be moved into larger pots or tubs, at the same time cutting off a few of the outside roots.

Care should be taken when potting plants to see that the pots or tubs are quite clean, that the soil is neither too wet nor too dry, that enough space is left between the top of the soil and the rim of the pot or tub to allow the plant to be given enough water.

It ought to be remembered that plants should not be made to grow too fast, but they should have just sufficient water given to them to keep them in a healthy condition; also that by keeping the soil about them frequently hoed or forked, not only maintains them in good condition, but reduces the watering by one half, and so reduces the cost of upkeep of the garden.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, VII.†

(*Continued from Bulletin for January.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

METHOD OF CLEARING LAND FOR RUBBER PLANTING.

The question of shade is also involved with that of the method of clearing the land. It is an almost universal custom in tropical countries to clear land by burning the dried forest growth which has been cut down. In fact, the primitive agriculture of the natives of tropical regions could scarcely be conducted on any other basis. There is much loss of fertility by the destruction of vegetable matter and humus, but the amount of labour required to thoroughly clear a piece of forest land in the tropics is prohibitively great. The fire not only removes the tangled mass of brush, but it performs an even more useful service in killing the stumps and roots which would otherwise reoccupy the land with new growth in a few weeks, and would remain indefinitely to dispute possession with anything which might be planted. To grow a herbaceous crop on unburned land under such conditions would be extremely difficult, but a tree culture is much more feasible, though whether the method of partial clearing is to be generally advised is not so certain. The gain, if any, is more likely to be found in the sustained fertility of the soil than in any saving of labour in clearing and cleaning the land ; for although there may be a saving at first which will permit an enterprise to reach a paying basis sooner, yet there is in prospect a long and expensive struggle with the persistent natural vegetation rooted in the soil. Moreover, it should be recognized that the conditions under which a plantation is set out in a partially cleared forest are of necessity only temporary. Many of the forest trees will not long survive the unwonted exposure to greater dryness and heat and to the attacks of parasites. The thinning of the forest greatly increases the force of the wind against the remaining tall trees, and in falling these will injure the rubber trees and will often require to be cut away not merely at one point, but at several points. Whatever the merits of the case from the standpoint of the stockholder, the plantation manager of the future is very likely to wish that his predecessors had adopted clean culture. The overhead shade which discourages the undergrowth will also discourage the rubber, and the decrease of such shade will increase the competition of the undergrowth with the rubber. The ideal of rubber culture does not require a roof of shade over the rubber trees nor a dense growth of bushes and vines under them. The roof should be of Castilloa foliage, and the ground should be covered by a mulch of dead leaves and

† Extract from the U. S. Department of Agriculture. Bull. No. 49, Bureau of Plant Industry.

branches, which enrich the soil and assist in the retention of moisture.

CLEAN CULTURE WITH FOREST PROTECTION.

If, then, the requirements met by close planting be eliminated from the shade question there remains little beyond the fact that in districts in which the dry season is unduly long it may be unwise to shorten the period of growth by cultural methods which increase the daily exposure to too dry an atmosphere, as there can be no doubt that the clearing of large tracts of land will mean warmer and relatively drier air, and that the dryness of the air near the ground will be further increased by the wind, against which the forest will no longer afford protection. It might accordingly be good policy on large estates not to clear continuous tracts for planting, but to leave belts of forest to break the wind and keep the atmosphere moist. This method would be particularly convenient where the land is to be cleared by burning, since in a tropical forest the trees often grow with their branches interlaced or are bound together by large climbing vines or lianas, so that it is often much easier to clear an entire strip of forest than to leave individual trees standing at anything like regular intervals.

METHODS OF HANDLING CASTILLOA SEEDS.

The thin-skinned seeds of Castilloa, like those of so many other tropical plants, are adapted only for germinating on the most soil of the forest. Instead of having a hardened shell for protection, there has developed only a fleshy pulp, which in nature helps them to remain moist until the rain begins. They are able to resist exposure to even a moderately dry atmosphere for only two or three weeks, and if packed together in any quantity they spoil even more promptly. The perishability of the seeds has been a considerable obstacle in the planting of Castilloa, and especially in its introduction into foreign countries. The first shipment of 7,000 seeds secured by the government of British India from Panama in 1875 was a total loss, and the introduction was made by means of a few cuttings, carried around by way of England. Later theKew Botanical Gardens sent rooted cuttings also to Liberia and to the Kamerun River settlements in West Africa, to Zanzibar, Mauritius, Java, and Singapore, as well as to Jamaica and Grenada in the West Indies.* In 1880 the largest of the Ceylon trees was 17 inches in circumference a yard from the ground, and in 1881 they flowered for the first time. The first flowers were all staminate, but a few seeds were produced in 1882, and these and their successors have furnished the basis of the experiments with Castilloa in the East Indies. The relatively unfavourable results may be due, at least in part, to the fact that the Panama tree is different from that of Mexico and Guatemala, which was sent to the East Indies only in recent years, after better methods of packing the seeds had been learned.

The preservation of the seeds depends upon their being kept

* W. Thistleton-Dyer, Trans. Linnæan Soc., London, 2d ser., 2: 214, 1885.

moist enough to remain alive and at the same time dry enough to discourage germination. Some advise washing the seeds; others leave the pulp adhering, but the latter course has the disadvantage of encouraging the growth of moulds and bacteria, which readily penetrate the thin outer membranes and attack the embryo itself. Several packing materials, such as leaf mould, sand, and sawdust have been suggested, but the best is probably powdered charcoal, which does not decompose nor harbour organisms.

The following statements from some who have experimented with shipment of Castilloa seeds may be of suggestive interest:

In Trinidad they are gathered when they fully maturé, washed, and slightly dried in the shade. They are then shipped in a sort of humus composed of fibres of rotten cocoanut husks and a little earth. This mixture must be somewhat moist. The seeds soon germinate in it and so remain for several weeks. Sowing must be done with great care on account of the long sprouts.

I also collected the mature seeds and washed them thoroughly, so that no trace of the fleshy red pulp remained on them. Then they were dried in the shade from twenty-four to forty-eight hours, and then mixed with sawdust and packed in small tin boxes 10 centimeters (4 inches) square and 3 centimeters (1·2 inches) deep. I dropped a few drops of water on the sawdust before closing the box. With this packing the seeds were sent to Berlin, and from there forwarded to Kamerun and East Africa, and 50 per cent. of them were on arrival still good and in condition to germinate.*

A shipment of 2,000 Castilloa seeds sent from Paris to Peradeniya, Ceylon, packed in leaf mould in four tin boxes, was opened in six weeks, to find 37 per cent. still alive and the remainder destroyed by moulds and bacteria. This made it evident that leaf mould was not a desirable medium and sterilized sand was suggested instead.†

The seeds were carefully cleaned of all pulp, and then dried slightly in the shade and packed in shallow tins with powdered charcoal slightly damp. By this method they commence to germinate in the tins. Care must be taken that the seeds do not touch each other, for if too many are packed together it will cause heating and the loss of the whole.‡

SEED BEDS AND NURSERIES.

Whether it is better to plant the seeds where the trees are to stand or to sow them in nurseries from which the seedlings are to be subsequently transplanted, is one of the many questions on which opinions differ, though the latter method commands a large majority of preferences. Of 26 plantations from which reports have recently been published by the India Rubber World, only 3 plant "at the stake" exclusively.

At La Zacualpa Mr. Harrison has tried planting in the permanent location, but finds that the very young seedlings are liable to be destroyed by insects and that they do not grow as well in partial shade as in the full sun. But instead of leaving the plants in the nursery for a year, transplanting begins when they are six weeks old, or when the plants are from 10 to 12 inches high, and continues to near the end of the rain, no nurseries being carried over the dry season. These are considerable deviations from the

* Dr. Paul Preuss, Expedition nach Central-und Sud-Amerika, 1901, p. 383.

† Agri. Bul., Straits Settlements, 1: 580. Dec., 1902.

‡ Letter from Mr. W. S. Todd, Amherst, Lower Burma, to Mr. Edgar Brown, in charge of Seed Investigation, U. S. Department of Agriculture.

methods which have been described in previous publications on rubber culture, most of which advocate the shading of the nurseries and the postponement of transplanting till the seedlings are a year old. It is claimed at La Zacualpa that the small trees suffer less from transplanting and that they are larger at the end of two years than if they had remained in the nursery for a year.

The seed beds at La Zacualpa are made each year in a new place convenient of access to the tracts which are to be planted. While the nurseries are not shaded overhead, they are generally located in clearings in the forest, where they have considerable protection against dry wind. The drying out of the soil would doubtless be fatal to young seedlings, but if the soil and air are sufficiently moist, the sun does not harm them.

The land used for nurseries is cleaned by burning, though this is not the case at La Zacualpa with the plantation proper. When older seedlings are transplanted it is customary, as with coffee, to cut the tap root down to 5 or 6 inches, rather than to plant it bruised or bent. If the soil is loose and fertile the seedlings are set in holes made with a pointed stake ; elsewhere it is better to dig holes as with coffee. Castilloa is not a delicate plant, and will endure any reasonable treatment. The worst danger seems to be that with long-continued rain and deficient drainage the young plants will rot off, or they may be killed by drought if planted too near the end of the rainy season. For those which have not become sufficiently established before the coming of dry weather artificial shade may be provided. At La Zacualpa one of the tracts, which represented an experiment in open planting, had each young seedling covered with a hood made of leaves of the manaca palm (Attalea).

(*To be continued.*)

BOARD OF AGRICULTURE.

The Monthly Meeting of the Board of Agriculture was held at Headquarter House on Tuesday 13th December, 1904, at 11.15 a.m. Present : the Hon. H. Clarence Bourne, Chairman ; the Director of Public Gardens, His Grace the Archbishop, Hon. T. Capper, Messrs. C. A. T. Fursdon, J. W. Middleton and the Secretary, J. Barclay.

Minutes—The Minutes of the previous meeting were read and confirmed.

A letter of apology was read from the Island Chemist who was indisposed.

Sugar Laboratory—The Chairman submitted a letter from the Chemist asking for approval of various items of expenditure for fittings and equipment of the Sugar Laboratory, Fermentation Laboratory and Distillery, from the allocation of £1,000. The items submitted were sanctioned except the amount for the purchase of a typewriter which was deferred.

It was resolved that more detailed estimates of the expenditure of the Sugar Laboratory Fund should be submitted with sub-heads sufficiently defined to enable the Board to allow charges against them to be sanctioned by the Chairman.

Secondary Schools—The Archbishop reported that the Standing Committee on Scientific Education in Secondary Schools was at work and would soon be able to report.

Agricultural Conference, Trinidad—The Chairman submitted a letter from Mr. H. Cork intimating that it was impossible for him to attend the Agricultural Conference at Trinidad owing to business matters requiring his attention here.

The Secretary reported that the Hon. T. H. Sharp had informed him that he would be going on a visit to St. Vincent, Barbados and other places to study the Cotton Industry, and if the Board did not secure a representative to attend the Conference at Trinidad he would be prepared to leave earlier than he had otherwise intended, and would go to Trinidad and represent them if he was duly accredited, and at least a portion of his expenses were paid. He was not sure whether the movements of steamers and his own business matters would enable him to attend during all the time of the Conference.

The Board decided to inform Mr. Sharp that if he could leave for Trinidad on the 26th December and attend at least a part of the Conference he would be duly accredited as the representative of the Board ; but only, if he could attend all the time of the Conference, would the usual expenses for such a representative be allowed.

Sterilizing Fruits—The Director of Public Gardens said that sometime ago the Archbishop had asked whether it would not be possible for us to do more in the way of preserving fruits for shipment abroad ; and he now submitted 8 jars of fruits preserved by a simple process of sterilizing, by heating to 150.° The fruit had been put up for 3 to 4 months and consisted of mangoes, pine-apples, bananas and akees ; and on a jar of mangoes being tested the fruit was found to be in perfect condition.

On the suggestion of Mr. Fursdon it was resolved to send the jars of fruit to the Agricultural Society's rooms to be exhibited there, and the Secretary was instructed to make this fact known and to explain the process to all interested.

Estimates—The Estimates of the Director of Public Gardens, and the Chemist were submitted, and after some discussion, were approved.

Steers at Hope—The Director of Public Gardens submitted an offer of £18 from Alonzo Rowe for the two old plough steers at Hope Experiment Station, and on the motion of Mr. Fursdon it was resolved to accept the offer, if a better could not be obtained.

The Secretary submitted a letter from the Board of Agriculture, London, enclosing Handbook on the Disease of Animals Acts referring to Great Britain. The Secretary was instructed to keep this at hand for reference when necessary.

Trade Marks—The Secretary submitted a letter from the Colonial

Secretary's Office asking the consideration of the Board on the question of amending Section 25 of Law 31 of 1903 so as not to permit the issuing of more than one Trade Mark to the same person for the same article of agricultural produce exported.

After discussion the Secretary was instructed to write the members of the Committee which had before considered the necessity for an Inspection of Fruit Law, and get their views.

Cotton—Mr. Fursdon's report on the work done by the Cotton Gin and the report of the Secretary on the Cotton Industry together with the opinions of the Cotton Expert on samples, were submitted and directed to be circulated.

Mr. Fursdon asked whether the opinion of the experts, after visiting the cotton cultivations here, had not in any way changed, with regard to the quality of first "ratoon" cotton.

Mr. Fawcett stated that they had considerably modified their views since they had visited places where cotton was being grown, but that they did not think the question could be definitely settled until they had tested samples of so-called first ratoon cotton.

Mr. Fawcett was asked to state in writing the precise purport of Mr. Oliver's later statement to him on the subject of so-called ratoon cotton, with a view to its publication.

A letter from Colonial Secretary's Office with report of the International Congress of Cotton Spinners at Zurich was submitted and directed to be circulated.

Locked Still—A report from the Chemist re installation of the Locked Still at Denbigh Estate was submitted and directed to be held over until next meeting.

Reports, Director Public Gardens:—

The following reports of the Director Public Gardens were submitted and directed to be circulated:—

1. Letter re resignation of Mr. R. L. Young, Local Instructor.
2. Mr. Cradwick re Shows and work done.
3. Experiment Station.
4. Mr. W. J. Thompson re work done.
5. Letter from Experiment Station, Porto Rico re Pine-apples and Cassava.

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Vol. III. **MARCH, 1905.** **Part 3.**

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations

C O N T E N T S:

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KINGSTON, JAMAICA:
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1905.

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BULLETIN

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Vol. III. MARCH. 1905. Part 3.

CITRONELLA GRASS IN CEYLON.

Director, R. Botanic Gardens, Ceylon, to Director, Public Gardens and Plantations, Jamaica.

Peradeniya, 7th Dec. 1904.

DEAR SIR,

I see in your October Bulletin a reprint of Mr. Sawer on Lemon and Citronella grasses from the *Chemist and Druggist*. Let me call your attention also to my reply in the same paper of 10th September. He is wrong about the Ceylon grasses, and it is difficult to hunt down an error that gets a start in a home paper, when one cannot reply in the next issue.

Yours faithfully,

JOHN C. WILLIS.

Director, R. Botanic Gardens, Ceylon, to Editor, Chemist and Druggist.

Peradeniya, 15th Aug., 1904.

SIR,

With reference to the interesting article by Mr. C. J. Sawer, appearing on page 179 of your issue of July 30, 1904, permit me to make a few observations.

In the first place, Mr. Sawer quotes the account of this grass in Trimen's "Handbook of the Flora of Ceylon," Vol. V., evidently under the impression that Dr. Trimen was the author of that volume. This is not the case; the late Dr. Trimen left no notes on grasses, and only a very poor collection in the herbarium at Peradeniya. Sir Joseph Hooker wrote the last two volumes of the "Flora" (see his remarks in the Preface to part IV), and is responsible for the statements there made: his account of the grasses is very incomplete in detail for the reason above explained. On page 180 Dr. Trimen is again used as an authority to dispute the statement, which is perfectly correct, that there are two forms cultivated in Ceylon. This authority is, as shown, valueless; it rests only on the fact that our herbarium as sent to Sir J. D. Hooker contained only one specimen of citronella grass. I have devoted a good deal of attention to the citronella-oil question in recent years, and large plots of these grasses are now in cultivation on the Peradeniya Experiment Station. Full reports will be issued by this Department at a later date. In the mean time, let me assure you that there *are* two cultivated forms in Ceylon, called *Lena Batu* and *Maha Pangiri* respectively. A good account of them is given in Messrs. Schimmel & Co.'s "Semi-Annual Report" for October. 1898. *Lena Batu* is the form cultivated by the native growers, and furnishes practically all the exported oil. *Maha Pangiri* is the form cultivated by Messrs. Winter & Son at Baddegama, and gives a much finer oil, but needs more trouble in cultivation, having to be frequently replanted. The native prefers the *Lena Batu* because he does not need to replant it. He frequently abandons the cultivation when the grass is ten years old or more. The wild *Andropogon Nardus*, one of our most common grasses, is known to the Sinhalese as Mana, and is distinct from the cultivated forms; it yields a good oil, but the quantity is smaller. Lemon grass is also cultivated in Ceylon, and we have a considerable quantity of it upon the Experiment Station at Peradeniya.

I am, Sir,

Yours faithfully,

JOHN C. WILLIS.

THE HALFWAY-TREE JAMAICA.

By the late RICHARD HILL.

I visited Halfway Tree on Sunday the 25th November, 1866. When I first saw the cotton tree at the junction of the four roads through the plain of Liguanea from which Halfway Tree receives its name, it had nearly lived out its time. It was of that lofty straight stemmed variety of Eriodendron which originally growing among some clustering trees had overtopped them and had spread its horizontal arms out above them at about some fifty or sixty feet in elevation from the root. Four or five of these arms yet remained with a few scattery stems on which a few straggling leaves vegetated, An age of surface rains rushing to the sea three miles away, had removed all the soluble earth from the platform roots, so that they made arched resting places, where the marketers coming from the mountains would rest themselves in groups for they had reached the 'Halfway Tree'. The straight stemmed Eriodendron does not give one an idea of centuries of growth as the short wide-buttressed species,—if it be a species,— does, with its close-leaved hemispherical top, and a thousand feet of circumferent shadow. The imposing majesty in the appearance of *this* tree, the ordinary silk-cotton tree of the open savannahs had led Indians and Africans to designate it the God-tree,—an epithet they do not use to the unbranched Eriodendron, though it may stand in solitary grandeur a hundred and twenty feet high. At the time of the conquest of the island two hundred years ago, the Halfway Tree was one of these tall solitary cotton trees of the Liguanea plain. Two hundred years more remote, the country was the home and inheritance of the Indians and the vertical moon saw these groups gathered beneath it at their midnight dances. The Halfway Tree ceased its associations with past and present history thirty years ago. (*Victoria Quarterly, Oct., 1890.*)

DISEASES OF COCONUTS.

The Director has examined from time to time all over the island reported cases of diseases of coconuts. In many instances the unhealthiness or death of trees was due simply to the unsuitable nature of the soil or climate. If the soil is a thick clay, or rocky, or very poor in plant food, or very dry, or liable to be saturated with standing water, the trees are never healthy, and when the conditions are more than usually unfavourable, they may succumb altogether. While in this unhealthy condition they are much more liable to the attacks of insect and fungous pests, and the immediate cause of death may be due to attacks which reach such vital parts as the terminal bud or the feeding roots.

But besides unhealthiness and death due to unfavourable conditions, there is a disease which attacks the flower parts and young nuts, sometimes spreading along the softer tissue, and at length reaching the terminal bud, causing the death of the tree.

Mr. Cradwick has been engaged at intervals during the last two years in applying various remedies suggested by me. These experiments are still in progress, but I may say that I find the most effectual remedy is to spray with Bordeaux Mixture at intervals of 6 to 9 months until there is no trace of disease. A spray pump is necessary, and even high trees can be sprayed by attaching a long hose to the pump, and sending a boy up with the nozzle, or even by tying it to the end of a long bamboo.

In Grand Cayman and in parts of Jamaica planters have not been successful in growing coconuts because the young plants die off just at the time of the first flowering. It is now hoped that with the use of Bordeaux Mixture, they will be able to grow them.

BORDEAUX MIXTURE.

Bordeaux Mixture is best made according to the following formula :—

Copper Sulphate	...	6 lbs.
Unslacked lime	...	4 lbs.
Water	...	50 gallons.

It requires careful mixing, or the ingredients will not combine properly. Put 25 gallons of water into a barrel, tie up 6 lbs. of copper sulphate in a piece of coarse sacking, and hang this by a stick laid across the top of the barrel so as to be just beneath the surface of the water until it has slowly dissolved.

In another barrel slack 4 lbs. of lime very slowly and carefully, at first only adding about a quart of water at a time, until a perfectly smooth paste free from grit is obtained, add water to make the whole 25 gallons and wait until cool. Now pour both together into a cask holding 50 gallons. The milk of lime should be thoroughly stirred before pouring, and finally the mixture should be well stirred for 4 or 5 minutes with a wooden paddle. If not perfect, the mixture is liable to injure the foliage and in order to test this, put the blade of a penknife into the mixture and leave it for 1 or 2 minutes. If there is any deposit of copper on the blade showing a brownish colour, it is not safe to use it, and more lime must be added until the knife is not discoloured.

EXPERIMENTS WITH SUGAR CANE IN BRITISH GUIANA.

Notes of a paper by Prof. Harrison, read at the Agricultural Conference in Trinidad, January, 1905, on "Recent progress of agricultural experiments in British Guiana.

(a) *Older varieties of sugar cane.*—The results of 15 years experiments show that taking the yield of Bourbon as 100, the values of the better kinds were :—

White Transparent	...	100
Mani ...	...	100
Po-a-ole ...	...	98.5
Red Ribbon	...	94.4
&c.		&c.

None of these varieties on the large scale equal in productiveness the Bourbon, besides they have defects either from the cultural or the manufacturing point of view or from both.

Few of these varieties are now to be found in the colony. Against 65, 608 acres or Bourbon in 1903-4 there were only 2,876 of White Transparent, and experiments with these varieties have now been discontinued.

(b) *Newer varieties raised from seed.*—In British Guiana we have raised about $\frac{1}{3}$ million of canes, and have selected some 26,000 for field experiments. Out of these we have selected a few hundreds for continued experiments, and from them the planters have selected a very few, say 50 varieties, as being possibly of value. Out of that 50, about one dozen show promise of being of actual value.

On an area of 35 acres preliminary small scale experiments are carried on, selecting the parent varieties first ; then the vigorous seedlings ; third culturally ; fourth, analytically ; fifth, repeating third and fourth methods with second and third ratoons ; sixth, growing on plots of 1-20th acre under identical conditions, and then selecting about one-fourth of third or fourth ratoons ; seventhly, several varieties of fifth and sixth selections will have been selected by planters by large-scale cultivation, and are now examined by manurial experiments.

The following shows the relative values up to third ratoons of the best of the varieties submitted to the sixth selection :—

No of variety.	Saccharose in expressed juice per acre of canes.	1900-1904. Indicated yields compare with Bourbon as 100.
147 B.	5.20 tons	175.7
145	5.11 "	172
625	4.99 "	168.2
115	4.74 "	160.5
1,087	4.70 "	157.4
109	4.66 "	157.3
74	4.63 "	154
2,468	4.11 "	137
2,190	4.10 "	136.7
1,640	4.05 "	135.9
3,157	4.05 "	135.9
132	4.03 "	134.4
2,028	3.98 "	133.9
1,896	3.97 "	132.9
1,880	3.96 "	131.3
116	3.78 "	127.5
130	3.72 "	126.8
135	3.72 "	125.2
754	3.60 "	123.8
102	3.37 "	123.2
117	3.19 "	113.
White Transparent	3.15 "	107.3
1,483	3.06 "	105.6
1,905	3.01 "	104.6
Bourbon	3.01 "	100.

The relative values of those of seventh selection are :—

D. 625	248.8
D. 116	219.1
D. 145	215.4
D 130	202.
D. 109	195.1
D. 115	189.8
D. 78	189
D. 95	188.2
D. 74	184.5
D. 3,957	182.5
White Transparent	142.2
147 B.	124.4
Bourbon	100
D. 2,190	100

Experiments on Sugar Estates.—Small scale experiments on estates are not considered of any value, but experiments have been established under which only results obtained on not less than areas of one acre and repeated on not less than 6 estates are required.

Some results of these field trials showing yield and proportions of yields compared with those of Bourbon and of white Transparent taken as 100 :—

No of variety.	Tons commercial sugar per acre.	Bourbon=100.	W. Transparent=100.
D. 625	2.58	137.2	150.
D. 95	2.06	111.2	121.5
Sealy	2.06	109.6	120
D. 145	1.99	105.8	115.7
D. 109	1.98	105.3	115.1
B. 147	1.93	102.6	112.2
Bourbon	1.88	100	109.4
D. 94	1.75	93.1	101.7
W. Transparent	1.72	91.5	100

Out of a total area of 78,468 acres under cane in 1903-1904, about 12,000 acres are under new seedling varieties. Of these the favourites are D. 109, B. 147, D. 145, D. 625, and B. 208.

In the selection of seedling varieties, more attention should be given to the size of the cane, number of shoots to the stool, and its ratooning power, rather than to its higher saccharine content.

The advantage of the seedlings most appreciated is that several yield remunerative crops where Bourbon will not now thrive.

Manurial Experiments.—Lime, 5 tons to acre, increases fertility of heavy clay-land in British Guiana. The excess yield upon limed plots in 9 crops amounted to 33 tons of canes on un-manured plots, and 35 tons on manured land.

Phosphates have as a rule exerted some effect when applied to plant canes, applying slag-phosphate at the rate of 900lb. per acre. Potash is not required.

Nitrogen—Results obtained over ten crops in 13 years indicate that every 10 lbs. of nitrogen in the form of sulphate of ammonia when added in proportions up to 300 lbs. per acre, give approximately 1.3 tons of canes, or say 2⅓ cwts. of commercial (96 %) sugar. It is an easy matter to estimate knowing the prices of sulphate of ammonia and of sugar respectively, if manurings on land in good heart with sulphate of ammonia are likely or not to prove profitable. Similarly with nitrate of soda up to 250 lbs. each 10 lbs. of nitrogen gives 1.4 tons of canes, or 2½ cwts. of sugar.

Experiments prove that all new varieties require manuring with nitrogen to give satisfactory results.

The nitrogen which accumulates in the upper layers of the soil during long periods of forest growth or of fallowing, while the land is covered by dense growth of sedges, grasses and leguminous plants, suffers great and rapid losses when the soil is put under intensive sugar cane cultivation, and it is to the loss of the accumilated stores of readily available nitrogen that the marked falling off in the yield of canes per acre which is almost invariably noticed when successive crops are taken off from either new or from long rested soils is due. This loss is greatly diminished where very heavy dressings of farm-yard or pen manure are regularly used and upon very heavy clay soils the loss may be reduced to a minimum and an actual gain ensue. The loss is greater on soils manured with nitrate of soda, than when sulphate of ammonia is used; and is greater on limed, than on not-limed soils.

Whilst there was a loss of phosphoric acid, it appeared that cultural operations have made probably available more potash, and more lime, each year than is required for the growth of the sugar cane.

The following are the general deductions arrived at during these experiments:—

(1) Nitrogen in the form of sulphate of ammonia, of nitrate of soda, or raw guano, and of dried blood exerted a favourable influence upon the yield of the sugar-cane, and is the manurial constituent which mainly governs the yield of the plant.

(2) Dressings of from 2 to 3 cwt. of sulphate of ammonia per acre appear to be the most certainly profitable applications of nitrogen.

(3) The application of superphosphate of lime to plant-canes may give increased yields when added to manurings of nitrogen and potash, but ratoons should be manured with nitrogen only.

(4) Slag phosphate is preferable to superphosphate of lime, but the use of basic superphosphate is promising.

(5) The effect of lime, chiefly mechanical, in improving the texture of the soil, may be obtained perhaps at a lower cost by using light ploughs or other cultivators.

(6) The addition of phosphoric acid, of potash, or of lime, does not affect the sugar contents of the juice of canes. The effects of nitrogen retards ripening, and thus the juice is not so rich in saccharose as is that of canes grown without manure. But this is more than offset by the larger yield of produce.

(7) Mineral phosphates to give increased yields must be applied to the soil in such heavy dressings as to render their use unprofitable.

(8) The addition of potash exerts little or no effect.

The normal weathering of the constituents of the soil while under good tillage sets free for each crop potash in excess of the quantity necessary for the requirements for the plants. This holds good under the conditions existent in British Guiana where the greater proportion of the potash taken up by the plants is directly returned to the soil, but where practically the whole of the produce is removed from the land it is probable that partial potash-exhaustion may take place in the course of a succession of crops of sugar cane.

Several of the new varieties appear to be able to utilise the nitrogen in the deeper layers of the soil to better advantage than the Bourbon cane does, and this is a matter of great importance with regard to the economical production of sugar from the sugar cane.

THE RELATION OF FORESTS TO STREAM FLOW.

By JAMES W. TOUMEY.*

Collaborator, Bureau of Forestry, U.S.A.

INTRODUCTION.

For the purpose of the present discussion "forest" must be understood to mean a growth of trees sufficiently dense to form a fairly unbroken canopy of tops, not a scattered growth of low, round-headed trees with bushes and herbage constituting the dominant types of vegetation.

Forests of this kind do not occur in the United States where the mean annual precipitation falls below 18 to 20 inches, except on restricted areas where unusual conditions prevail. The line of separation between the great eastern forest area and the plains approximately coincides with a north and south line marking a mean annual rainfall of 20 inches. The streams which rise in the Rocky Mountains and flow eastward are bordered by forests for long distances into the plains, where the annual rainfall is much less than 20 inches. These forests, however, are not so much a result of the rainfall in the regions where they occur as of surface and seepage flow from adjacent regions. The mesquito forests of the desert regions of southern Arizona, where the mean annual rainfall is but 8 to 12 inches, are made possibly by the seepage and surface waters from the adjacent mountains.

The question of the exact relation which exists between forests and stream flow has long been under discussion. The broad fact that a relation exists is indeed indisputable. Forest destruction always produces a change in the character of the run-off. But the scientific determination of all the causes which produce this effect, and of their relative importance is a difficult and complicated matter. In spite of the fact that for many years European forest experiment stations have been carrying on observations, mea-

* From "Yearbook of the U. States Department of Agriculture, 1903."

surements, and experiments designed to clear up this subject, final conclusions covering the whole field have not yet been established. In this country almost nothing has ever been done to secure accurate data for the investigation of this problem as a whole. Some light, however, has been thrown on the subject by means of a series of observations which have been going on for several years in the San Bernardino mountains in southern California. It is the purpose of the present article to make clear what are the various factors entering into the problem, and to state some of the more important facts that these observations in southern California reveal.

In the San Bernardino mountains records of precipitation for several years, at a large number of stations, show that differences in forest cover are closely correlated with differences in rainfall. This correlation is so close that it is possible to judge the mean annual precipitation with a fair degree of accuracy from the appearance of the forest alone. In these mountains forests cover the slopes wherever the mean annual rainfall exceeds 20 to 24 inches ; however, on southern and western slopes forests of equal density represent a larger rainfall than on nothern and eastern slopes.

Other things being equal, regions having the greatest rainfall bear forests of the greatest density and luxuriancy of growth ; but where the mean annual rainfall falls below 18 to 20 inches, types of vegetation in which trees predominate are replaced by those in which shrubs and herbage predominate.

WHAT CAUSES RAINFALL.

Because rainfall is most abundant where forests grow, many believe that forests exert an important influence on the amount of precipitation. A more reasonable inference, however, is that *rainfall is the great factor in controlling the distribution and density of forests.*

Precipitation occurs whenever the air is suddenly cooled below the dew-point. The most effective cause of this is the expansion of air in ascending. This upward movement is caused very largely by cyclonic storms.

Whether forests have any appreciable effect in cooling the air to below the dew-point is uncertain. From the known effect of forests on the temperature and relative humidity of the air, it is reasonable to infer that they may have some such effect, at least to a small degree, and consequently that they have some influence in increasing precipitation. The present evidence, however, derived from many series of observations conducted in Europe and elsewhere, is so conflicting that a definite answer to this question, having the stamp of scientific accuracy, is not possible.

WHAT BECOMES OF THE RAINFALL.

That the excessive destruction of forests is followed by the drying up of streams and springs and by a diminution in the minimum flow of rivers is a well established fact. The forest is the most effective agent known in regulating the disposition of the precipitation after it reaches the ground.

Rainfall escapes from the ground upon which it falls in five ways—through evaporation, transpiration, surface run-off, seepage run-off and deep seepage. By evaporation is meant the moisture which passes into the atmosphere in the form of vapour from water and soil surfaces and from objects resting upon such surfaces, including vegetation. Transpiration is that portion of the rainfall which sinks into the soil, and which is later taken up by the vegetation through the roots and given off to the atmosphere through the stems and foliage. To this latter should be added, although not actually a part of it, the comparatively small amount of moisture taken up by the vegetation, but which through chemical change becomes a part of the organic vegetable structure. By surface or superficial run-off is meant that portion of the precipitation which, from the time of falling until its exit from the drainage basin, passes over the surface without gaining access to the soil. On the other hand, by seepage run-off is meant that portion of the rainfall which sinks into the earth, but which later reappears on the surface at lower elevations, and with the surface run-off escapes from the drainage basin in the streams. By deep seepage is meant that portion of the precipitation which sinks into the soil, but to such depths that it does not reappear later on the surface of the drainage basin.

Evaporation and transpiration are frequently classed together as evaporation. In the irrigated parts of the West they are together known as "fly-off". So, also, the rainfall which does not escape through evaporation and transpiration or through deep seepage is often classed as run-off or stream flow.

DO FORESTS INFLUENCE EVAPORATION?

In order that the moisture which falls to the earth in the form of rain and snow should be most efficient in sustaining vegetation and in feeding streams, as little as possible should escape in the form of evaporation. Under the best of conditions a very large part of the annual rainfall is returned to the atmosphere through evaporation. For humid regions, bearing the same types of vegetation, the amount does not vary much from year to year, no matter what the fluctuations in rainfall are—a fact first made known by Messrs. Lawes, Gilbert and Barrington in the classical Rothamsted investigations. These gentlemen explain this persistency in the rate of evaporation by the fact that heat and abundant rain seldom occur at the same time. Consequently, in a wet season, the lower temperature and more or less saturated atmosphere prevent excessive exaporation; while in a dry season, although the temperature is higher and the air drier, there is less water to evaporate, and the two extreme conditions balance each other so far as the amount of evaporation is considered. This is not true, however, in arid and sub-arid regions, because during years of minimum rainfall the upper layers of the soil are often so dry for months at a time that there is very little moisture to evaporate, while on the other hand during years of maximum precipitation the atmosphere is not sufficiently saturated to check rapid evaporation.

There is little or no difference between evaporation from a water surface and from any other surface that is thoroughly wet, when both are exposed to the same atmospheric conditions. The evaporation from a water surface is, however, always the same under the same conditions, but it is not the same from other surfaces, because they vary from completely wet to completely dry.

In the forest the crowns of the trees remain wet but a short time after precipitation. During this period, however, the evaporation is undoubtedly very rapid, on account of the large surface and from the fact that the crowns are exposed to the wind and sun. But in a long series of investigations made at the Forest Experiment Station at Nancy, France, and recently published, it was found that a deciduous forest near that station held back from the ground less than 8 per cent. of the total precipitation. Although this is almost immediately returned to the atmosphere in the form of evaporation, it is a comparatively small amount of the annual rainfall. On the other hand, evaporation from the soil in the open and in the forest continues often for long periods after the precipitation ceases. After the crowns become dry, evaporation is much retarded in the forest, because the forest floor is protected from the wind and sun. To such an extent is this true that the loss of moisture through evaporation is much less than that lost from an equally saturated soil or from a water surface in the open. Repeated European observations, extending over long periods of time and shorter observations made in this country, conclusively show that evaporation from water or other wet surfaces on the floor of the forest is but one-third or one-fourth that from similar surfaces in the open. From the investigations of the moisture content of soils in the San Bernardino Mountains, the results of which are as yet unpublished, it appears that the first foot in depth of the mineral soil in the forest may contain two or three times as much moisture as soil of the same general character from similar situations in the open.

During the summer it is impossible to determine by actual measurement the loss of water from the soil either in the forest or in the open, because conditions as to the moisture content constantly vary. During the winter, however, the evaporation from a snow surface can be measured with a fair degree of accuracy. Measurements made in the San Bernardino Mountains show that evaporation from snow surfaces may be four or five times as great as from water surfaces under similar exposure, and also that the rate of snow evaporation is profoundly influenced by the wind. In our western mountains, where the snows are exposed to dry winds, the loss through evaporation is a large percentage of the total snowfall. In the San Bernardino Mountains, snowfalls a foot in depth are sometimes evaporated in two or three days without even moistening the soil. In so far as forests check the winter winds and provide shade, they lessen winter evaporation. This lessening of the evaporation from snow surfaces, through the action of forests, is seen in the fact that snows linger much later in spring in well-wooded regions than in open areas.

It appears, then, that forests materially retard evaporation, both of soil moisture and of snow fall.

DO FORESTS INFLUENCE TRANSPIRATION?

When land is covered with vegetation a certain amount of the rainfall is taken up by the growing plants. A small part, through chemical change, becomes incorporated into the plant, but the larger part is returned to the atmosphere through transpiration. Although those who have investigated this subject are by no means in accord, there is reason to believe that considerable difference exists in the amount of water taken up by the different types of vegetation in the process of growth. On the whole, the forest probably takes up less water from the soil than the average agricultural crop. Risler, from a lengthy series of investigations, reached the conclusion that forests actually take up less than one-half as much water from the soil as the average agricultural crop.

The above would lead one to infer that where the soil, if not covered with forest growth, is clothed with grass or some other low form of vegetation, the return of moisture to the atmosphere, through evaporation and transpiration, or, in other words, the "fly-off," is less from the forest than from the open. But in regions having a short wet season followed by a long dry one the return of moisture to the atmosphere is probably greater from a forested area, because in the open for a large part of the year there is very little to evaporate, and the scanty growth of grass and other low forms of vegetation gives little opportunity for loss through transpiration.

THE INFLUENCE OF FORESTS IN REGULATING THE RUN-OFF.

Stream flow consists of both surface run-off and seepage run-off. Although these two cannot be separately determined, total run-off admits of accurate measurement. Surface run off may be considered as flood water, while seepage run-off is that portion of the drainage which gives the streams a sustained flow. It is evident that any factor which decreases the surface or superficial run-off and increases the seepage run-off is of the utmost importance in regulating the flow of streams.

The proportion of flood water to seepage is influenced by the rapidity of the rainfall. It is well known from direct observation that a slowly falling, prolonged rain, even on the naked soil of steep slopes, is all taken up by the soil. On the other hand, a heavy shower of short duration, falling on the same slope, may largely escape as run-off. In the first instance each drop has time to be absorbed by the soil, while in the latter the accumulation of drops is more rapid than the absorption, and the excess moves over the surface to lower elevations. The forest canopy very perceptibly extends the period of time during which the rain reaches the soil, and in this way lessens surface run-off.

Again, forests. by checking the velocity of wind and covering the mineral soil with a thick layer of dead leaves and other forest litter, effectively prevent soil transportation by both wind and water. On high elevations, where streams generally have their birth, the influence of the forest in this respect is of the utmost importance. So great is this influence that it exerts a marked effect upon topography. In mountainous regions particularly, the repeated destruction of forests permits the soil formed by the decomposition of the rocks at the sources of streams to be transported to lower elevations, with a consequent slow change in the details of the landscape. Such regions, if unforested, are apt to have precipitous slopes and scanty soil on the higher elevations. In that case there is no adequate medium to absorb the rain, and it flows over the surface. On the other hand, if such regions are well wooded, the slopes are less precipitous, and a considerable depth of soil usually covers the broad summits. As a result, the rain water is absorbed and the surface flow is reduced to a minimum.

Not only is it essential to have an adequate medium present to absorb the rain, but it must be of such a character as to absorb quickly. The rapidity with which rain is absorbed is very largely governed by the physical properties of the soil, the organic litter upon it, and the vegetation. Decayed organic matter, by itself or in combination with mineral soil, absorbs moisture much more rapidly than soil containing little or no organic matter; hence, the greater the amount of leaf mould and other litter, the more rapidly will the rain be absorbed. Rapidity of absorption is also influenced by the degree of looseness of the mineral soil. In the forest the mulch of leaves and litter keeps the mineral soil loose and in the best condition for rapid absorption.

Not all the rain that is not absorbed by the soil where it falls reaches the streams by flowing over the surface. Much of it is taken up in passing from the place of falling to the stream. The amount taken up depends upon the obstructions in its pathway. Where there are no obstacles, as on barren ground, the moving water, by eroding channels, forms small rivulets, and these larger and larger ones, which flow with constantly increasing velocity. As a result, the water passes rapidly over the surface, and but little gets into the soil. When the soil is covered with obstructions, such as are offered by a forest with its accumulation of litter and vegetable growth, the rain which is not immediately absorbed is checked in its flow over the surface. The water, being held back, is finally taken up by the soil and thus prevented from forming small rivulets through erosive action.

The forest, in extending the time during which the rain reaches the soil, in its effect upon local topography, and in supplying a larger and better absorbing medium, must necessarily have a profound influence in increasing the seepage run-off, and in proportionately decreasing the surface flow.

COMPARISON OF RUN-OFF FROM FORESTED AND NONFORESTED AREAS.

There are so many complex conditions influencing the flow of streams that it is extremely difficult to determine the effect of forests on run-off by the comparison of the discharge of streams on forested and nonforested catchment areas. It is believed by many that stream flow is so largely influenced by the amount intensity, and character of the precipitation, the configuration and area of the catchment basin, the character of the absorbing medium and the underlying rocks, and the general climate, as well as the forest itself, that we shall probably never be able to measure quantitatively the influence of forests on the flow of streams by the comparison of forested and nonforested regions. Catchment areas differ so greatly in the features mentioned above that our most conservative and able investigators have been forced to the conclusion that " in respect to run-off, each stream is a law unto itself." Although the above is probably in the main true, yet, by the careful selection of small catchment basins for comparison, it appears that the influence of the forest in diminishing the surface run-off can be determined with a fair degree of accuracy. When the catchment areas compared are in the same region, are influenced by the same or nearly the same climate and precipitation and by the same storms, have approximately the same configuration and area, and have a similar mineral soil and underlying rocks, the effect of these various factors on the run-off can be ignored, and the differences in the behaviour of the stream flow on the forested and nonforested areas can be assigned to the influence of the forest.

In a careful study of the behaviour of the stream flow on several small catchment areas in the San Bernardino Mountains, it has been found that the effect of the forest in decreasing surface flow on small catchment basins is enormous, as shown in the following tables, where three well-timbered areas are compared with a non-timbered one :

Precipitation and run-off during December, 1899

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square miles.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0 70	Forested ...	19+	36−	3
1.05	do. ...	19+	73+	6
1.47	do. ...	19+	70−	6
.53	Nonforested ...	13—	312+	40

At the beginning of the rainy season, in early December, the soil on all four of these basins was very dry as a result of the long dry season. The accumulation of litter, duff, humus, and soil on the forest-covered catchment areas absorbed 95 per cent, of the unusually large precipitation. On the nonforested area only 60 per cent. of the precipitation was absorbed, although the rainfall was much less.

Rainfall and run-off during January, February, and March, 1900.

Area of catchment basin.	Condition as to cover.	Precipitation.	Run-off per square mile.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0.70	Forested ...	24	452	35
1.05	do. ...	24	428	33
1.47	do. ...	24	557	43
.53	Nonforested ...	16	828	95

The most striking feature of this table as compared with the previous one is the uniformly large run-off as compared with the rainfall. This clearly shows the enormous amount of water taken up by a dry soil, either forested or nonforested, as compared with one already nearly filled to saturation. During the three months here noted, on the forested basins about three-eights of the rainfall appeared in the run off, while on the nonforested area nineteen-twentieths appeared in the run off.

Rapidity of decrease in run-off after the close of the rainy season.

Area of catchment basin.	Condition as to cover.	Precipitation.	April run-off per sq. mile.	May run-off per sq. mile.	June run-off sq. mile.
Sq. miles.		Inches.	Acre—feet.	Acre—feet.	Acre—feet.
0.70	Forested	1.6	153—	66—	25—
1 05	do. ..	1.6	146—	70	30—
1.47	do. ...	1.6	166	74	30
.53	Nonforested ...	1	56	2—	0

The above table clearly shows the importance of forests in sustaining the flow of mountain streams. The three forested catchment areas, which, during December, experienced a run-off of but 5 per cent, of the heavy precipitation for that month, and which during January, February, and March of the following year had a run-off of approximately 37 per cent. of the total precipitation, experienced a well sustained stream flow three months after the close of the rainy season. The nonforested catchment area, which during December, experienced a run-off of 40 per cent. of the rainfall, and which during the three following months had a run-off of 95 per cent. of the precipitation, experienced a run-off in April (per square mile) of less than one-third of that from the forested catchment areas, and in June the flow from the nonforested area had ceased altogether.

DO FORESTS INCREASE THE RUN-OFF ?

Owing to the very complex nature of the investigation involved in determining the effect of forests on the amount of run-off, the available evidence does not admit a definite answer that will be of general application. It is reasonably certain from present evidence that in some regions the effect of the forest is materially to increase the run-off. It appears equally certain, however, that in other regions, and on certain classes of catchment areas, the effect of the forest is to materially decrease the stream flow

Mr. Rafter, in his recent publication, "Relation of rainfall to run-off," makes this statement: "With similar rainfalls, two streams, one in a region having dense primeval forests, the other in a region wholly or partially deforested, will show different run-off. The one with the dense forest will show a larger run-off than the stream in the deforested area." This author concludes, from the careful study of a large number of catchment areas in the State of New York, that the effect of the forest on at least a portion of the area studied is to increase the run-off to an amount equal to from 5 to 6 inches in depth over the entire catchment area.

In humid regions, where the precipitation is fairly evenly distributed over the year, and where the catchment area is sufficiently large to permit the greater part of the seepage to enter the stream above the point where it is guaged, the evidence accumulated to date indicates that stream flow is materially increased by the presence of forests.

In regions characterized by a short wet season and a long dry one, as in southern California and many other portions of the West, present evidence indicates, at least on small mountainous catchment areas, that the forest very materially decreases the total amount of run-off.

Annual rainfall and run-off on forested and nonforested catchment areas in the San Bernardino Mountains, California.

Area of catchment Basin.	Condition as to cover.	Precipitation.	Run-off per sq. mile.	Run-off in percentage of precipitation.
Sq. miles.		Inches.	Acre—feet.	Per cent.
0.70	Forested .	46	731	28
1.05	do. ...	46	756	30
1.47	do. ...	46	904	36
.53	Nonforested ..	33	1,192	69

On small nonforested catchment areas in the West, and possibly on large ones as well, a very large part of the heavy precipitation of the rainy season flows over the surface, quickly reaches the stream, and is discharged from the catchment area as flood water, much as water escapes from the roof of a building. On such areas the actual loss through evaporation during the dry season is probably far less than from a well-wooded area, because the surface soil and streams are dry, and there is very little moisture left to evaporate. On such denuded areas it appears that the run-off for the few months that the streams flow is considerably larger than that for the entire year from similar forested areas. Although a nonforested area may, in certain instances, produce a larger run-off than a forested one, this probably never occurs except when the run-off from the nonforested area is largely flood water, and of destructive rather than constructive significance.

CONCLUSION.

In conclusion, it may be said that although the forest may have, on the whole, but little appreciable effect in increasing the rainfall and the annual run-off, its economic importance in regulating the flow of streams is beyond computation. The great indirect value of the forest is the effect which it has in preventing wind and water erosion, thus allowing the soil on hills and mountains to remain where it is formed, and in other ways providing an adequate absorbing medium at the sources of the water courses of the country. It is the amount of water that passes into the soil, not the amount of rainfall, that makes a region garden or desert.

CULTURE OF ORNAMENTAL AND FLOWERING SHRUBS AND CLIMBERS.

By WILLIAM J. THOMPSON, F.R.H.S. Travelling Instructor, and Superintendent, Kingston Public Garden.

It should be remembered that when plants of this class are put out, it is usually intended that they are to remain in the same position for a long time. This being so, care should be taken to see that the land they are to be planted in is deeply cultivated—that is to say, holes should be dug to a depth of about two feet, and from three to four feet across: the same soil should be put back in each hole with a half barrel of rotten manure, or succulent weeds may be mixed with the soil, and in planting, the base of the plant should be placed so that when the soil has settled down, it will be at least three inches below the surface of the surrounding ground. By paying attention to this simple rule, the shrubs or climbers planted will not need half the water and attention if the base of the plant is placed on a level with the surrounding ground, or a little above it.

The shrubs or climbers having been planted, it is of great importance that each plant is given about four gallons of water, to settle the soil about their roots and to start them growing. This copious watering at the time of planting is of the greatest importance.

Beyond watering and keeping clean, the plants will not need any special attention until they are beginning to outgrow the space allotted to them.

When it becomes necessary to prune the plants, it should be done just as they have finished flowering and before they begin to start into growth again.

If the plants are attacked by scale insects it will be an indication that they are getting in poor condition, and the most effective and least expensive way of improving their condition will be to prune them back to within about eighteen inches of the ground, and have the soil about the roots cultivated to about fifteen inches deep, and from a foot to three feet wide. In doing this be careful not to disturb the soil within a radius of twelve inches of the stem of each plant. All roots met with in carrying out this cultivation may be cut away without any harm being done to the plants. When the cultivation has been carried out, that is the same soil and a little manure put back into the trench, a few gallons of water should be given each plant.

To some people the above may seem an expensive way of cultivating; but I can assure them, that it gives the best results in the long run.

SAFFRON.

Crocus sativus is a light-purple autumnal-flowering species. It yields the saffron of the shops, which consists of the deep, orange-coloured stigmas of the flowers gathered with part of the style and carefully dried. A grain of good commercial saffron is said to contain the stigmas and styles of nine flowers, and consequently 4,320 flowers are required to yield one ounce of saffron.

The flowers appear in the late autumn. Though termed perennial, it must be remembered that each corm, which may be regarded as a joint of a short vertical rhizome, has but a duration of two years.

The mode of collection and preparation of saffron *varies somewhat in different countries, although in all it consists essentially in removing the stigmas with the upper part of the style from the other parts of the flower, and afterwards drying the parts thus detached. In France, the flowers are gathered at the end of September or the beginning of October, after which the stigmas with the end of the style, are quickly removed ; and these parts are then immediately dried on sieves over a gentle fire, the drying process only taking half an hour. In the Abruzzi, the gathering takes place in the early morning, at the latter part of October and during the whole of November. The collectors are chiefly women, who are furnished for the purpose with wicker baskets, which they place on their arms, and as they pass along the furrows left as pathways between the ridges of saffron plants, they pluck the whole flowers and place them in their baskets, in which they carry them home : the stigmas being removed afterwards at leisure, and then dried.

Saffron was formerly in great repute as a stimulant, antispasmodic, and emmenagogue ; but at present it is scarcely ever employed for such purposes. Its chief use in medicine is as a colouring and flavouring agent. As a condiment it is, however, still much in use in various parts of the Continent, as in Austria, Germany, and Switzerland ; and to some extent even in parts of Great Britain. In India saffron is extensively employed by the natives in their religious ceremonies, as also in medicine, and as a condimentary substance. Saffron is also used by bird fanciers, as hey believe it assists the moulting of birds.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, VIII.†

(*Continued from Bulletin for February.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

CASTILLOA AS A SHADE TREE.

The substitution of Castilloa or other rubber-producing species for the unproductive shade trees commonly grown with coffee, cacao, and other tropical crops has been persistently advocated ever since the subject of rubber culture began to receive popular attention. The advantage of such a plan appears so obvious and

*See Bentley and Trimen's Medicinal Plants.

† Extract from the U. S. Department of Agriculture. Bull. No. 49, Bureau of Plant Industry.

certain that many experienced tropical agriculturists have been betrayed into direct and even emphatic statements for which the facts have unfortunately failed to provide a warrant. Indeed, it might be said that this phase of rubber culture affords the best illustration of the lack of definite knowledge which hinders practical progress.

In the first place, the shading of coffee and cacao is a subject upon which there is much popular misconception and difference of opinion, the planters of some regions shading heavily and those of others not at all, and explaining their methods by the most contradictory reasons.* It seems, however, that there is not the slightest reason to believe that either coffee or cacao is injured by standing in the sunlight, or is in any way advantaged by having its leaves shaded, though in countries subject to a long dry season the shading of the ground and the retention of atmospheric humidity may be beneficial cultural measures. That Castilloa is in no way adapted for serving these purposes is apparent as soon as it is known that wherever there is a distinct dry season the leaves fall off at exactly the time when they are most needed. It is true that they would still be of some service in covering the earth, but on the other hand, the loss of the accustomed shade renders the atmosphere much drier and may be a distinct injury to the coffee.

Not only does Castilloa thus lack the first qualification of a shade tree, but its cultural requirements and those of coffee are entirely at variance. Castilloa seems likely to produce rubber in paying quantities only at low elevations, while the profitable cultivation of coffee is seldom considered possible at an altitude of less than 1,000 feet. In elevated continuously humid coffee districts the rubber trees will hold their leaves but will produce little or no rubber, while to choose an intermediate situation would be more likely to insure two failures than to double the chances of success.

The suggestion of Castilloa for cacao shade is somewhat more rational, since both trees are natives of the same regions of low elevation. As noted elsewhere, rubber was first planted at Tapachula as shade for cacao, but the experiment did not appear promising from the standpoint of the cacao, and was abandoned. Some of the cacao trees still remain, but they have never been vigorous and produce very little. Other causes of failure may, of course, exist, but it seems certain that the close planting which is now favoured would make a rubber plantation a very poor place for cacao, and there is every reason to believe that, while cacao may not be benefited by shade, it may be seriously injured by sudden exposure to the sun, as happens when the leaves of Castilloa fall in the dry season.

A further difficulty in the use of Castilloa as shade is that in

* These have been discussed in some detail in Bulletin No. 25, Division of Botany, U. S. Department of Agriculture, entitled "Shade in Coffee Culture." Also see Bulletin of the Department of Agriculture, Jamaica, June and July, 1903.

order to permit anything to grow under it, wide planting is necessary, and this usually means a spreading low growth for the rubber trees, generally considered undesirable, because it makes the extraction of rubber difficult if it does not actually decrease the yield.

Vanilla culture under Castilloa has also been suggested, and may be worthy of consideration, since it is held that a period of dryness and exposure to the sun is necessary for the proper ripening of the pods. To successfully combine two or three cultures is, however, a difficult matter, even when all are well known, but the supposed practicability of such combinations has rested on ignorance of important details.

Several years ago the culture of Castilloa received a considerable impetus from the recommendation of Dr. Daniel Morris, now Imperial Commissioner of Agriculture for the British West Indies, that Castilloa be used as shade for coffee and cacao in British Honduras, and an estimated return was made of $5 per tree in eight or ten years, or $125 per acre, to be repeated at intervals of five years.

According to Dr. Carl Sapper, a German scientist very familiar with Central America, this advice has been followed with disastrous results. He says:

In fact, the developments thus far in the field of Castilloa culture show on the average very little in the way of favourable results. Particularly does it seem to have failed completely when it has been combined with other tree cultures in order to lessen the expenses of opening rubber ptantations. Thus, on the advice of the well-known English botanist, D. Morrris (then in Jamaica), rubber trees were planted for shade in the coffee plantation San Felipe, near El Cayo, in British Honduras, and the result was that these shade trees ruined the coffee, but did not on the other hand themselves develop normally, because they were planted too close. In other places, as in Tabasco, in the Department of Pichucalco, in Chiapas, and in Chamá (Department of Alta Verapaz, Guatemala) rubber trees were used for shade on cacao plantations, but the cacao planters tell me that ule trees impair the growth of the cacao and do further damage through the falling of the leaves, so that they would much prefer to be rid of these shade trees if that were practicable. In other instances, where the ule was planted by itself, too close an arrangement was chosen, so that the trees were impeded in development, and are still after 12 years of existence mere tall, slender, unproductive poles, as at Los Amates, Department Izabal, Guatemala, with only four yards of space." *

It seems, however that Dr. Morris has a favourable report regarding Castilloa as a shade tree for cacao, both in British Honduras and in the West Indies, and his former advice was repeated before the Agricultural Conference of the West Indies in 1901. He said:

In 1883 I published an account of the Castilloa rubber tree of British Honduras and the manner of extracting and curing the rubber. At that time I recommended that these trees might be used as shade trees for cacao. A trial was made sixteen years ago on a cacao plantation on the Settee River, and I learn from a letter from the Superintendent of the botanic garden at Belize, dated November 8 last, that the rubber trees have answered admirably for this purpose. He writes: "At Kendal on the Settee River the cacao plantations are thriving well. * * * Cas-

* Der Tropenpflanzer.

tilloa was planted for shade; these are also in good condition; * * * * there is not a better tree for that purpose." I am glad to find that similar results are reported from Trinidad and Tobago.*

The report from Tobago, to which Dr. Morris refers, is particularly enthusiastic, and seems to indicate that under the conditions existing on that island the planting of Castilloa with cacao may not be inadvisable:

I find that cacao bears very well under the shade of Castilloa. Nine years ago I planted an acre of rubber and cacao together—the rubbers at 24 feet apart and the cacao 12 feet—and so far as I have noticed there is very little, if any difference, in the bearing of these cacao trees and those under the shade of the *Bois immortel*. On finding this, I planted last year 15 acres in the same manner, and there is every reason to expect that in another eight or nine years they will give a gross return of about 50 pounds per acre. Coffee also bears well under *Castilloa*.†

The difference between Castilloa and leguminous shade trees may become apparent in later years as the nitrogenous constituents of the soil become exhausted. As explained elsewhere, the question is not whether Castilloa can be used as a shade tree, but whether it will be productive where it is of use in this capacity.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 10th January, 1905. Present: the Hon. the Colonial Secretary, presiding, Mr. Wm. Harris, Acting Director of Public Gardens; the Island Chemist; His Grace the Archbishop, the Hon. T. Capper, Messrs. C. A. T. Fursdon, C. E. deMercado and the Secretary, John Barclay.

Trade Marks—With regard to the Colonial Secretary's letter re the amendment of the section 25 of Law 31 of 1903, concerning Trade Marks, after discussion it was resolved to reply to the Colonial Secretary that the Board feared that the proposed amendment would serve little useful purpose, because it could be so easily evaded, as trade marks could be taken out in other names, and used by an exporter.

The Secretary was also instructed to say that the members of a former committee which had considered the whole matter of the orange industry had been asked for their opinions, and six were in favour of the proposed amendment and four against it.

Sugar Industry Fund—The Secretary submitted a letter from the Acting Treasurer, showing statement of the Board's account with the Treasury in the matter of the Sugar Industry Fund up to 30th September, 1904, and showing as receipt in addition to the £1,000 Imperial Grant interest on loans to sugar planters amounting to £400 13s., making a total of £10,400 13., and payments

* West Indian Bulletin, 2 : 113, 1901.
† West Indian Bulletin, 2 : 111, 1901.

amounting to £830 5s. 6d., leaving a balance of £9,570 7s. 6d. A receipt was asked for from the Board as a final discharge to the amount shown as payment, and the Chairman was asked to give the necessary receipt, after the statement had been checked by the Chemist.

Shows—A letter from Mr. Cradwick to the Director of Public Gardens was submitted, stating that as the Montpelier Show had been put forward to the 23rd March, instead of the 24th May, he asked to be allowed to postpone his visit to Portland until April, instead of March, so that he might act as secretary to the Show.

This was agreed to.

Water Buffalo—The Secretary submitted a letter from Mr. S. Henderson, Woodford Lodge, Trinidad, giving the details asked for regarding water buffalo cattle, saying that he would have much pleasure in taking the representatives from Jamaica at the Agricultural Conference in Trinidad to see his cattle.

The Secretary was instructed to publish the information contained in this letter and what might be received from Mr. Fawcett and Mr. Williams.

Ramie—A letter was submitted from the Hon. H. Cork. addressed to the chairman, stating that he was informed that there was now a market for ramie fibre in Holland, which merely required that the material be sent in a dried state, and asking that information be obtained on the subject.

Blood from Slaughter House—The letter also asked that the matter of utilizing the blood at the Slaughter House and the city refuse as manure be considered.

The Chemist stated that the city refuse was only worth 12/6 per ton as a manure.

Chemist's Reports—The Chemist submitted his reports as follows :

1. Sugar Industry Funds—Financial details of the locked still experiment, showing an increase on the £300 estimated of £49 16s. 11d., and asking that the Board pass revised estimates of £355 to allow of a margin for contingencies.

This was agreed to, Mr. deMercado dissenting asking that his protest against the whole scheme be again noted, seeing that the Board had not authorized the scheme before it was commenced, and that it was subsequently approved only by a majority consisting of official members.

2. Financial details of new building at Laboratory, showing that the Public Works Department had expended £959 13s, a saving of £40 upon the £1,000 authorized. Statement of account with reference to the fittings and equipment of the Laboratory, showing an estimated liability of £808 12s. 10d. on the authorised expenditure of £1,000 leaving an estimated balance of £191 7s. 2d., and asking for authority to spend £154 as per further details submitted, which would leave a balance of £37. The Board agreed to

the expenditure, with the express understanding that these estimates should not be exceeded.

3. Standardization of Jamaica Rum—This was directed to be circulated.

4. Proposed legal standard for milk—giving details of the analyses of the milk of 92 Jamaica cows, and suggesting the adoption of the following standard for Jamaica: total solids, 12 per cent.; solids, not fat, 8½ per cent.; fat, 3¼ per cent. This was directed to be circulated for the remarks of the Board.

5. Application for admission as agricultural students by H. L. Forbes, Kingston, S. M. Daley, Stony Hill, L. A. Cooke, Kingston, and P. L. Irving, Deeside. It was agreed to admit the first three, and admission of the fourth (Irving) was left to the Chairman, when the Chemist submitted satisfactory particulars as to his means.

6. Progress Report, Sugar Department—This was directed to be circulated.

7. Details Diploma Examination—These were directed to be circulated.

The Acting Director of Public Gardens submitted reports as follows:—

1. Mr. Palache on School Gardens in Manchester.

2. Re cocoa trees dying in St. Mary—The Secretary was instructed to write cocoa planters in Highgate and Troja and get all the details he could, and ask Mr. Cradwick to make enquiry into the matter when he went to St. Mary in February.

3. Work of Hope Experiment Station—These three reports were directed to be circulated.

4. Letter from the Board of Trade, Commercial Department, London, with reference to the report by Mr. F. V. Chalmers, and asking for samples of tobacco to be sent them.

The Acting Director of Public Gardens was instructed to send the samples asked for.

The Acting Director of Public Gardens reported that he had now two crops of tobacco in store, amounting to over a ton, and asked for instructions as to what price he should accept for it. On the motion of the Archbishop, the Department was authorized to dispose of the tobacco as best they could.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. APRIL, 1905. Part 4

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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ROSES.

By WALTER JEKYLL.

We live in a favoured land. Take up any English or American book on practical gardening, and it will be found that a great part of it is devoted to precautions against frost. Here we are spared both the thing and the precautions. Except for special purposes, such as showing, it may be said that no cultural directions for growing roses are necessary. Possibly, however, a few hints and reflections, together with a judicious modicum of warning may be found useful.

Let us suppose, then, that we have a few rose-plants, whether from our own cuttings or the gift of kind friends, or a consignment from a nurseryman. We will assume that sufficiently large holes have been dug at adequate distances—above all, not too close, which is the usual mistake—and that these have been filled again with soil (probably the same soil), and that this soil is sufficiently free, i.e. not sticky, so that it will clog the tender rootlets and prevent their growth. If it is so, there is no particular need to add any enrichment; indeed, an artificially-enriched soil will be a hindrance at first, and fresh manure positively injurious and probably fatal. Handle your young plant tenderly, as you would any baby thing, and if you have no experience, call in a coffee or orange planter to show how the rootlets should be gently spread out and the covering earth laid lightly over them. Do not press the soil down at all; a good watering will settle it sufficiently. Then shade with any handy small stuff, taking care that the plant is left airy. If it is winter, put the shading on the east, south and west sides, leaving the north side open; if spring, be extra careful about the head shading, if summer, the south side will be left open. How much shade is necessary will depend upon locality; in hot places it must be thicker, in cool places less thick. The point is to keep your plant cool and comfortable. The shade had better be left on for some weeks, and finally lightened by degrees, instead of throwing it all off on one day. Pieces of palm-leaves make excellent shade, and few things are better than Umbrella Grass (Cyperus).

If the weather is dry, water must be given every day or two. On no account allow the young plants to flower. This requires a little self-denial. We are so anxious for quick results, and if the rose is one that we do not know, we want to see what it is like. Resist temptation and ruthlessly nip off all buds, or you will have poor, weak plants.

If the soil is naturally rich, the plants will go on well for some time, but if they look poor, manure may be given, and if large flowers are wanted, the roses must have liberal treatment. Indeed, when they are established bushes, they may get as much manure as can be spared. A mulch, spread thick, is always a benefit when they have emerged from babyhood and come to years of discretion.

To those who are choosing roses from catalogues the following hints may be useful. Never attempt to grow any of the Hybrid Perpetuals; they do not like Jamaica. People often make the mistake of wanting to grow what others have not got. They see Tea Roses everywhere, and long perhaps for the sight and scent of old favourites of their youth at home. But let them put away this vain longing. The result of indulging it will be a forest of sticks, no leaves, very rarely a flower, and a bush that looks utterly miserable.

Of Hybrid Teas some do well, but most require a good deal of attention and care. In a country where we cannot have the old cabbage rose we are unwilling to be without the next best smell, and so we grow La France. It gives good enough flowers, but the bush never looks quite healthy. Captain Christy does better, and is decidedly worth growing. The much-vaunted and much-advertised Grüss an Teplitz does fairly well, but those who have a keen sense of colour will much prefer the glorious old Chinas, Cramoisi Supérieur, and its smaller, even more beautiful and sweeter, relation, Gloire des Rosomanes. These are both very common in Jamaica and are easily propagated, cuttings seldom missing. Madame Alfred Carrière does remarkably well and is one of the loveliest of roses in the eyes of those who care more for pure beauty than show, and the scent is delicious. Madame Ravary is so beautiful that it should be tried at high elevations; it seems to be impatient of heat. Papa Gontier is very fine and strong, and the buds are perfect; but no one with an eye for colour can admit it into any part of his garden. It was with great regret that I did away with a rose that has such remarkable strength and vigour and healthiness of leaf, but the colour of the fully-expanded blossoms is impossible. Of Viscountess Folkestone, so splended at home, I have no experience, but I cannot pass over its name without mention, and most people know and are fond of Kaiserin Augusta Victoria.

We now come to the Tea and Noisette section. These are the roses for Jamaica, and there are only a few that do not thrive. The third name in the alphabetical list in the catalogue under my eye happens to be one of the failures. This is Aimée Vibert, and I much regret it, for it is wonderfully beautiful. Alister Stella Gray, on the other hand, is admirable. Not only does it supply the place of the Yellow Banksia, which does not thrive, but it has the additional merit of being always in flower. Others to be greatly recommended are Anna Olivier, Beauté Inconstante, Catherine Mermet, Cloth of Gold, Gilbert Nabonnand—one of the very best with its loose, shell-like petals,—Hon. Edith Gifford, which is perhaps the most flowery of all, Madame Chedane Guinoisseau, Madame Falcot, Madame Hoste, Marie Van Houtte (the strongest bush-rose in the whole garden), Rêve d'Or = America (the strongest of the climbers), Sunset, The Bride, White Maman Cochet, and William Allen Richardson.

Billiard-and-Barre is an exquisite rose in this class, but the leaves are poor, and the same may be said of the, otherwise fine, Climbing Perle des Jardins. Céline Forestier is a very ugly rose here as far as its growth is concerned, but it is worth growing in out-of-the-way places for the sake of the beautiful form of the flower when three-quarters expanded. Comtesse de Nadaillac, much prized in England, is a comparative failure; the flowers burn in the sun, as do those of Souvenir d'un Ami and Etoile de Lyon. No rose that is subject to sunburn is worth keeping. Devoniensis, always lovely in bud, has an awkward straggly growth. I leave the one old plant, but make no new ones. L'Idéal is not the success that I hoped, and sometimes the colour is suspect. Ma Capucine, in spite of its pretty coppery buds, is hardly worth growing: it bleaches too much, and Sunset, which is something in the same style, is an improvement upon it. Madame Carnot is a thoroughly bad rose here, ill-formed and poor in every way. Madame Lambard had, most unexpectedly, to be condemned for its bad colour; occasionally it is beautiful—as beautiful as Catherine Mermet,—but nine out of ten of its flowers have that blue tinge which is so disagreeable. Maréchal Niel is a complete disappointment and is done away with. The flowers burn or damp off, and it is not worth keeping for the sake of an occasional good flower, although all must be sensible of its beauty and enamoured of its delicious tea scent.

Souvenir de J. B. Guillot was an experiment that failed. The catalogue describe it as "coppery orange red, base of petals metallic yellow." As a rule I avoid all reds unless certified good by an expert in colour, but here I thought I was safe. Alas for fond hopes! In bud it was all that the catalogue promised, but, fully open, it was nearly—not quite, for that is impossible—as bad as Papa Gontier. It went on the rubbish-heap. Souvenir d'Elise, described as "very large, full, and most perfect globular form" is, to my mind, very ugly in form and far too tight. Sunrise, one of the best and most faithful—for it does not bleach—of the coppers has a poor constitution and wants nursing, but it is worth it.

Three of the roses in the above list are very much alike, viz.: Marie Van Houtte, White Maman Cochet and The Bride. They are all splendid, but personally I prefer the last. Marie turns a full and rather uninteresting pink at certain times of year, and Maman has a sprawly growth, whereas The Bride is sturdy and upright. For those who esteem size, Maman is the best.

It must be understood that I am speaking throughout only of what I know. No doubt there are many other roses in this class as good as my best, and here it may be well to add that my own experience is confined to a locality which has an elevation of 2,000 feet.

Among the Bourbons the old Malmaison is always admirable; strong, free and healthy.

The Dwarf Polyanthas seem to do well. Perle d'Or is most beautiful, and Léonie Lamesch, which I have not tried, is said (from a safe source) to be a lovely colour. White Pet has a bad manner of growth, and, though it flowers profusely, does not seem quite healthy.

In ordering roses from England it is, perhaps, as well to note that *dwarfs* must be asked for in all classes. Of 36 in one consignment, only one died and owing to the weather, they were the rather unusual time of three weeks on the journey. I see no difference in the health of these English plants, budded on briars, and that of my own cuttings on their own roots, and I find the English names correct, whereas the American names are not always to be depended upon.

Let no one attempt Briars or Moss roses or Wichurianas; they will be failures. Also avoid Gloire de Dijon and all its derivatives; they do not like heat, or perhaps it would be more correct to say that they want a winter. Félicité Perpétue is also to be avoided: it will not flower.

Two of the best roses for Jamaica have dropped out of catalogues. They are Henry Bennett, a constant bloomer, and its near relation Madame Joseph Schwartz. These are admirable roses in a mixed garden. So are Cramoisi and Gloire des Rosomanes, Perle d'Or and W. A. Richardson. Other kinds are, for various reasons best by themselves in a garden of their own. If the mixed garden is on a slope, Rêve d'Or and Cloth of Gold are useful as heavy screens from sun where shady places are desired, but in a flat garden it is waste to have roses overhead which only the birds see.

The exquisitely-beautiful Cherokee rose (R. lævigata) must not be forgotten. Nothing is lovelier in the hills: nothing more deliciously sweet.

No rule as to distance in planting can be given. Captain Christys may be put in 3 feet apart; Marie Van Houttes must have 10 or more. All depends upon the manner of growth of each rose.

Nothing has been said about pruning, because this is a subject which hardly admits of successful treatment in writing. It is so entirely a matter of practice and general horticultural intelligence. Dead wood should, of course, be cut out, and branches that interfere with each other. Where roses are much cut for the house, this is probably in itself a sufficient pruning, and everybody knows that the old flowers should be taken off.

CANKER OF COCOA.

The Canker or Coral Spot Disease of Cocoa stems is due to a species of Nectria, as explained in the *Bulletin of the Botanical Department, Jamaica*, Aug. 1901, pages 121, 122. The following notes are taken from a leaflet published by the Board of Agriculture and Fisheries, London, on a Coral Spot Disease which attacks trees in the British Isles. Attention is directed to the 'Preventive Measures,' which are applicable also in Jamaica.

CORAL-SPOT DISEASE.

One of the most common and most generally distributed of British fungi is that to which the name of Coral-Spot Disease has been given. (*Nectria cinnabarina*). The first stage of the disease takes the form of bright coral-red warts, which are about the size of millet seed, and are thickly scattered over the surface of dead or dying branches of the tree attacked. These red warts are very conspicuous, and at one time this condition of the fungus was considered to be an independent plant, and called *Tubercularia vulgaris*. At this stage numerous and exceedingly minute spores are produced, and readily scattered by the wind or by insects.

At a later stage the coral-red changes to a rusty-brown colour. The surface becomes rough with projecting points, and a second form of fruit is produced. In many instances the fungus passes through all its stages on dead branches, and in such a case no direct injury will be done, but rather a certain amount of good consequent upon the hastened decay of the wood on which the fungus is growing. The indirect danger arising from its presence on dead wood is the possibility of infection of living plants by the spores produced. The earliest indication of disease caused by *Nectria cinnabarina* is the drooping and yellowing of the leaves, which soon die and fall to the ground. In a few weeks the bark becomes slightly shrivelled, and the characteristic coral-red warts appear on the surface. Death of the leaves, and finally of the branch, is due to the choking of the wood vessels by the *mycelium*, which cuts off the supply of water and food.

The fungus is remarkable for the great number of species of woody plants upon which it can grow and produce perfect fruit, being met with on all fruit and forest trees, excepting conifers, and also on various shrubs. Amongst plants specially susceptible to the attacks of *Nectria* may be mentioned sycamore, elm. hazel, apple, pear, and red and black currants.

Preventive Measures.

1. Whenever diseased branches are observed they should be removed and burned without delay, as after infection recovery is impossible, and any delay in removal permits the formation of spores and probable infection of neighbouring plants.

2. Fallen branches, stored pea-rods, poles, &c., are often literally covered with the bright coral-pink warts of the *Nectria*, and should then at once be destroyed.

3. When pruning, it is a wise precaution to protect every cut or damaged surface with a coat of gas-tar, and also to remove and trim the ends of branches broken by the wind or by other agency.

VANILLA INDUSTRY.

By J. R. JACKSON, A.L.S.

Some curious facts have recently come to hand regarding the vanilla cultivation in Tahiti and Mauritius. The exports from Tahiti to the United States have been declining, apparently from the inferiority of the product. The small trade that now exists seems to be generally in the hands of Chinamen, who encourage trade with the natives by accepting options on the vanilla output, and ultimately receive the beans in the crudest form and proceed to cure them. The name Tahiti, as applied to vanilla, is said to be sufficient to condemn the exports from the colony, and the American Consul has endeavoured to enlist the interest of the officials in a plan for compulsory inspection and grading under the control of the Government. The matter, however, has not been looked upon favourably by the officials, though it has by many planters and merchants. The Consul therefore warns importers of vanilla from Tahiti carefully to examine any beans that they have reason to suspect of being cured by Chinese, as these traders are accustomed to pick up beans that have been rejected by others as totally unfit for market, soak them in salt water or let them remain for a time in coconut oil, and then pack them in the bottoms of tins containing better grades. Chinamen will buy even mouldy vanilla pods and mix them with sound ones. It is stated, however, that there are a few companies of native planters who are trying to put a high-grade vanilla on the market.

With regard to Mauritius, a better tone accompanies the information on the cultivation of the plant in that island, where it is stated, a Committee was recently appointed to make recommendations for amending the laws relating to vanilla. The following notes are gathered from the report of this Committee: That vanilla grows luxuriantly in Mauritius and constitutes an important source of revenue. There is practically no disease on fully-grown plants, and the failures in certain plantations are mostly due to bad cultivation. There are some 3,000 vanilla planters in the island, but the majority of these are small proprietors who have a few plants in their gardens or orchards. The exports of prepared vanilla in 1902 amounted to 7,712 ℔., and the cultivation is capable of considerable extension. In spite of care taken to save the pods, they are subject to the depredations of thieves, whom, owing to the nature of the product, it is very difficult to detect. With the view, therefore, of protecting the planters, it is recommended that stringent regulations be made for the licensing of all sellers and purchasers of vanilla, the fixing of a special mark by growers on their green pods, and the giving of notice to the authorities before vanilla is gathered. It was also recommended that a special inspector be appointed for the purpose of reporting on all vanilla plantations, preparing houses, etc.

In the Seychelles, the vanilla cultivation has for some time been very successful, and large quantities have been offered for sale in the London market, mostly realizing good prices. At the first auction of the year, on January 13, the quantity of vanilla offered was so large that the sale was not completed till late on the following day (the 14th). As many as 2,860 tins were put up for sale, the total weight of which was about 15¾ tons, and constituted a record bulk, the chief portion being from the Seychelles. Nearly the whole of this quantity was sold during the two days at fairly good prices, fine quality realizing from 12s. to 15s. 6d. per ℔.

It is worthy of note, in connection with the foregoing remarks, that the fear expressed some years back that the synthetic production of vanillin would ruin the vanilla culture, has not yet been fulfilled. The numerous and increasing uses of vanilla for flavouring purposes in chocolates and other kinds of confectionery are accountable to a large extent for the present very large consumption of vanilla.—*Gardener's Chronicle of December 24, 1904.*

NOTES ON FERN CULTURE.

Nearly all ferns require a quantity of water and should never be dry at the roots at any season, consequently a very important matter is that of efficient drainage.

Anything like a sour or water-logged soil is detrimental even to those ferns which are not easily injured in other respects.

Success in the cultivation of established plants depends more on this, with careful watering, atmospheric moisture and shade, than on any soil in which they may be grown.

The majority of our native ferns will succeed well in a mixture of peat and loam which should contain a fair amount of old brick and lime rubble broken up to about the size of beans, to ensure porosity. Charcoal may also be used for the same purpose.

DISCOVERY OF MANICOBA RUBBER FORESTS.*

During the past few months discovery has been made that there are in the interior of this state vast forests of trees from which can be produced a high grade of rubber known to the trade as "maniçoba," or "Ceará."† The area is said to be very large, but cannot be defined, as the region has not been fully explored. The attention called to the first discovery, has led to further exploration, with the result that from time to time comes notice of other sections where like trees occur in profusion.

The output of maniçoba rubber has rapidly increased during the last few years and bids fair to be so large an item in the exports of this district as to warrant specific report.

The tree which furnishes the product from which maniçoba rubber is made is known, in most sections, as "mandioca brava," which means "wild mandioc." It is so named because of the marked resemblance of the young trees to the mandioc,‡ which forms the most common crop of all sections. It in reality belongs to the same family, but unlike the other, produces latex and seed. During prolonged droughts the people have dug up its roots and ground and prepared them as in mandioc, though with greater labour and less benefit, because of the smaller amount of nourishment contained in the finished product, and the work necessary to wash out the greater amount of poison.

It is native to many parts of Brazil, and when planted will grow on the interior plains and highlands as well as close to the sea. It has been observed to grow from near the equator to the southern limits of Brazil, except in those sections which, because of their altitude, have frosts or rapid and marked changes in temperature. It is very susceptible to frost, being either killed or injured thereby when bananas and other tropical plants would be unhurt. In its wild state it has been known for some time in Ceará and Piauhy, and from those states has come the greater part of the maniçoba rubber of commerce, but it is now believed to exist in even greater abundance in Bahia. It is also cultivated in many sections, large plantations having been set out during the last few years in Sergipe, Bahia, and other states.

* Report by United States Consul Furniss, Bahia, Brazil.

† *Manihot Glaziovii.* ‡ *i.e.*, Cassava.

The tree grows rapidly from either seeds or cuttings. In four or five years it will reach a height of from 20 to 50 feet, and a circumference of from 12 to 50 inches, depending upon the soil and climatic conditions. It grows erect and branches some distance above the ground.

I have never seen the tree in flower, but am told that after it is 4 or 5 years old it produces numerous flowers, which are followed by nut-like fruits about the size of a large plum, each one containing four seeds. When the seeds have reached maturity the shells suddenly and forcibly break open, hurling the seeds to some distance. The seeds resemble weather-beaten cherry seeds in shape and colour, though much larger, thicker and harder. On account of their hardness they are not readily attacked by insects, resist water, and do not easily germinate. The seeds will average about 900 to the kilogram (2.2 pounds). They can be bought here for about $1 a kilogram, and for much less if taken in quantities.

As has been stated, the tree is reproduced either by seeds or by cuttings taken from old trees. When the seeds are used it is considered best to plant them in beds, 2 or 3 inches apart. The proper time to plant is just before the rainy season. On account of the slowness with which the seeds germinate, many file two edges of the shells carefully until they are just cut through, thus permitting rapid entrance of moisture. The seeds are planted about an inch below the surface in a place exposed to the sun and are watered from time to time if necessary. They come up in from three to six weeks. Others soak seeds in water about a week and then plant them as described above, when they will come up in from two to four months. Year-old seeds are said to germinate best, and good seeds can be told by the rapidity with which they sink in water. When planted in the ground in the ordinary way they sometimes do not come up until the following year.

As soon as the plants are a few inches high, and while the rains are yet on, they should be transplanted about 10 feet apart. When reproduction by cuttings is desired, branches are taken from old trees and stuck in the ground to the depth of 2 or 3 feet during the rainy season, when they soon take root.

Seedlings are said to be preferable, as they resist drought better. They produce latex later than cuttings, yet they are said to give more when the proper time comes and do not so readily die as a result of the extraction.

The best soil in which to plant is a question not yet settled. In the wild state the tree seems to flourish best on sandy soil mixed with clay, the clay aiding in retaining moisture, It also occurs in quantities on hard clay soils and on sandy soils which seem unfit for any other form of vegetation. I have seen in this State planted trees growing luxuriantly in the very sandy soil within sound of the sea. In some places in the State of Sergipe the tree grows well on the heavy black soils thought to be so essential to sugar cane culture. In Ceará, in a region which has periodic droughts of great duration, it is said to grow wild forming forests on the sides of hills the soil of which is clay containing reddish pebbles called 'iron stones.' From what I have seen I am inclined to believe that it will prosper, under proper climatic conditions, in any soil which will retain moisture, though doubtless the better the soil the stronger the trees.

The plants once up do not seem to demand much attention; at any rate they seldom get it. Some argue, particularly in Ceará, that underbrush is beneficial, retaining the moisture and protecting the trees, while others claim that the soil should be cultivated to produce the best results. It is my opinion that cultivation is desirable. The best trees I have seen have been in the open and had been cultivated.

Trees will produce milk after the first year or two, but it is thought best not to commence extraction before they are 4 or 5 years old; otherwise they are less capable of resisting drought and perish more easily. The latex seems to flow more freely during and immediately after the rainy season, but produces then a smaller percentage of rubber and coagulates less rapidly, requiring from four to six hours, which, because of the future treatment, is frequently a help rather than a detriment. During the dry season the flow of the latex is less. It then comes out drop by drop, contains a larger percentage of rubber, and frequently coagulates so rapidly as soon to close the orifice from which it is flowing. The temperature, likewise, seems to modify the flow, it being interrupted during the cold weather and augmented during the hot weather. In places constantly hot and humid there seems to be no interruption in the production of milk.

The manner of extracting, collecting, and preparing the latex varies in different sections. In some places serpentine incisions are made around the trunk of the tree, in other places a large horizontal chip is taken from the bark and wood, and in still other places either a slightly oblique or a V-shaped incision is made. The first method enables a larger and quicker collection of the milk, but tends to kill the tree. The second method exposes the tree to the destructive action of ants. The other two methods are the best, with a preference for the V-shaped incision as therewith a greater number of lactiferous ducts are cut with the least injury to the tree.

If either the V-shaped or the oblique incision is made, it is customary to commence at the height a man can reach and make them from 2 to 3 inches in length. Care should be taken not to cut through the bark to the wood. Two or three of these incisions, the number varying with the circumstance of the tree, may be made at intervals on a line with each other. On the following days like incisions may be made a few inches below the others until the tree has been tapped to within a foot or two of the ground. The tree should then rest for a couple of months, when the operation may be recommenced, new incisions being made parallel to the old ones.

The amount of rubber which may be extracted from each tree has been variously stated; but, depending as it does upon the age of the tree and the different conditions which affect its nourishment, it cannot help varying greatly. It was estimated that under good conditions, with the tapping done carefully at the best time, the average yield of a wild tree would be somewhat over 3 Troy ounces, while experiments made in Sergipe show that planted trees, partially cared for, and properly tapped, will yield a considerably greater quantity.

When it is remembered that about 676 trees can be planted to an acre, the product per acre, taking the average given, would be 676 kilos (1,490 pounds), which, at the present price of the best quality, (and if proper care is used there should be no other), would be worth $1,352. The value of the yield of plantations nearer the market, or with better transportation facilities, would be ev en greater. If the trees are planted on good ground other light crops can be grown between them, increasing the revenue.

The roots give the greatest quantity of milk, but it is not thought desirable to extract it there because the position is not so well adapted to its proper collection, the ascent and descent of the sap is interfered with more markedly, and the roots being exposed to the sun the closing of the cut ends of the lactiferous ducts by coagulation is more rapid.

The best rubber which has come to this market has been prepared by an American, who has acquired considerable property in the heart of the newly discovered region. His rubber has been prepared by keeping the milk liquid until he was able to fill up pans, then letting it coagulate, immediately thereafter submitting it to pressure between boards and subsequently washing and drying it on several days in succession. As a result he produces slabs one-fourth by 10 by 20 inches, of a beautiful amber colour, with agreeable odour and wonderful elasticity. His rubber has brought the best price offered in the market, and has been classed in New York and Liverpool as equal to first-quality Pará rubber. He informs me that he is making active preparation to go into the business on a more extensive scale by cleaning up the lands where the Maniçoba trees occur wild and planting in places where it does not now exist.

From my investigation I am convinced that the culture of Maniçoba could be most advantgeously introduced into the South of the United States, and particularly into Porto Rico and the Phillipines.

Besides the large areas in which Maniçoba trees occur wild in the State of Bahia, there are vast areas suited to their culture. The larger portion of the wild trees are on State lands, which can be acquired either outright by purchase or by lease granting privilege of rubber extraction, requiring a certain number of new trees to be planted each year and making provision for official inspection, &c.

Recently about all of the productive State lands so far discovered, have been leased, but this does not prevent some one other than the lessee from purchasing the land at any time, thus summarily terminating the lease. For this reason I would advise only purchase of land outright, especially since the land can be bought at a very reasonable figure.

DISEASES OF TOMATOES.

Bacterial Disease.

The following is the report of the Mycologist of the Imperial Department of Agriculture for the West Indies on a bacterial disease of tomatoes, published in the *Agricultural News* :—

Microscopic examination of the diseased tissues points to the disease being of bacterial origin. Such a disease, caused by *Bacillus solanacearum*, has been reported from several localities in the United States.

The first prominent indication of the disease is the sudden wilting of the foliage, which may occur first on a single shoot, but finally affects the whole plant.

Subsequently, if the plant is young and not very woody, the stem shrivels, changing to a yellowish green and finally to brown or black. The vascular bundles become brown before the shrivelling takes place. The organism attacks the parenchyma of the pith and bark, converting nearly the whole interior of soft stems into a mass of broken-down cells mixed with bacteria. The host plants are tomato, potato, and egg-plant, possibly also other solanaceous plants. Insects are largely responsible for the spread of the disease.

As preventive measures, the destruction of all leaf-eating and leaf-puncturing insects is the first thing to be considered. Early and complete removal of diseased plants, rotation of crops and selection of seed from plants grown where the disease is not prevalent are other suggestions of possible value in preventing the spread of the disease.

Sleepy Disease.

A leaflet of the Board of Agriculture and Fisheries, London, on the "Sleepy Disease" of tomatoes, (*Fusarium lycopersici*) is reprinted below :—

Description and appearance of Plants attacked.

The plant may be diseased inside when quite young, but the outward manifestations do not necessarily appear at once. The first indication that the tomato is affected is shown in the drooping of the leaves and their bad colour. If the root is split the woody portion is seen to be of a dingy yellowish brown colour, which becomes more marked if left open for half a day. When the plant has been attacked about three weeks the lower portion of the stem is usually covered with a delicate white bloom of mildew. Eventually the stem is covered with patches of a dull orange colour, and becomes very much decayed. The disease can always be identified by a brownish ring just within the bark at the base of the stem or thicker branches of the root.

The disease is due to a fungus which flourishes in the soil and enters the plant by the root. During its development it passes through three stages, the first of which usually lasts about a week, the stem at the end of that time being much decayed and covered with a gelatinous mass. During the last stage the spores are resting and preparing to attack the young plants another year, or whenever a suitable opportunity presents itself. The plant can only be attacked by the fungus in the last stage of its existence.

1. It must be remembered in the first place that diseased plants never recover, and therefore no attempt to save the plant is successful.

2. As the disease grows inside the plant, it is useless to spray with a fungicide.

3. As the resting spores of the fungus live and thrive in the earth and attack the plant through the root the disease must be attacked in that quarter.

It is therefore recommended that :—

Treatment.

1. All diseased plants should be uprooted immediately the disease is noticed, and should be burned.

2. The soil in which the plants grew should be removed and sterilised by heat, or mixed with a liberal allowance of quicklime.

3. If it is not practicable to remove the soil, it should receive a liberal dressing of gas-lime. This should be allowed to lie on the surface for ten days, and should afterwards be thoroughly incorporated with the soil. After this the soil should remain for at least ten weeks before anything is planted in it. It should be soaked with water once a week.

4. As much lime as the plants will allow should be mixed with the soil in which tomatoes are grown, more especially if they are grown in the same beds during successive seasons.

5. The infected soil from a bed should not be thrown out at random, but should be sterilised by admixture of quicklime, and care should be taken not to bring it in contact with tomato beds.

6. Only short-jointed sturdy plants should be used, and those should be fairly hard and the foliage of a dark bronze appearance. All spindly or drawn plants should be rejected.

7. The plants should be allowed plenty of air, light, and room for growth.

THE OPIUM POPPY.

By WILLIAM HARRIS, F.L.S., Superintendent of Hope Gardens.

The opium-poppy (Papaver somniferum) is an erect annual plant, slightly branched, 2 or 3 feet high with the stem and leaves of a glaucous green colour. The leaves are oblong in outline, pinnasect, and irregularly sinuous at the margin. The flowers are few, 3 to 7 inches across, composed of 2 sepals of the same colour as the leaves, 4 petals which are variable in colour, sometimes pure white with a greenish base, or pale violet with a dark purple or nearly black spot at the base, and numerous stamens. The fruit is a capsule, usually more or less globular, 1½ to 3 inches in diameter, containing numerous, very small reniform seeds which are white, grey, violet or black.

As in the case of most cultivated plants there are many varieties and forms.

The original home of the opium-poppy is probably south-eastern Europe and Asia, though at present it is met with throughout Europe and Asia, north-western Africa and North America.

The cultivation of the poppy for opium dates from antiquity and was carried on in Asia Minor, Italy and Greece in classical times. The spread of its culture through the nations of Asia appears to have been primarily due to the Arabs. It may be grown for this purpose in any warm country in suitable soil, but the yield of opium in temperate regions, though of equal quality, is small; at present the great opium-producing countries are India, China, Asia Minor, and Persia, and to a small extent in Egypt: it has also been grown in the south of Europe, in France, England, Germany, in California, Louisiana, and Virginia, and in Victoria and Queensland. The plant is also grown in many parts of Europe for the capsules and seeds—"Poppy-heads" and "Maw-seed."

Soil.—A sandy loam is considered the best for opium, the produce having a dark-brown colour. Alluvial land is good, but the opium is rather darker, more liquid and less granular.

Poppies may be grown year after year in the same land if it is manured, the dung of goats and sheep being considered the best manure for this purpose. Ashes are peculiarly valuable as a poppy-land manure, provided the potash has not been allowed to be washed out of them through carelessness. Nitrate of potash is said to be one of the best mineral manures for poppy and may either be applied as a top-dressing at different stages of the crop or scattered over the field after sowing the seed;—green manuring is also recommended.

Sowing the seed.—The land having been ploughed and harrowed the seed is sown in India about the middle of November and must be concluded in December. The seed is moistened the night before sowing, mixed with fine earth, and scattered broadcast at the rate of about 9 lbs. of seed per acre, and seed, according to variety, costs in France from 5d. to 8d. per lb.

When the plants are two inches high the land is weeded and the seedlings are thinned, the retained plants being about three or four inches apart. A fortnight later the field is again weeded and the weakest plants are removed, those that are allowed to remain being seven or eight inches from each other.

In dry districts the plants must be irrigated about once a fortnight.

Flowering, collecting the petals.—The plants take from 75 to 80 days from germination to reach the flowering stage. The petals are gently removed when fully matured, which is on the third day after expansion. These petals constitute the "flower leaves" of the manufacturers and are employed in the outer casing of the opium balls or cakes.

Collecting the juice.—The following is the Indian method. In the course of eight or ten days after gathering the petals, the capsules are sufficiently advanced for the extraction of the juice. Superficial, horizontal or diagonal incisions are made into the capsules as they successively advance to maturity, each capsule receiving from four to six incisions according to its size, a special instrument called a "nushtar" in India, being used for this purpose. This operation is best performed in the afternoons or evenings. The milky opium sap thus directed outwards is scraped off next morning into a shallow cup and allowed to dry in a place away from sunlight. When fresh the juice is pinkish, but below it there is a dark fluid like coffee, called "pussewah" in India. The vessel in which the collected juice is placed is slightly tilted to allow the pussewah to drain off into a covered jar.

The opium is turned every few days for three weeks or a month to ensure a uniform dryness. The drug, as prepared by the Indian Government, is tested by subjecting a small weighed quantity to a temperature of 200° F., when after everything volatile has been driven off, if it leaves a residue of 70 per cent. it is known as standard opium.

The opium is now put in wooden boxes, each holding ten cwts. and occasionally stirred up until it reaches the proper consistence.

It here becomes covered with a thin blackish crust, which deepens by the exposure to the air and light. If it is of a low consistence it is placed in shallow drawers and constantly turned till it reaches the quality of standard opium. The opium is then cut into pieces of twenty pounds in weight, thrown into shallow wooden drawers and thoroughly kneaded. It is then put in large cisterns and receives a further kneading by men who wade through it knee-deep.

Packing.—The petals which were gathered from the expanded flowers are damped overnight to make them pliant. Some of these "flower leaves" are placed in a brass cup and glued together with a mixture called "lewah," composed of inferior opium, "pussewah," and the washings of pots which have contained opium. Leaf after leaf is added till the shell is half an inch thick; the opium is then put into it, and the leaves which were allowed to hang over the edge of the cup are glued with "lewah" over the upper surface until the whole is encased with leaves and "lewah." The ball of opium now resembles a 24 pound shot, It is then rolled in the dried and powdered leaves and stems of the poppy plants, and exposed to the sun for three days. Should it become distended it is opened to allow the gas to escape and again closed. The balls of opium are then placed on open battens where they are exposed to a free current of air, and in two months' time they are ready for shipping.

From 40 to 70lbs. of the Smyrna variety of opium may be got from an acre, and this was worth 7/3 to 8/2 per lb. in England in December, 1904. At the same time Persian opium was sold at 13/ per lb.

Poppy Heads and Seeds—The poppy heads or capsules from which the juice was collected, are cut from the stems when ripe, stored, and the seeds are shaken out when dry. The seeds are pressed for the oil they contain, and yield from 40 to 50 per cent. of a bland pale golden-coloured oil, which may be bleached by exposure to the sun. The cold-drawn oil is fit for food, and is used to adulterate olive-oil. It is used for mixing paints; and as it saponifies readily, the inferior oil is used for making hard soap, and also for burning in lamps.

The dry cake, after the oil has been expressed, is capital food for cattle, and in India a coarse unleavened bread is made from it.

The opium obtained in Asia Minor, which is the most important variety known in Europe and the United States, is collected and prepared as follows:—

About the end of May, or sometimes even as late as July, according to the elevation of the land where the *Papaver somniferum* is cultivated, the plants, which are the variety *glabrum* of Boissier, arrive at maturity and the flowers expand. A few days after the petals have fallen, and when the capsule is of a light green hue, it is ready for incision, which is performed in the afternoon, and in the following manner:—A transverse incision is made with a knife about the middle of the capsule, the incision being carried round until it arrives nearly at the part where it commenced; or, sometimes, it is continued spirally to half-way beyond its starting-point; and in rare cases it is also incised vertically as well. The greatest precision is necessary in making the incision, for sho d it be too deep, and the interior coating of the capsule be also cut, the exuding juice would then flow into the inside and be lost; and if the incision be not deep enough, all the juice would not ooze out. It is also stated that in the former case the seeds will not ripen, and no oil can then be obtained from them. The following morning those engaged in collecting the opium lay a large poppy leaf on the palm of the left hand, and having a suitable knife in their right hand, they scrape the opium which has exuded from the incision in each capsule during the night, and then transfer it from the knife to the leaf. At every alternate scraping the knife is wetted with saliva by drawing it through the mouth to prevent the half-dried juice adhering to it. Each poppy capsule is, as a rule, only cut once, but as each plant produces several capsules which do not arrive at maturity at the same time, it is usual to pass over the field a second or even a third time, in order to incise such capsules as were not ready at the first cutting; and then the opportunity is also taken of recutting such capsules as exceed the usual size. As soon as a sufficient quantity of the half-dried juice has been collected to form a cake or lump, it is wrapped in poppy leaves, and put for a short time to dry in the shade. There is no given size for cakes of opium, and they vary very much, being from a few ounces to two or more pounds.

The cultivators, who are small land proprietors, then sell the opium to the merchants in the interior, and by these the opium is at once packed in bags together with the chaffy fruits of a species of *Rumex* to prevent the lumps from sticking together, after which the bags are sealed and placed in wicker baskets of an oblong shape and forwarded chiefly to Smyrna, although some of a superior quality is sent direct to Constantinople. But in some cases it would appear that the drug, which is purchased in a soft state, is incorporated into larger masses by means of a wooden pestle, then enveloped simply in poppy leaves, and afterwards packed in bags, sealed as before, and forwarded to Smyrna. The opium after being sold at Smyrna is transported to the buyer's warehouse, when the seals of the bags are broken in the presence of the buyer, seller and a public examiner, the latter of whom inspects the drug carefully and rejects any of suspicious quality. The examination of opium is not carried on after any scientific method, but its quality is judged of by its colour, odour, appearance and weight; nevertheless, the estimate is generally correct.

The seeds have no narcotic properties; the dark coloured kinds are called *maw-seeds* and are used as medicine for birds, and are largely eaten by them. The whole seed is prepared as a comfit like caraway, and is said to have an agreeable flavour.

The capsules contain a small quantity of the more important principles found in opium. The preparations of poppy capsules are similar in their effects to, but are much weaker, and less to be depended upon than those of opium.

Opium is one of the most valuable medicines known. For other medicines there are one or more substitutes, but for opium none—at least in the large majority of cases in which its peculiar and benficial effects are required. To this must be added, however, that while its proper use is of such inestimable value, its enormous consumption by the habitual opium eater, and in other ways, probably causes more misery to the human race than any other drug.

By far the most important constituent of opium is *morphia*, and hence the quality of opium is judged by the yield per cent. of this alkaloid ; it is combined with a peculiar acid called *meconic acid.* Besides these constituents, opium contains a number of other principles, some of which have basic, and others neutral properties. In many cases, however, the principles extracted from opium are secondary or derivative constituents which are produced in the processes employed by the chemist for the separation of its primary or natural constituents.

Opium is largely used in addition to its narcotic properties, as an alleviative, soporific, and antispasmodic. It is generally used either in a solid form or in tincture under the name of *laudanum.*

Varieties of Opium.—The varieties of opium which have been distinguished by pharmacologists are Smyrna, Constantinople, Egyptian, Persian, European, East Indian, and Chinese. Of these varieties, only the first four are ordinarily found in European and American commerce ; and of these, again, Maltass has shown that there is no real difference between the Smyrna and Constantinople varieties, both being the produce of the same districts, from which they are forwarded to Smyrna or Constantinople for sale, and are thence exported, but more particularly from Smyrna, to other parts of the world. These two latter varieties, which are the produce of Asia Minor, are those alone which are official in the British Pharmacopœia.

Asia Minor Opium.—Under this head are included all opiums which are known as *Smyrna, Constantinople, Turkey,* or *Levant.* It is the produce of *Papaver somniferum*, var. *glabrum,* the purple variety. It occurs in irregularly rounded or flattened masses, which vary commonly in size from about eight ounces to two pounds, but smaller and larger lumps may be also found. Externally the lumps are usually covered with portions of poppy leaves scattered over with the reddish-brown chaffy fruits of a species of *Rumex.* In some masses, in consequence of their having been much handled, the pericarps are more or less separated from the fruits ; so that the seeds are alone found upon the surface ; and in the kind of opium formerly distinguished as Constantinople, the Rumex fruits are generally entirely absent, the surface being covered with poppy leaves only. When first imported, the interior is moist and coarsely granular in appearance, and small shreds of the epicarp of the poppy capsule are commonly to be observed in its substance ; the colour is reddish or chesnut-brown. By keeping, the masses become harder and blackish-brown, or even quite black if kept for many years. The odour is strong, peculiar, narcotic, and unpleasant to most persons, although to others it is by no means disagreeable ; the taste is nauseously bitter. This is, as a rule, the best kind of opium, yielding on an average a larger proportion of morphia than any of the other kinds ; according to the British Pharmacopœia it should yield from six to eight per cent. at least.

Opium much richer in morphia may, however, be met with. The above proportions are those found in the drug as imported in its fresh and soft state. When dried, in which condition it should be alone used for pharmaceutical preparations, the authors of Pharmacographia say, that "good Smyrna opium ought to afford 12 to 15 per cent. of morphine, and that if the percentage is less than 10, adulteration may be suspected." In the Pharmacopœia of the United States it is also stated that opium, when dried at 212° until it ceases to lose weight, should yield at least 10 per cent. of morphia by the official process.

Adulterations.—Smyrna opium is frequently adulterated, and with various substances, such as sand, pounded poppy capsules, gum tragacanth, pulp of figs or apricots, gum arabic, molasses, starch, sugar, &c. It is also by no means rare to find bits of clay, stones, bullets, and other foreign matter in the masses; and, in some instances, opium is found in commerce from which the morphia has been extracted. The only reliable test of the purity and quality of opium is the proportion of morphia it yields.

Egyptian Opium,—This kind is obtained from the same variety of *Papaver somniferum* as that from which Asia Minor Opium is procured, but comparatively little, much less than formerly, is now met with in Europe and the United States. As usually seen it is in flattish or plano-convex cakes from 3 to 4 inches in diameter, and covered externally with portions of poppy leaves; but no Rumex fruits are found. Formerly, the cakes of Egyptian opium were always covered with the remains of a leaf with radiate venation, which was ascertained to be that of the Oriental Plane (*Platanus orientalis*). It is usually very hard and dry, although sometimes soft and plastic. It is distinguished from Asia Minor Opium by its dark liver colour, and by not blackening by keeping. Its odour is also less strong, and somewhat musty. It is frequently adulterated, and, as a rule, very inferior to Smyrna opium; but its quality varies much, for while ordinarily, as imported, it only yields 3 or 4 per cent. of morphia, in other cases as much as 8 per cent. has been found. Some chemists have also extracted much narcotine from this variety of opium.

Persian Opium. This is the Trebizond opium of Pereira. It is derived from *Papaver somniferum* var. *album*, the white flowered variety. It is found in various forms, thus, in somewhat flattened cylindrical sticks, in short, rounded cones, in flat, circular cakes, and in roundish, irregular lumps. The sticks, which are of very inferior quality, are about six inches in length, and about half an inch in diameter. Each one is enveloped in a smooth, shiny paper and tied with cotton. The other forms of Persian opium are either covered with broken stalks and leaves, or wrapped in paper. Fine Persian opium has a firm consistence, a good opium smell and taste, and a light brown, somewhat reddish colour. Some Persian opium has a greasy exterior, and when cut globules of oil may be seen in its interior. This oily character is caused by its being collected with a flat scraper or knife moistened, as well as the fingers of the gatherer, with linseed oil.

East Indian.—In India the cultivation of the opium-poppy is mainly confined to three centres which afford "Patna Opium" in Behar, "Benares Opium" in the North-West Provinces, and "Malwa Opium" in Central India.

The white variety of Poppy is the kind usually cultivated except in Central India, the "Malwa Opium" being largely the produce of the purple variety of Poppy.

The total area under Poppy cultivation in India is probably over 1,000,000 acres, and the Government derives a revenue of about £8,000,000 from exported opium.

For much of the information contained in these notes, which have been prepared at the request of a correspondent, I am indebted to the "Dictionary of the Economic Products of India" by Sir George Watt; "Subtropical Cultivations and Climates" by R. C. Haldane, and "Medicinal Plants" by Bentley & Trimen.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, IX.*

(*Continued from Bulletin for March.*)

By O. F. Cook, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

EXTRACTION OF THE LATEX OF CASTILLOA.

Scarcely second in practical importance to a solution of cultural problems is the attainment of satisfactory methods of tapping. The object is not merely to avoid the destruction of the trees, but to learn how the maximum quantity of rubber may be secured with the least injury to future productiveness. The planter needs to know how soon young rubber tress should be tapped, how the incisions should be made, how close together, how large, and in what direction, how often tapping may be repeated, at what seasons, and much more.

The first notion of the visitor from the United States is that it will be a very simple matter to improve on the rude gashes made by the machete of the rubber gatherer, but this has not proved to be easy. The rubber milk is not the sap of the tree and cannot be drawn out by boring holes in the trunk, as is done with the sugar maple. The milk does not pervade the tissues of the tree but is contained in delicate tubes running lengthwise in the inner layers of the bark, and to secure milk in any quantity it is neces-

* Extract from the U. S. Department of Agriculture, Bull. No. 49. Bureau of Plant Industry.

sary to open many of these tubes by wounding the bark. The rubber is formed in floating globules inside the tubes and can not pass through their walls, so that even a suction apparatus would not bring it out unless the tubes were cut.

PRIMITIVE METHODS OF TAPPING.

The method by which the natives of Soconusco have been accustomed to extract the milk is as follows :—The ulero makes with his machete diagonal lines of gashes that open channels along which the milk can flow until it is all brought to one side of the tree, whence it is led down to a cavity hollowed in the ground and lined with the tough leaves of Calathæa. These are dexterously lifted up, and the milk is poured out into a calabash or other vessel and carried away to be coagulated. The diagonal channels are from 2 to 3 feet apart, and those of each successive tapping are inserted between the older scars. The diagonal lines are carried well around the tree ; to tap it on the other side requires much deeper cuts in order to pass the milk across the older grooves, down which it would otherwise run and be lost. That the trees at La Zacualpa had been able to survive so much of this barbarous treatment and were still vigorous and heavily laden with fruit seems to indicate great tenacity of life. And yet even this rough handling represents an improvement upon the former custom of cutting the trees down entirely or hewing steps in them for the ulero to climb up. Instead of the forked stick used as a ladder at La Zacualpa the large forest trees were ascended for 30 feet or more by means of ropes, vines, climbing irons, and steps cut in the trunk. The following is a description of a method of tapping the trees in the forest of Nicaragua :

When the collectors find an untapped tree in the forest they first make a ladder out of the lianas or "vejucos" that hang from every tree. This they do by tying short pieces of wood across them with small lianas, many of which are as tough as cord They then proceed to score the bark with cuts which extend nearly around the tree, like the letter V, the point being downward. A cut like this is made about every 3 feet all the way up the trunk. The milk will all run out of the tree in about an hour after it is cut, and it is collected into a large tin bottle made flat on one side and furnished with straps to fasten onto a man's back. A decoction is made from a liana (*Calonyction speciosum*), and this, on being added to the milk in the proportion of 1 pint to the gallon, coagulates it to rubber, which is made into round, flat cakes. A large tree, 5 feet in diameter, will yield, when first cut, about 20 gallons of milk, each gallon of which makes 2½ pounds of rubber. I was told that the tree recovers from the wounds and may be cut again after the lapse of a few months ; but several I saw were killed through the large harlequin beetle (*Acrocinus longimanus*) laying its eggs in the cuts, and the grubs that are hatched boring great holes all through the trunk. When these grubs are at work you can hear their rasping by standing at the bottom of the tree, and the wood dust thrown out of their burrows accumulates in heaps on the ground below. (*a*)

(*To be continued.*)

(*a*) The Naturalist in Nicaragua. Thomas Belt, F.G.S., pp. 33-34. The liana called by Belt *Calonyction speciosum* is generally called *Ipomoea bona-nox*.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Head Quarter House on Tuesday 16th February, 1905, at 11.15 a.m. Present: The Director of Public Gardens, the Island Chemist, His Grace the Archbishop, Messrs. C. A. T. Fursdon, J. W. Middleton and John Barclay, the Secretary. The Chairman, the Hon. Colonial Secretary, wrote that as he had to attend a meeting of the Privy Council at the same hour, he could not attend, and His Grace the Archbishop was voted to the Chair.

The Archbishop asked leave to present a report of the Committee on the Teaching of Agricultural Science in Secondary Schools. The report was read and adopted. It was agreed that the Secretary should send a copy of the report to the Schools Commission, with the request that they would consider it.

Mr. Middleton remarked that there was no provision made to ensure the return of these trained men to the Island. It was agreed to ask the Schools Commission to consider this point; and the Committee was asked to continue its work.

The resignations of Hons. J. V. Calder and H. Cork and Mr. Joseph Shore as members of the Board were presented. The Secretary was directed to express the Board's regret, and to write the Agricultural Society asking if they would nominate a representative in the place of Mr. Cork.

The Secretary was instructed to suggest to the Governor the name of Mr. G. D. Murray to fill Mr. Calder's place as being accessible to Kingston and one who would represent the Sugar Industry.

The Chemist's reports on Sugar Experiments, and the Analyses of Milk, which had been circulated were submitted with the members' criticisms. The Chemist replied to the criticisms, protesting against the destruction of the experimental work at Worthy Park by Mr. Calder. The Chemist presented a report on the Banana Experiments at various centres, during 1904, in which he pointed out the difficulties of this work and the failure of planters to record the output of bunches from the manurial plots. These matters were left in the hands of the Chairman.

The Secretary submitted a copy of the Fruit Marks Act of Canada, together with a letter of explanation from the chief of the Fruit Division of the Department of Agriculture there. He was instructed to circulate these among the members of the Board for their opinions and to publish them, if possible, in the newspapers and the Agricultural Journal.

The Secretary stated that with reference to the reported dying out of cocoa trees in St. Mary, he had written cocoa planters in that parish, chiefly around Troja and Highgate districts, asking for reports on their cocoa trees and he had received replies from Messrs. John Lockett, Troja; F. N. Prendergast, Highgate; H. T. Graham, Highgate; W. Westmoreland, Highgate; E. Hope Dyer, Highgate; T. M. Gray, Clonmel. With the exception of Mr. Dyer, who was the correspondent of the "Daily Telegraph" who had raised the scare, and Mr. Lockett who was losing young cocoa trees, the general opinion was that some cocoa trees were dying through the after effects of the hurricane when the cocoa trees had not got proper attention in pruning back, relieving them of their pods and in moulding up the roots, but there was no general dying out of trees. He had sent copies of the letters to Mr. Cradwick who was engaged making enquiries in St. Mary and would soon make a report to the Director of Public Gardens.

A letter from the Managing Commissioner of Kingston General Commissioners with regard to the utilization of blood at the Slaughter House was submitted. It was thought that the cost of fitting up an apparatus to deal with the blood would cost more than the resulting fertiliser would warrant, and the whole matter was referred to the Chemist for a report to be made.

A letter from the Colonial Secretary was submitted notifying that the Inspector of Police for Hanover in reporting on that parish for the quarter ending 31st December, 1904, had called attention to a disease among coco-nut trees there which had destroyed a number of them.

The Secretary reported that Mr. Cradwick and Professor Earle had already made an investigation on the coco-nut trees in Hanover and reports had been made to the Board. A memorandum from the Director of Public Gardens on the subject was submitted and the Secretary was directed to send this to the Colonial Secretary, and to ask Mr. Fawcett to direct Mr. Cradwick's attention to the particular coco-nut trees referred to.

A letter was read from the Colonial Secretary with copy of letter from the Secretary of State for the Colonies saying that Armenians in Russian Caucasus, agriculturists and chiefly growers of tobacco, were being expelled and asking if any of these would be useful as immigrants in Jamaica. The Secretary was instructed to reply that more information appeared to be necessary. (1) As to whether these Armenians would be of a class that would devote themselves to general agricultural labour. (2) Whether they would be likely to continue long working on estates, or would desire to settle on their own land. (3) If the Government satisfied themselves on these and other points, a small number might be invited here to see how they would adapt themselves to our conditions. (4) If the Government decided to invite them to come, it should be prepared to allot crown lands.

A letter from the Colonial Secretary with enclosed letter from Sir Daniel Morris was submitted, saying that a suggestion had been made to hold the next Agricultural Conference in Jamaica and the Board was asked for its views. It was resolved to recommend to the Government that the Agricultural Conference should be held here in 1906.

The Reports of the Chemist were submitted as follows :—

(a) Report Agricultural Education for Christmas term 1904.
(b) Result Agricultural Scholarships Examination.
(c) Report Sugar Cane Experiment.
(d) Report Banana Experiments 1904.
(e) Completion of new Buildings of Laboratory.
(f) Arrangements of planters for Chemical control of Sugar and Rum.
(g) Letter re Cassava Factory.

The Secretary was instructed to circulate these reports with the exception of (b) which he was directed to send to the Schools Commission and to ask their consideration of the points raised.

Reports from the Director of Public Gardens were submitted as follows :—

1. Mr. Cradwick re Cane Tops sent out.
2. Tobacco—Correspondence with Mr. Chalmers and Board of Trade.
3. Sale of Tobacco Crop.
4. Experiment Station.
5. Travelling Instructors.

These were directed to be circulated.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. MAY, 1905. Part 5.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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KINGSTON, JAMAICA:
Hope Gardens.

1905.

JAMAICA.

BULLETIN

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Vol. III. MAY, 1905. Part 5.

NOTES ON SUGAR CANE FROM THE AGRICULTURAL CONFERENCE, TRINIDAD.*

I.—By PROF. J. P. D'ALBUQUERQUE.

The following table gives the average results during 1900-4 of some of the best of the earlier varieties cultivated as selected seedlings on small estate plots :—

1900-1904.

Variety.	Yield of Saccharose in pounds per acre.			Purity of Juice.
	Plants.	Ratoons.	Average.	
Black Soils :				
B. 208 ...	6,989	3,626	5,307	high
B. 147 ...	6,941	3,500	5,220	fair
White Transparent ...	6,675	3,040	4,857	high
Sealy Seedling ...	6,447	...	...	low
B. 376 ...	6,353	...	...	high
B. 645 ...	5,767	...	...	fair
D. 95 ...	5,157	4,114	4,635	high
B. 379 ...	...	2,067	...	high
Red Soils :				
B. 208 ...	7,071	4,762	5,916	very high
B. 376 ...	6,386	...	...	fair
Sealy Seedling ...	6,349	...	...	low
D. 95 ...	5,693	5,611	5,652	high
White Transparent ...	5,373	4,386	4,879	high
B. 147 ...	5,090	2,870	3,980	fair
B. 379 ...	...	5,557	...	very high

* For the complete papers, see W. Indian Bulletin, V. 4, 1905.

In black soils at Barbados for the most part plant canes are alone cultivated. The following, therefore, are the relative results, during these four years, of some of the best selected seedlings grown as plant canes in black soils, taking the White Transparent variety at 100 as the standard :—

White Transparent	...	100
B. 147 ...	...	104
B. 208 ...	...	105

In red soils the following were the corresponding average results for plants and ratoons :—

White Transparent	...	100
D. 95 ...	...	116
B. 208 ...	...	121

The average results of B. 147 in red soils place that variety below the White Transparent.

It should be pointed out, that the best variety judged by the average of all localities is not necessarily the variety that will give the best results on a particular estate. The planter should ascertain the reports of the varieties that give the best results in his locality, and in the first place give them a trial. In this way he will adapt the results to the circumstance of his own cultivation. This conclusion is well pointed by the results obtained with B. 147, which are much better in one or two parishes of Barbados than elsewhere in that island. In these parishes the increased yield is far beyond the average quoted above, and has been such as to justify one large proprietor in planting it on a large scale on several estates.

ARTIFICIAL CROSS FERTILIZATION.

This experiment has been successfully carried out last November by Mr. Lewton-Brain, Mycologist on the staff of the Imperial Department of Agriculture, who worked with some of the most promising varieties of Barbados seedlings. A very small proportion of the seed germinated, but sufficient to justify a continuation of the experiment next season on a much larger scale.

ATTEMPTS TO IMPROVE EXISTING VARIETIES BY CHEMICAL SELECTION OF THE 'SEED-CANE.'

During the period 1900-4 a continuous series of experiments has been carried on with the object of ascertaining whether it is possible, by repeatedly selecting plants from the richest plants of a given variety, gradually to increase the average richness of the variety.

It appears that, with a given variety, the richness or poorness of the seed-cane does not affect the quality of the juice of the resulting crop. If these results are confirmed by subsequent experiments, one of two conclusions seems inevitable. Either it is impossible, on account of disturbing influences, to ascertain the relative potential richness of individual canes of the same variety, or the average richness of a given variety is a constant property of the variety, and not capable, under ordinary conditions, of being influenced by making use of the ordinary variations, such as are found in seed-cane. The latter seems to us the more probable conclusion, a conclusion which is in harmony with the results in British Guiana of Professor Harrison, who concludes that the relative richness of seedlings is qualitatively, if not quantitatively, constant.

MANURIAL EXPERIMENTS.

The results may be stated in the following general terms :—

(1) Land that received no farmyard manure showed substantial increase in yield as the result of the application of artificial manures, containing nitrogen, phosphoric acid, and potash.

(2) In the case of land that had received large applications of farmyard manure, nitrogen as a rule, was the most important ingredient of artificial manures applied either to plant canes or ratoons.

(3) The application of phosphoric acid in the form of superphosphate or of basic slag in a few instances was followed by moderate or large increase of the returns, but in the majority of cases, it had either a very small effect or no effect.

(4) Potash in the form of sulphate of potash produced in many cases increased returns.

(5) Sulphate of ammonia appears in many cases to be slightly superior to nitrate of soda.

(6) At Dodds, the early application of dried blood has, in some seasons, given better results than other forms of nitrogen.

(7) The application of nitrogen, phosphoric acid, or potash appears to have no direct effect upon the composition of the cane juice. The beneficial effect of such applications apparently depends upon increase of cane growth. If, however, the nitrogen is applied too late, it retards or prevents the ripening of the cane, and so may lead to comparatively poor and impure juice.

(8) The application of slaked lime to the extent of half a ton per acre was followed, even in land that was rich in carbonate of lime, by substantial increase in the crop: a result apparently due to an improvement in the physical condition of heavy clay soils.

(9) The monetary result of the application of one or other constituent of artificial manures is so greatly dependent upon the market price of sugar, that it is difficult to make a simple statement of general utility for Barbados. The profit on manuring is the value of the increase of canes less the cost of the manure, and less the cost of manufacture. A manuring which, in one year at one market price, gives a profit, may in other years, result in loss.

The following recommendations appear to be those most generally applicable :—

(1) Where early cane manure is to be applied, the farmyard manure should be applied to the land at an interval of two or three months before the early cane manure.

(2) In the case of land that has been well manured with farm yard manure, apply soon after planting the canes 1 cwt. of sulphate of potash per acre.

(3) To the land that has received insufficient farmyard manure, or that is known to be deficient in available phosphoric acid, apply soon after planting the canes, 1½ cwt. superphosphate, (containing 40 per cent. available phosphate) or 2½ cwt. of good basic slag.

(4) In June, that is, at the beginning of the period of most active growth, apply 2 cwt. of sulphate of ammonia. In July or August, if, after heavy rains, the canes turn pale in colour, apply a further 1 cwt. of sulphate of ammonia.

(5) To ratoons, soon after the stumps begin to spring, apply 1 cwt. of nitrate of soda, 1 cwt. of sulphate of potash with or without 1½ cwt. of superphosphate according to the land. In June, apply 2 cwt. of sulphate of ammonia. A further application not later than August of 1 cwt. of sulphate of ammonia should only be made, if, after having heavy rains, the pale colour of the canes renders it likely that more nitrogen would be beneficial.

EXPERIMENTS ON TILLAGE.

A series of duplicate experiments was carried out during the season 1901-3 at Hampton plantation with a view of comparing the results of ordinary hand tillage, such as is practised in Barbados, with those of tillage with ordinary ploughs, subsoilers, American disc ploughs and cultivators. The results were in favour of hand tillage to the extent of about 500 lbs. sugar per acre, an amount that, in Barbados, would more than cover the extra cost of hand labour.

II.—By Hon. Dr. F. Watts.

These experiments may be classed in two periods. In 1891 experiments were instituted in Antigua to ascertain the manurial requirements of the sugar-cane and also to discover suitable canes for cultivation in that presidency. These were carried on until 1898.

This period covered the anxious time when cane diseases were rampant, and it seemed quite possible that the sugar industry would be seriously crippled or ruined.

It was difficult to draw reliable conclusions from the results of the manurial experiments of that period, for the canes on the various plots were so badly attacked by disease, principally 'rind fungus' (*Trichosphoeria*), as to make the results uncertain or contradictory, still by careful scrutiny we were able to arrive at some general conclusions.

These experiments, however, had a distinct value and served to settle some points in the public mind. It was seen that there was no relationship between the manures used and the occurrence of the cane disease, that manure neither caused it, nor could cure it. The canes of the plot being under close observation afforded useful information concerning the disease in a general way.

Under these circumstances, the experiments with varieties of sugar-cane at once assumed considerable importance, for on our experiment plots planters could see for themselves that certain varieties of canes were highly resistant, if not quite immune. I well remember an excellent demonstration where a plot of Bourbon canes grew side by side with a plot of White Transparent, so that the canes on the boundary interlaced: on the Bourbon side it was difficult to find a sound cane, while among the White Transparent it was equally difficult to find a diseased one. This was convincing and the lesson was speedily applied in practice.

Upon the formation of the Imperial Department of Agriculture for the West Indies the experiments were placed upon a broader basis and extended to the neighbouring presidency of St. Kitt's.

EXPERIMENTS WITH VARIETIES OF SUGAR CANE.

As the result of our experiments, we recommend for cautious introduction into Antigua: B. 208, B. 156, Sealy Seedling B. 306, B. 109, and D. 95.

In St. Kitt's, the following canes appear to be worthy of consideration: B. 393. B. 208, D. 74, White Transparent, B. 109, and B. 306. To these we must add B. 147 which has given excellent results over large areas, though it occupies a somewhat low place in our experiments. Of these D. 74, White Transparent, Mount Blanc, and B 306 appear to be fairly resistant to drought, while B. 268 appears to require a greater rainfall.

MANURIAL EXPERIMENTS.

We can only claim that our results are applicable to the conditions of the Leeward Islands. The peculiar features of other countries may render these conclusions inapplicable.

The first point of considerable interest which we think is demonstrated is that, if the soil is properly prepared and in its preparation an adequate quantity of good pen manure, or its equivalent, is used (about 20 tons of pen manure per acre), then artificial manures are neither necessary nor remunerative. This is a generalization of great importance to planters, particularly as it appears reasonable to urge that the use of pen manure, or its equivalent, is necessary in the Leeward Islands in order to maintain in the soil a sufficient supply of humus.

With ratoon cultivation the conditions are very different. There we find nitrogenous manures of great importance and necessary in order to obtain remunerative results.

Our experiments over the three seasons 1900-3 afforded data whereby we could ascertain whether the nitrogen, phosphate, and potash exercised any marked influence upon the saccharine richness of the sugar-cane. As the result of the study of the data thus furnished, we arrived at the conclusion that the saccharine richness of the cane is not affected in any marked degree by the manures used, and that when any form of manure, in quantities likely to be used in actual practice, increases the weight of cane per acre, it increases, in the same proportion, the weight of sucrose. This leads to the conclusion, important to the planter and sugarmaker, that while it is useless to look for increased saccharine richness as the result of any form of manuring, it is, on the other hand, unnecessary to fear injury or falling off in quality from the use of such quantities of manures as can be profitably employed.

This study of our figures led to another important conclusion, namely, that we should have arrived at the same conclusions for the information of planters concerning the effects of artificial manures, had we used as our basis of comparison the weight of canes instead of the weight of cane sugar in the juice expressed. From this it follows that in future we can greatly simplify our work by putting aside as unnecessary the laborious analysis of hundreds of samples of cane juice and using the weight of cane produced as the basis of comparison between our various plots.

RAIFFEISEN AGRICULTURAL BANKS.*

By the EDITOR.

Agricultural Loan Banks on a popular basis are much wanted in Jamaica, and probably, also in the rest of the West Indies.

I propose to lay before you a statement of the principles that, I think, should guide us in the formation of such banks.

At no time was the necessity for people's banks in Jamaica so manifest as after the hurricane of August, 1903. The peasant proprietors of devastated fields were inclined to be apathetic, fatalistic. Owners, generally, large and small, were in want of cash to put their properties in order, and ensure crops for the following year. The Government came promptly to the rescue, sending out agents to rouse and instruct, and distributing broadcast leaflets of agricultural advice. For those who wanted money, a system of temporary government loans was organised. This step strengthened credit; large estate owners obtained relief from banks in the ordinary way; while to those who preferred it, government loans were granted.

I will give some details of this system of government loans, as it may be taken as a suggestive example in case government banks are ever instituted.

A law† was passed, September, 18, 1903, of which the preamble ran thus:— 'Whereas in view of the damage done by the hurricane of the 11th day of August, 1903, it is desirable to empower the Government of Jamaica to make temporary loans to those who have sustained damages by the hurricane, and to provide simple and efficacious means of making and securing the repayment of such loans.'

* Read at the West Indian Agricultural Conference, held at Trinidad, January, 1905.

† Jamaica Law No. 47 of 1903, *The Hurricane Loans Law, 1903.*

The rights conferred on the Government in respect of these loans were: a preferential charge upon the crops, a charge upon the land, and a power to sell the borrower's interest in the land on default of repayment according to the specified time and manner.

The borrower was to covenant: to use the loan on the cultivation of the land; to repay the loan with 6 per cent. interest and all expenses incurred; to produce, if required, at stated intervals, and vouch for its accuracy, an account of expenditure; to allow inspection of the land by government agents; to uphold cultivation so that the security is not deteriorated; and if required, to inform the agent of sales and contracts for sale of produce, and give an order on the purchaser for purchase money to be applied to repayment.

The Colonial Secretary was appointed Chief Loan Officer; the Auditor General and a clerk in the Colonial Secretary's Office were also Loan Officers.

The conditions under which loans were granted were:—

(1) That no loans were to be granted where the area in cultivation was less than 5 acres, unless the applicant was unable to work on his own land and had to obtain assistance.

(2) No more than £3 an acre was to be lent.

(3) The loans to be advanced in seven monthly instalments.

(4) The rate of interest, 6 per cent. per annum, calculated monthly.

(5) Loan to be repaid, one-half on May 15, 1905, one-fourth on June 15, 1905, and one-fourth on July 15, 1905.

(6) In case of default, the Loan Officers had the power to assign the produce of the borrower's land to nominated buyers.

The afflicted parishes were divided up into small districts, and local committees appointed in each district to advise the Loan Officers confidentially of the trustworthiness and ability to repay of each applicant for a loan. Help was given by some of the Instructors, and Revenue Officers, and a Travelling Agent was appointed. No salary was granted to any officer in respect of his services, except to the Travelling Agent. The expenses have thus been kept low, and it is anticipated that the 6 per cent. interest charged will not only repay Government 3 per cent. on the money advanced which would have been earned on deposit, but also all the incidental expenses.

There were 2,983 applicants for loans, and after inquiry loans were granted to 1,477 persons, amounting altogether to £36,704.

The full amount of £3 per acre was not in all cases granted or claimed. If a rough calculation be, however, made, and the £36,704 be divided by 3, we get 12,235 acres, chiefly bananas, amongst 1,477 borrowers—an average of $8\frac{1}{3}$ acres per borrower.

As the time for repayment has not arrived it is impossible to to say yet whether all the loans will be repaid without default, but the Government does not anticipate any loss.

The presumed success of the government loans has greatly encouraged those who have for long been desirous of attempting the establishment of people's banks on the model of that marvellous and admirable system invented by the genius of Raiffeisen in Germany more than fifty years ago.

In the first place it was most encouraging to find so many persons of high standing in the community ready to serve on the local committees for the benefit of their neighbours. Our experience in the branches of the Agricultural Society had already shown this spirit of devotion on the part of some of the landed proprietors, ministers of religion, and others, but here, where the need was evident and pressing, there was a universal exhibition of willingness to co-operate in assisting the Government freely and without recompense. By so doing they naturally increased the security of the loan, and helped to keep the rate of interest low.

Again, it was noticed with satisfaction that it was considered feasible to grant loans to the owners of only 5 acres of land if it was all under cultivation.

I would call attention to special points in the precautions taken by the Government:—(1) Loans were only granted to those who were recommended by the local committee, who from personal knowledge believed that repayment in full could, and would be made. (2) The loan was granted for a specific purpose. (3) The local committee, or the government agent, by personal supervision, took care that the loan was properly applied. (4) Repayments of loan were not asked for until such time had elapsed as was necessary to allow the loan to become productive. (5) The power of at once calling in the loan, if repayments were not punctual.

These precautions are similar to some of the rules laid down by Raiffeisen, but they do not go so far—they cannot reach the very poor man, nor do they make the repayment so secure as in his banks.

I do not intend to enter into the question of Planters' Banks, my subject is People's Banks. For them I do not advocate the formation of government loan banks. I think the system of Raiffeisen in every way, both from an economic and an educational point of view, more suited to our needs. I will therefore now indicate the main and essential features of that system as portrayed in the writings of Henry W. Wolff,* and, as far as possible in his own words.

* (1) *People's Banks: A Record of Social and Economic Success*, 2nd Edition. London, P. S. King & Son, 7s. 6d.

(2) *Agricultural Banks: Their Object and Their Work.* Agricultural Banks Association. London. 1s.

(3) *Village Banks, or Agricultural Credit Societies for Small Occupiers, Village Tradesmen, etc.* How to start them—How to work them—What the rich may do to help them. With Model Rules and Model Account Sheets added. London, P. S. King & Son. 6d.

(4) *A People's Bank Manual.* P. S. King & Son 6d.

The foundation of the system is the unlimited liability of each and all the members of the bank.

In the Scotch Credit System, which did such wonders for Scotland in the early part of last century, there is the principle in germ, but in germ only. The Lords and Commons Committee of 1826, in reporting on it says:—

'Any person who applies to the bank for a cash credit is called upon to produce two or more competent securities, who are jointly bound, and after a full inquiry into the character of the applicant, the nature of his business, and the sufficiency of his securities, he is allowed to open a credit . . . . This system has a great effect upon the moral habits of the people, because those who are securities feel an interest in watching over their conduct; and if they find that they are misconducting themselves, they become apprehensive of being brought into risk and loss from having become their securities; and if they find they are so misconducting themselves, they withdraw their security.'

Here are the two main pillars of co-operative credit recognised—joint liability and individual checking. The sureties become an intermediate body between capital and want, helping the latter but also effectually safeguarding the former.

But this is co-operative banking applied to people who possess property and also some commercial education. Raiffeisen's object was to dive deeper and so he proceeded upon broader and more popular lines. He multiplied the sureties, and quickened the vigilance and control by responsibility carried still further.

The fundamental idea of co-operative credit banking is, that a number of persons, all quite poor, or poor and rich combined, join together to pledge their credit in common, in order thereby to obtain the temporary command of money, which, individually, they cannot secure, with a view to disposing of that money among themselves, for temporary employment and for profitable purposes.

If we can ensure repayment from members and thereby secure—*absolutely* secure—those who virtually pledged all that they possess we create a good foundation for credit, and make the scheme practicable. This is done by selecting the members, by watching the borrower, by watching the loan and reserving power for calling it in, and by subordinating everything that is done to the one consideration of safety.

The unlimited liability of all the members of the bank directly serves to supply all this.

Without unlimited liability, you can never make sure that your bank will be sufficiently careful in the selection of its members. Such selection, limiting the membership to persons absolutely trustworthy, is the first condition of success. With only his 5s. or £1 share at stake, no person would care to say 'No' to the application for admission of any but an openly disreputable neighbour. But make people understand that, in electing the new member, they practically make themselves liable for any default which he may make, and all considerations of etiquette and mere neighbourly courtesy are sure to vanish. This strictness in election is one of the causes which makes these banks such wonderful moral reformers. When a man knows that before he can be admitted to share in the advantages of a cheap lending institution, his character will be submitted to the searchlight of his neighbours' knowledge, the idle will become industrious, and the reckless careful.

Next, unlimited liability secures good administration. It ensures that the most competent men shall be elected as officers, and the unlimited liability which the officers share with the other members leads them to be extremely critical in their disposal of bank moneys, and very strict in their demand of prompt repayment, which is one of the essential conditions of success, economic and educational.

Without unlimited liability, furthermore, there could not possibly be all that watchfulness and control which keeps everything safe. The borrowers must remain honest, thrifty, careful and deserving of credit, The employment of the loan is watched and its application to its proper purpose—failing which it is called in unmercifully—otherwise there can be no success. Prompt payments are insisted upon. The whole fabric is built up upon a system of mutual checking, the borrowers being checked by the committee, the committee by the council, the council by the mass of members—all without offensiveness, all in the interest and for the protection of the very people checked. All that zealous, lively, warm, and loving interest in their local association, which is such a feature among members of Raiffeisen banks, is plainly traceable to the principle of unlimited liability, which makes everyone feel that he and his fellows have become 'members one of another.' Under this system an association becomes what every genuine co-operative association should be—an honest and industrious family, with a community of aims, of interests, and of sympathies.

Another very important element of success is the smallness of the district assigned to every bank. In any but a small district there cannot possibly be that knowledge and vigilance and checking of one another which constitutes a *sine qua non* of success.

The organization of the association is entirely on democratic lines. No difference of any sort is recognised between poor and rich, except that the rich, bearing the brunt of the liability, are by accepted understanding allowed also to take the leading part in the administration. The Committee consists of five, and is charged with all the executive work. The Council of Supervision consists, according to the size of the district, of from six to nine members, and is entrusted with checking and supervising the Committee, overhauling all that it has done at least once a month. And on both Committee and Council it is understood that the richer members should be in a majority.

Neither members of the Committee nor members of the Council of Supervision are allowed to draw a farthing of remuneration, be it in the shape of salary or of commission. Every chink and crevice is deliberately closed against the intrusion of a spirit of cupidity or greed, so as to make caution and security the sole guiding principles of action. A salaried officer may not feel so free to refuse an application for a loan, and may not be able so easily to consider business purely on its merits. One man only is paid—the cashier; and he has no say whatever in the employment and distribution of money, being merely an executive agent.

The simplicity of business ensures safety. The rules of Raiffeisen banks forbid most positively 'banking' in the ordinary sense of the term, or risk, or speculation of any kind. Their business is simply to lend and to borrow. If a loan should go wrong, under such circumstances, you know exactly what you can, at the worst, be made liable for. That £1 or £10 *absolutely* limits your loss. And joined to this simplicity of business is the simplicity of business arrangements, bookkeeping, organization, and so on. Everything is simple, everything is intelligible.

As the rules were originally framed, no member was asked to pay down anything on joining, either for shares or in entrance fees. The German Government overruled this regulation and insisted that there must be shares. The Raiffeisen association met this dictation by making their shares as small as possible, generally 10s. or 12s., payable by instalments.

No dividends or distribution of profits is allowed under any circumstances. One of the essential features of the organization is that individuals are to derive no benefit except the privilege of borrowing, and every farthing which is left over out of transactions is rigorously claimed for the reserve fund, which is an entirely peculiar feature. It belongs wholly to the bank, and must not be shared out on any pretence. It is really the backbone of the whole system. Very small at first it grows very slowly, only increasing little by little, but in the course of time it becomes 'an impregnable rock of financial solvency.' The first object is to meet deficiencies or losses for which only with hardship individual members could be made responsible. Its next is to supply the place of borrowed capital, and so make borrowing cheaper to members. Lastly should it outgrow the measure of such employment, it may, at the discretion of the society, be applied to some public work of common utility benefiting the district. The rules of the bank should clearly state, that, even if the association should be broken up, the reserve fund should remain intact in the hands of trustees until another association is formed, failing which in reasonable time, it should go to some public object for the benefit of the district. Thus no temptation can arise to break up the association for the sake of dividing the reserve fund. The existence of such a fund binds members together, for all are naturally anxious to retain their interest in it; they strive to continue worthy of membership, and others are attracted and incited to make themselves morally eligible.

The practice of lending is on the same lines of caution and stability. Although the association exists for the very purpose of lending, it deliberately makes borrowing not easy, but difficult. Every borrower must prove not only that he is trustworthy but that his enterprise is economically justified. Moreover, he must bring the signatures of two members, as sureties on his application form, who promise to be jointly liable with him. He may be so sanguine as to be sure in his own mind of success, but the object must be scrutinized and accepted first by his sureties and next by the Committee. Once the money is granted, it must be applied strictly in that particular way for which it was asked.

Once every month the Council of Supervision meets for the special object of reviewing the position of debtors and their sureties, and considering the employment given to the loan money. Should a surety be found to have seriously deteriorated in solvency or in trustworthiness, a better surety is at once called for. If he is not forthcoming, or it the debtor is found to be misapplying the money, the loan is at once called in at four weeks' notice.

Another safeguard is to insist that interest and principal must be paid to the very day. The principal, for loans running any length of time, is made repayable by equal instalments, and prompt and punctual repayment not only facilitates the carrying on of the business, but is far more valuable still as training the borrowers to habits of punctuality.

The method adopted in lending is made as simple and as intelligible as possible. All that, as a rule is asked for is a note of hand, unbacked, or else backed by one surety, or more generally by two, according to circumstances. That precludes all raising of money by passing on acceptances. Every farthing that is wanted, as far as it is not supplied by the savings or other deposits paid into the bank, has to be raised by borrowing. At the outset this may appear rather a cumbrous proceeding. But what with a high reputation secured by exemplary business habits, and the substantial guarantee of unlimited liability of all members, the banks have long since gained for themselves a position commanding such very easy credit, that they have no difficulty whatever in borrowing all that they want either from public banks, or from private individuals, at the cheapest market rates. Confidence in this security is so well established that in Germany Law Courts actually allow trust moneys to be paid in to them on deposit.*

The Raiffeisen system of agricultural loan banks has worked wonders in Germany and in other European countries. It remains to be seen whether it can be successfully adopted in the West Indies. But our Agricultural Societies in Jamaica have shown such good examples of co-operative effort in many ways, that we are somewhat sanguine.

We have lately been directing the attention of our people to the system, and I believe that no less than three banks will be started during the present month. It is a hopeful sign, full of promise for the New Year.†

COTTON: SELECTED SEED FOR 1905.‡

As announced in the *Agricultural News* (Vol. IV. p. 72), it will not be possible to obtain reliable cotton seed from the United States this year, as the planters in the Sea Islands have resolved not to sell their seed 'to communities outside of South Carolina.'

This means that in order to carry on the cotton industry in the West Indies the planters will have to depend on seed to be obtained locally.

Although the situation, at first sight, might be regarded as discouraging, there are good grounds for believing that the promising cotton industry started in these colonies will not materially suffer from the action taken by the planters in the Sea Islands. Thanks to the efforts made last year by the Imperial Department of Agriculture, there is already existing in the West Indies a supply of Sea Island cotton seed as good as, if not better than, the crop lots produced in the United States. All that is necessary is to make a rigorous selection of the best seed and, after having it carefully

* There is another form of Loan Bank which has also done good work in Europe, that is the 'Credit Associations' of Schulze. Schulze required unlimited liability, selection of trustworthy officers, and sound rules; but the keystone of his system was the compulsion to save, regularly and steadily. Every member is expected to take one share and one share only. He is not allowed to take more, in order to prevent the association from being captured by capitalists. The value of the shares was fixed very high, at first about £50, paid up by instalments which may be very small. With the help of the capital in course of formation, of savings deposited, and of the credit which the small capital and unlimited liability of a large number of members, the associations are in a position to raise all the money required. The interest was at first high. These banks are not particular about the object of the loan, or the person of the borrower, but they demand security in the form of mortgages, pledges, sureties, bills. The loans may be large or small, according to the security offered, but must be for short terms—for three months, with renewal for another three months occasionally permitted. Business is carried on by a Committee of three who are elected and paid a salary, with a commission added. To check the Committee and to audit these accounts a Council of Control of nine members is also annually elected. It is considered well to have as large and as mixed a constituency as possible, consisting of members of all callings, whose blending will equalize supply and demand of money, security and risk. The Credit Associations aim at high dividends by the largest possible extension of their business. This leads to speculation for the sake of gain and very often ends in disaster.

† [These banks started in the parish of Manchester are not Raiffeisen, but rather on the lines of Schulze's Credit Associations, except that the liability is limited to the amount of one share.]

‡ Reprinted from the *Agricultural News*, Vol. IV, p. 97.

disinfected, to place it within reach of the planters in such quantity and at such a price that in no instance will it be necessary to plant inferior or doubtful seed.

Last year the Imperial Department of Agriculture imported and supplied to planters 35,700lb. of Rivers' selected Sea Island cotton seed and the results from this seed, in good soils and with suitable cultivation, have been uniformly satisfactory. In some instances Mr. Oliver reports that the cotton produced this year from Rivers' seed in the West Indies 'is better than Rivers' own cotton;' so that, so far from having deteriorated, it would appear that the soil and climate, in some localities at all events, in the West Indies are capable of producing a higher quality of cotton than the Sea Islands themselves. This is confirmed by the fact that the shipments of 62 bales from Messrs. Simmons & Hazell of St. Vincent 'are quite the best cotton grown under the auspices of the British Cotton-growing Association and have been sold at an all-round price of 17d. per lb.' If this cotton had been 'in the market in October and November last,' it is stated, 'it might easily have been sold for 21d. per lb.' Again we are informed: 'West Indian cotton is to-day fetching 2d. to 3d. per lb. over similar qualities of American cotton.'

It is reasonable to suppose that if the seed from the high-priced cotton, above referred to, were carefully selected and grown under suitable conditions, the crop to be reaped next year should be as good as, if not better than, this year's crop.

The advantage is all in favour of the West Indies, for this is the original home of Sea Island cotton, and the conditions, on that account, should be more congenial to it here than in South Carolina.

Coming now to practical measures, it is proposed, in order to safeguard the prospects of the cotton industry, that the Imperial Department of Agriculture should undertake to acquire all that can be spared of the best seed and have it carefully handpicked and disinfected and supplied to the planters at cost price.

The Department will purchase the seed in the condition in which it leaves the gins, mixed with bits of lint, immature seeds, trash, etc. It will have this carefully picked over by hand so as to retain only about one-half to consist of the largest and finest seed for planting purposes. The residue will be returned to the grower to be crushed for feeding purposes. The selected seed will then be disinfected in order to protect it from fungoid and insect pests and it will be offered to planters for sowing purposes at the rate of 5c. (2½d.) per lb. This is at a lower rate than is charged for long-staple cotton seed either in the Sea Islands or in Egypt.

It is strongly urged that no cotton seed be planted this year unless it has been disinfected beforehand. Otherwise in the case of seed shipped from one island to another, there would be the probability of introducing either the cotton worm, the leaf-blister mite, the cotton stainer, black boll, anthracnose or other diseases into localities where, hitherto, they have been unknown. For instance, the cotton worm is not prevalent in St. Vincent, the leaf-blister mite and the cotton stainer are not present at Barbados, and few, if any, of the diseases familiar in the lesser Antilles are to be found in Jamaica.

A general and indiscriminate interchange of untreated cotton seed between the several islands would result in such a wide-spread distribution of cotton diseases as would probably kill the industry.

It is desirable, therefore, under the special circumstances now existing, that the distribution of seed for planting purposes should be placed in the hands of a central authority, having no pecuniary interest in the matter, possessing the confidence of the community and provided with the necessary staff and appliances for carrying on the work solely in the interest of those concerned.

Cotton growers who desire a supply of the "selected and disinfected cotton seed" offered by the Imperial Department of Agriculture for planting during the coming season are advised to communicate, without delay, with the officers of the Department in the Colonies in which they reside. A remittance for the full amount must accompany the order, or it cannot be entertained. Orders will be received, for the Leeward Islands, by Dr. Francis Watts, Antigua; for Barbados by Mr. John R. Bovell; for St. Vincent, by Mr. W. N. Sands. Applications from Jamaica, British Guiana, Trinidad, and other colonies, not mentioned above, may be forwarded direct to the Imperial Commissioner of Agriculture, Head Office, Barbados. Applications will be dealt with in the order in which they are received.

[Six hundred pounds of seed have already been received by the Director of Public Gardens and Plantations from the Imperial Commissioner, Barbados, the lint of which obtained this year 16½d. per lb. This is 2d. higher than the price obtained for lint from the Sea Islands them-elves. Six hundred pounds have also been received from the Agricultural Superintendent, St. Vincent, the lint from which realized 17d. per lb. Some seed from both Islands is still on hand, and will be charged for at rate of 2¼d. per lb. Application to be made to Director, Public Gardens and Plantations, Kingston P.O.]

COTTON: DISEASES.

Commissioner of the Imperial Department of Agriculture for the West Indies to the Director of Public Gardens and Plantations, Jamaica.

Barbados,

April, 6, 1905.

Sir,

I desire to obtain information in regard to the pests and diseases of Cotton in Jamaica, and would be glad of any specimens of the same and observations as to the seriousness of attack of any particular fungoid disease or insect or other pest that may be met with affecting cotton plants.

2. I understand that the cotton worm occurs in Jamaica, but am not informed as to the seriousness of its attack, nor as to its distribution in different parts of the island. Also the Cotton Stainer, *Dysdercus andreae,* is reported to occur in Jamaica, but very little information seems to have reached this Department as to its prevalence.

3. It would be interesting to learn whether the Leaf-blister mite is known in Jamaica; if not, great efforts should be made to keep this out of the island.

4. With regard to fungoid diseases, the only one recorded here from Jamaica is the leaf-spot caused by *Cercospora gossypina.* I should be glad to learn if any of the following diseases occur in Jamaica :—leaf mildew, leaf rust (*Uredo gossypii*), anthracnose (*Colletotrichum gossypii*), or black boll (a bacterial disease). These are some of the diseases known to occur in other West Indian Islands.

5. I should also be glad to know if you have any cotton diseases which so far have not been recorded from the other islands. These are described in the "West Indian Bulletin," the "Agricultural News," and the "A. B. C. of Cotton Planting," issued by this Department.

6. I would add that it would be useful if members of your Society or Board could supply specimens of these diseases and pests for study and information regarding them for the use of Cotton growers generally in these Colonies.*

I have the honour to be,

Sir,

Your most obedient servant,

D. MORRIS,

Commissioner of Agriculture for the West Indies.

COTTON: ROTATION OF CROPS.

The following correspondence is published for the purpose of directing attention to an important subject, with the hope that experiments may be started and definite information eventually obtained as to the best rotations for the several districts where cotton is cultivated.

The Honble. the Colonial Secretary to the Director of Public Gardens and Plantations.

Colonial Secretary's Office,
16th December, 1904.

Sir,

Referring to the debate at the meeting attended by Messrs. Oliver and Stancliffe on the subject of cotton growing, I am directed to invite you to devise and publish (after consultation with the

* Notes on the occurrence of disease, with specimens, will be taken charge of by the Director of Public Gardens and forwarded to the Commissioner.

Imperial Commissioner) a proper rotation of crops, embracing cotton, suitable for the West Indies, so that the cotton grower need not think himself dependent upon cotton ratooning, and I am to offer the following suggestions (subject to your better knowledge) on the matter.

2. Taking cotton as the crop to be cultivated during the first year, the land, after being thoroughly cleaned and all weeds and vegetation thereon burned or buried, should be ploughed with a deep soil plough to a depth of some five to eight inches. Where the locality is a dry one, the furrows should be run across the natural fall of the land.

3. After ploughing and cleaning the land it should be laid out in ridges and furrows, the tops of the ridges being about six inches higher than the bottom of the furrows. The cotton should be sown in the bottom of the furrows, and as it grows up the earth of the ridges should from time to time be removed to its stem by a hoe, so that when the cotton matures it will appear to be growing out of the top of a ridge.

4. Second year. When the cotton has all been cleared away, a comparatively shallow ploughing will suffice to prepare the soil for the second year's crop, which should be some cereal,—maize for choice.

5. The usual objection to maize is that it is easily destroyed by weevils after harvest ; this evil may be avoided either by selling early or by kiln-drying the corn. Several large cotton growers might combine for the purchase of a kiln.

6. Third year. After a light ploughing the land might be sown with some leguminous plant, such as beans, peas, clover, alfalfa, lucerne, lupines, rabi, vetches, rovithi or eleusine Levakana. The last grows well in tropical climates and affords seed useful for food, but rabi supplies a valuable food for cattle, requires very little care or cultivation, and is to be preferred on that account.

7. Fourth year. Unless you have something valuable to suggest in the fourth year, the land might be allowed to lie fallow, to be followed by cotton again in the fifth year.

I have, etc.,
H. CLARENCE BOURNE, Colonial Secretary.

The Commissioner of the Imperial Department of Agriculture to the Director of Public Gardens and Plantations, Jamaica.

Copy.

Barbados, February 13, 1905.

Sir,

With reference to the letter from the Colonial Secretary of Jamaica, No. 11783/12679, dated December 16th last, communicated to me at the recent Conference at Trinidad, I would mention that the rotation of crops for cotton adopted in the Sea Islands is described in the "West Indian Bulletin" Vol. IV. pp, 294-295. This rotation has apparently not been taken into consideration in the letter from the Colonial Secretary. An extract from the concluding portion of the chapter is enclosed.

2. It is probable that no system of rotation will be adopted either in Jamaica or elsewhere unless it is in full harmony with local conditions and provided its ultimate effects will be to produce the maximum amount of fine cotton at the lowest possible cost.

3. It will be necessary to work out a rotation not only for Jamaica as a whole but for each district of the island with due regard to the character of the soil, amount of rainfall and the requirements in regard to other industries.

4. The only effective way of arriving at a satisfactory rotation will be to carry on experiments in association with one or two leading planters in each district. The Board of Agriculture might be able to arrange this and tabulate the results. As you are aware, theoretical recommendations in a matter of this kind have no appreciable effect on the practice of cultivators in the West Indies.

5. As a contribution to a study of the subject, I enclose a copy of a letter from Mr. J. R. Bovell in which he offers recommendations likely to be of value.

6. Later, when the officers of the department in the several Colonies have had time to look thoroughly into the subject, have carried out experiments and obtained the views of the leading planters, it is probable that I may be in a position to advise further in the matter.

I have, etc.,

D. MORRIS.

Extract from West Indian Bulletin, Vol. IV., pp. 294-295, on the rotation of crops in the Sea Island districts.

It seemed, however, to be the general experience, that the growth of a leguminous crop every second year did not conduce to a successful cotton crop, and that once in four years was as often as it could be grown with advantage,—that is to say, the rotation would be: first year, cotton; second year, fallow; 3rd year, cotton; 4th year, leguminous crop. When the leguminous crop was grown it was sown between the rows of the old cotton crop after a picking was finished. The crop grown is cow peas or even garden peas for the market, which grow up and twine around the old cotton stalks. It is then grazed by cattle and trampled down, and the new cotton ridges are formed over the old hollows where the leguminous crop had grown. The idea regarding the frequent growth of a leguminous forage crop is certainly interesting.

It is maintained that the quality of the fine Sea Island cotton suffers, and that ripening is delayed and the yield diminished. The interesting point to notice, however, is that although such is maintained to be the case, yet nitrogenous manures, such as cotton seed meal, &c., are employed for cotton.

Mr. J. R. Bovell to the Imperial Commissioner of Agriculture.

Barbados, 11th February, 1905.

Sir,

I have the honour to acknowledge the receipt of your letter No. B, 392, dated January 30, enclosing a copy of a letter handed you by Mr. Fawcett in reference to the rotation of crops in connection with cotton cultivation in Jamaica, and asking me for my views on the subject.

As has been pertinently pointed out by various agricultural authorities, it is impossible to recommend a rotation that will apply to all districts even in a single country, and therefore it is hardly possible to suggest a rotation that will be equally applicable to all parts of Jamaica.

On the whole, the suggestions made by Mr. Bourne are, I think, reasonable. If the rotation is a fourth year one, the land the fourth year might be planted in sweet potatoes or yams.

In Georgia the Director of the Experiment Station recommends where cotton is the principal crop that this should follow corn and peas. The corn is planted, and when it is about half grown, cow peas are then sown between the rows. The corn is reaped and the cow peas are allowed to mature and fed to the animals. The resulting manure is then broadcasted on the land and turned in along with the cow pea stubble. The following year cotton is grown. For the next crop in rotation he recommends oats, and then the rotation commences again. In each case the crop is carefully fertilized.

With regard to Jamaica, personally I should be inclined to recommend cotton for the first year's crop, yams or sweet potatoes for the second, and Indian corn and cow peas for the third, each crop to be suitably manured.

For instance, a yield of say 1,000 lb. of seed cotton per acre, i.e. 300lb. of lint and 700lb. of seed, would remove from the land per acre 25lb. of nitrogen 12lb. of phosphoric anhydride and 13lb. of potash A crop of six tons of sweet potatoes would remove about 30lb. of nitrogen, 13 to 14lb. of phosphoric anhydride and about 65lb. of potash per acre. A crop of Indian corn yielding about 29 bushels of corn per acre of 70lb. per bushel, would remove in round numbers 24lb. of nitrogen, 8½lb. of phosphoric anhydride and 3¼lb. of potash. A crop of black eye cow peas, weighing say 2 tons per acre, would supply about 36lb. of nitrogen, 22lb. of phosphoric anhydride and 50lb. of potash. In this case the nitrogen would be obtained principally from the atmosphere, the phosphoric anhydride and potash principally from the sub-soil. As the black eye peas would fix a great deal of nitrogen from the atmosphere, which would be valuable, I should apply a small quantity of farmyard manure to the cotton, supplementing it with phosphoric anhydride and potash, and to the sweet potato and yam crops I should apply farmyard manure, supplemented by potash. A ton of good farmyard manure contains about 12lb. of nitrogen, 5lb. of phosphates and 11lb. of potash.

Trusting that the informotion supplied is what you require.

I have, &c.,

JOHN R. BOVELL.

From Director of Public Gardens to Hon. Colonial Secretary.

28th March, 1905.

Sir,

I have the honour to forward a letter received from Sir D. Morris with reference to rotation of crops in cotton cultivation.

2. I referred the letter to Mr. Barclay, the Secretary of the Agricultural Society, and enclose his memorandum.

3. As has been pointed out, nothing very definite can be suggested, first, from want of experience of cotton-growing in the West Indies, and secondly, because each district in the Island may require a different treatment.

The following rotations might be tried :—

(1) Cotton—March to September.
Cassava—October to February, twelve months.
Corn—March to August (manured).
Leguminous plants (peas, &c.,) September to December.
Cotton—March, &c.

(2) Cotton—September to March.
Cassava—April to July of following year.
Corn—August to February (manured).
Leguminous plants (peas &c.) March to June.
Cotton—September &c.

(3) Cotton—September to March,
Cassava—April to July of following year.
Cow Peas—August to October.
Tobacco—November to February.
Corn—March to August (manured).
Cotton—September, &c.

(4) Cotton—March to September.
Tobacco—November to February.
Corn—March to August (manured).
Leguminous plants (peas) October to January.
Cotton—March, &c.

I have, &c.,

W. FAWCETT, Director.

The Secretary of the Jamaica Agricultural Society to the Director of Public Gardens and Plantations.

The districts in Jamaica where cotton will likely be grown to any extent are such as are too deficient in rainfall to grow our usual economic crops—except sugar. These are lower St. Catherine, Vere, the plains of St. Elizabeth, the coast lands of St. James, Trelawny and the lowlands of St. Andrew and St. Thomas.

In all these districts cattle are generally kept, and in St. Elizabeth horse-stock also. In the sugar cane districts it is not likely planters will grow cotton on the best sugar cane lands, nor even when about to fallow the land from cane put it under cotton for a season. They will require to find out by experience whether cane, cotton, then cattle to feed down the old cotton stalks, then cane again will work well in the results from the first crop of cane after cotton.

If cassava was a commercial product for starch-making on a commercial scale, as it may be, cassava, cotton, guinea grass and live stock would form a likely rotation. As it is, in stock-rearing parts, such as the savannahs of St. Elizabeth, I can only suggest small fields of cotton grown for a year, corn and peas (when seasons allow, and which favour the spring of grass) six months, guinea grass and stock for two years. It is no use suggesting guinea corn grown on a large scale—it seldom pays, though small plots are useful. Cotton might form a useful catch crop planted through bananas, coconuts or orange trees to fill up in most districts, whether under irrigation or not. It is being tried.

JOHN BARCLAY.

The Commissioner of the Imperial Department of Agriculture to the Director of Public Gardens and Plantations.

Barbados, April 6, 1905.

Sir,

In continuation of my letter J. 589 of February 13, last, I have the honour to forward, herewith, a copy of a letter received from Dr. Francis Watts, in which he reviews the proposals put forward by Mr. J. R. Bovell in regard to the rotation of crops for cotton, and adds some suggestions of his own based on experience in the Leeward Islands.

2. It is proposed later on to prepare an article on the subject for publication in the "West Indian Bulletin," and I would be glad to receive any additional information that you could furnish with special reference to the circumstances of Jamaica.

I have, &c.,

(Sgd.) D. MORRIS.

The Honourable Francis Watts to the Imperial Commissioner of Agriculture for the West Indies.

Antigua, March 27th, 1905.

Dear Sir Daniel,

In reply to your request for a brief memo. on the letter addressed by the Colonial Secretary of Jamaica to the Director of the Public Gardens and Plantations on the cultivation of cotton and the question of rotation of crops which accompanied your letter, No. A. 391 of January 30th 1905.

2. In paragraph 2, of the letter referred to, it says, "Where the

locality is a dry one the furrows should be run across the natural fall of the land." This should be the direction in any case, for, if the locality is a wet one, they will tend to prevent the washing away of soil during heavy rains. With this comment paragraphs 2. and 3, may stand.

3. For the second year I would suggest, such crops as Guinea Corn, Cassava or Sweet Potato,

4. For the third year a leguminous crop. The crops proposed in the letter under comment are not all leguminous, nor do they all appear suitable for the conditions in question. I would suggest a selection from the following:—

Pigeon Pea or Gungo Pea, (Cajanus indicus) Woolly Pyrol, (Phaseolus Mungo) Velvet Bean, Red Bean of Jamaica, Bonavist of Barbados, Ground Nut or Pindar or some form of Cow Pea if a suitable one is found.

5. For the fourth year, Yams, if the time and season serve, or Corn (Maize) if a short period crop is necessary. For this year's crop the land should be well manured either with the green dressing of the previous year and, if necessary and possible, with farm-yard manure. We then come to the first year's crop, Cotton.

6. The question of manures for Sea Island cotton has not been yet worked out for the West Indies. It will probably be well to plough in crushed cotton seed at the rate of 3 to 6 cwt per acre or an equivalent amount of farm-yard manure according to the condition of the soil and the manuring which it received in the previous year.

7. The objection to Maize, in paragraph 5 of the letter under consideration, may be met by thoroughly sun-drying the cobs and storing them in bins into which a little bisulphide of carbon is put to destroy weevils. These bins may be of iron, concrete or wood: the former two are preferable, perhaps, as being rat proof.

Yours sincerely,

FRANCIS WATTS.

Note by Dr. Cousins on foregoing papers:

All the four rotations suggested are impractical in so far as they ignore the second crop of cotton which may often exceed the first in value under the conditions obtaining in Vere and St. Catherine. Most of the lands now in cotton would grow it without rotation for at least 10 years in my opinion.

Cassava is the ideal alternating crop for cotton. Cassava bitty and cotton seed would make a splendid food for stock. The cassava could be interplanted between the cotton to save time. Our cotton lands in Jamaica are greatly superior to Sea Island soils in fertility. To fertilise these soils would be absurd. As we have no alternating husbandry in Jamaica, it is not a practical question to discuss theoretical rotations of imaginary crops.

H. H. COUSINS.
25.4.05.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held on Tuesday 14th March. Present: The Hon. the Colonial Secretary in the chair, the Director of Public Gardens and Plantations, the Island Chemist, His Grace the Archbishop, Messrs. C. A. T. Fursdon, C. E. deMercado, and Secretary John Barclay.

New Members—The Secretary read a letter from the Colonial Secretary intimating that His Excellency the Governor on the nomination of the Board had appointed Mr. Geo. D. Murray to be a member of the Board in the room of the Hon. J. V. Calder, who has resigned. The Secretary also read letters from Mr. M. H. M. Farquharson, declining nomination as a successor to Mr. Shore and from the Secretary of Westmoreland Sugar Planters Association, declining to nominate anybody in their interests. The Secretary stated that he had not heard from the Northside Sugar Planters Association on the matter. It was decided that the Secretary should ask the Hon. C. B. Vickers, Bluefields, if he would allow his name to be nominated as a member of the Board, and, failing him, Mr. P. H. Greg, Mesopotamia.

Agricultural Science Teaching—The Secretary read a letter from the Secretary of the Schools Commission in reply to his letter transmitting a report of the Committee of the Board on agricultural science teaching in Secondary Schools and a report by the Island Chemist having reference to the results of an examination of students for Agricultural Scholarships, the letter was directed to be circulated. The Secretary was instructed to call the attention of the Colonial Secretary to paragraph (2) dealing with the £60 scholarship and the three £10 scholarships, recommending them to be combined and made available for aiding scientific agricultural education, and stating that the proposal had been approved by the Superintending Inspector of Schools and the Island Chemist.

Blood at Slaughter House—The Secretary submitted a statement by the Island Chemist on Mr. Cork's proposals to utilise the blood at the Slaughter House as a fertiliser, showing a probable margin of £11 per annum : also correspondence from Mr. Cork on the subject. The Chemist stated that dried blood as a source of nitrogen was not so good value as sulphate of ammonia; and it was accordingly resolved to let the matter drop.

Cocoa Trees in St. Mary—A Report to the Director of Public Gardens by Mr. Cradwick on the Cocoa Trees in St. Mary was submitted and directed to be circulated.

Tobacco—A letter from the Colonial Secretary's office was submitted transmitting a letter from Mr. F. V. Chalmers reporting that he was unable to purchase 300 lbs. of unmanufactured leaf tobacco here at anything like 7d. per lb. and suggesting that this high price restricted production and should receive immediate attention. The chairman stated that Mr. Chalmers told him that he would be prepared to spend a very large sum next year in buying tobacco at 7d. per lb. if it could be got, but that people had told him that it did not pay to sell it at that price.

Contagious Diseases Animals Act.—The Secretary submitted a letter from the Colonial Secretary's Office enclosing copy of a Bill entitled A Law for the Prevention of Contagious Diseases among Animals, which was directed to be circulated.

Cotton.—An application for the loan of a Cotton Baling Machine by Hon. Dr. Pringle was submitted. It was resolved to loan the machine if Dr. Pringle would pay for its removal and return. A letter from Mr. Fursdon was submitted saying that as there was no prospect of any more cotton being sent, he would be glad if the Board would arrange to take charge of the Gin.

A report from the Director of Public Gardens was submitted showing a sale of cotton from a quarter acre grown at Hope amounting to 171lbs. of seed cotton at 3d. amounting to £2 2s. 9d. stating that he had purchased lint to send to the Exhibition and 100lbs. of the seed, making a reduction of 17 8d. and leaving a net credit of £1 5s. 1d.

A letter was submitted from Colonial Secretary's Office, transmitting letter from Sir Daniel Morris, and extract of letter from Mr. E. Lomas Oliver, asking all growers to ship cotton to the British Cotton Growing Association in order that the price may be kept up to a minimum of 1s. per lb.

Orange Trade.—The Secretary submitted a letter forwarded by the Governor from Mr. Joseph Darling re Orange Trade. This was directed to be circulated.

Leave of Absence.—The Secretary submitted a letter to the Chairman asking for leave of absence from the 3rd April to about the middle of July to allow him to act as one of the representatives of Jamaica at the Crystal Palace Exhibition. The Archbishop moved, seconded by Mr. deMercado, that His Excellency the Governor be recommended to grant the leave of absence desired.

Reports—Reports by the Director of Public Gardens were submitted as follows:—

(a) Report Experiment Station.
(b) Report from Travelling Instructors.

The following reports from the Chemist were submitted:—

(a) Result of Diploma Examination.
(b) Residential Qualifications for Diploma.
(c) Labour at Experiment Station.
(d) Cost of Distribution of Canes.
(e) Locked Still at Denbigh.

The additional sum asked for in (e) was allowed, amounting to £20 to make some additions to the installation of the locked still at Denbigh, which would, in the opinion of the Chemist, make the check so thorough as to satisfy all the requirements both of the estate and of the revenue in the production of rum.

[Issued 19th May, 1905.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. JUNE, 1905. Part 6.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

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HOPE GARDENS.
1905.

JAMAICA.

BULLETIN

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DEPARTMENT OF AGRICULTURE.

Vol. III. JUNE, 1905. Part 6.

REPORT ON THE DIPLOMA EXAMINATION HELD AT THE GOVERNMENT LABORATORY DECEMBER, 1904.

General Report from Professor J. P. deAlbuquerque, M.A., F.I.C., F.C.S.

Government Laboratory, Barbados, West Indies,

February 13, 1905,

Sir,

I have the honour to forward the results of the examination of December last for the Diploma of Agriculture at Jamaica.

Six candidates presented themselves for examination, the subjects being Agriculture, Chemistry of Agriculture, Botany, Elementary Physics and Entomology.

A syllabus of each of these subjects was forwarded to me, together with one giving the details of the practical work, the laboratory records of which have been marked by the teachers and form part of the examination for the diploma. This is evidently a course to be commended, as the teachers are in the best position to judge in such practical subjects the work and capabilities of their pupils.

The syllabus is, in my opinion, admirably adapted for the purposes of a secondary school of agriculture, and on the whole, combines a sound grounding in purely scientific subjects, together with a well chosen selection of the most important and typical of the West Indian crops, whereby to point the purely scientific teaching and connect it with the practical agriculture of the West Indies.

The answers of the candidates throughout bear evidence of sound and careful teaching. The reports of the examiners give detailed criticism of the individual papers; from them it will be seen that the results in Chemistry of Agriculture, Botany, Elementary Physics and Entomology were very satisfactory. In Agriculture the percentage of marks was lower, but, in my experience, this subject which is the connecting link between the purely theoretical and the purely practical, is much more difficult to teach young pupils; and here also, I regard the results of the examination, while indicating directions for improvement, as distinctly satisfactory, and affording testimony to the successful effort of the teachers.

All the candidates passed, but there was considerable difference in their attainment and merit. The performances of G. D. Goode, S. Sharp, and A. B. Lindo were, on the whole, very creditable, and I reccommend that these candidates be awarded a diploma in the first class. To H. L. Nethersole, R. S. Martinez, and W. A. Hewitt, I recommend the award of a diploma in the second class.

All the examiners concur in this general report.

I have the honour to be,

Sir,

Your most obedient servant,

J. P. DEALBUQUERQUE, M.A, F.I.C., F.C.S.

Island Professor of Chemistry and Agricultural Science.

MARKS.

	A. Agriculture.	B. Chemistry of Agriculture.	C. Botany.	D1. Elementary Physics.	D2. Entomology.	Total.	Percentage of Total.
Total ...	200	200	100	50	50	600	
1st Class—							
Goode, G. D. ...	100	176	81	47	31	435	72.5
Sharp, S. ...	134	142	70	44	39	429	71.5
Lindo, A. B. ...	124	158	76	32	38	428	71.3̇
2nd Class—							
Nethersole, H. L....	112	104	72	36	40	364	60.7
Martinez, R. S. ...	100	106	68	36	40	350	58.3
Hewitt, W. A. ...	86	98	58	34	30	306	51.0

J. P. DEALBUQUERQUE.

13 Feb., 1905,

Report of Examiners on Agriculture.

The second question was in no case well answered.

The questions in Section B were fairly well answered. The knowledge shown was, however, rather general; for example, candidates had but a very hazy idea of the quantities of manures to be applied.

Candidates failed to show a very intimate acquaintance with the structure of the common plough. Still less was known of the 'disc' plough, most candidates avoiding that part of the question.

The two candidates who took the question on cotton in Section D, gave good answers. The operations in connection with cane planting were not well explained.

In Section E, all candidates took question 10 in relation to tobacco. In two cases, a fairly accurate knowledge of the requirements was shown. The remaining candidates avoided details.

The papers of Sharp and Lindo were, on the whole, good. and these two candidates exhibited a good all-round knowledge of the subject. Nethersole's paper is fairly good. Martinez, Goode and Hewitt are weaker.

J. P. DEALBUQUERQUE, M.A., F.I.C., F.C.S.
Island Professor of Chemistry and Agricultural Science.

W. R. BUTTENSHAW, M.A., B.Sc.,
Technical Assistant, Imperial Department of Agriculture.

13th Feb., 1905.

Report of Examiners on Chemistry of Agriculture.

The answers in Section A—Theoretical Chemistry—were generally very good indeed, and all the questions were attempted by one or other of the candidates.

In Section B—Elementary Organic Chemistry—the answers of Goode were especially satisfactory; those of the other candidates were good to fair. No candidate knew the answer to the last part of Question 5. One candidate attempted question 6, but failed to give an accurate account either of the properties or formula of acetic aldehyde.

In Section C—Agricultural Chemistry—each of the questions was well done by one or other of the candidates. The answers to question 10 were generally the least complete, and with the exception of two candidates, the statements of the composition of farmyard manure were wide of the mark.

On the whole, a generally high standard of answers was maintained in this paper. Goode was throughout very satisfactory; his answers were brief, accurate and to the point: Lindo and Sharp were also good; the answers of the other three candidates were, on the whole, fair.

J. P. DEALBUQUERQUE, M.A., F.I.C., F.C.S.,
Island Professor of Chemistry and Agricultural Science.

W. R. BUTTENSHAW, M.A., B.Sc.,
Technical Assistant, Imperial Department of Agriculture.

13th Feb., 1905.

Report of Examiner on Botany and Elementary Physics.

In each subject, six papers were sent in. Thhe candidates were the same in each subject.

All the Botany papers were well done. The highest marks were 81 per cent., obtained by George D. Goode, while the lowest marks obtained were 58 per cent. Question 4, which was to be answered by all candidates, was, on the whole, well done, though none could think of an experiment to prove satisfactorily that the root-hairs are the plant organs which absorb water from the soil. The candidates who answered question 1 failed to grasp the fact that the cotyledons of the bean seed are a *part of* the embryo; all stated that they *enclosed* the embryo.

The paper in Elementary Physics was also well done by all the candidates. The highest marks, 93 per cent., were again obtained by George D. Goode. The lowest marks obtained were 64 per cent.

I have the honour to be,
Sir,
Your obedient servant,

LONGFIELD SMITH, B.Sc. (Edin.) Ph.D., (Leipzig.)
Lecturer in Agricultural Science,

13th Feb., 1905.

Report of Examiner on Entomology.

The knowledge of general entomology seems to be good, every boy having a good idea of the characteristics of insects and of metamorphosis.

In answer to question 3, however, only 7 orders of insects are mentioned, and the order Neuroptera is given as having incomplete metamorphosis and as including the Dragon flies. This is not correct, but may have been adopted by the teacher for the sake of simplifying the course. I would suggest the use of 9 orders, as follows :—

	I	Thysanoptera	Thrips
with incomplete metamorphosis	II	Odonata	Dragon flies
	III	Orthoptera	
	IV	Hemiptera	
	V	Neuroptera	Lace wings *Chrysopa*, &c.
	VI	Coleoptera	
with complete metamorphosis	VII	Lepidoptera	
	VIII	Diptera	
	IX	Hymenoptera	

This makes it possible to treat the Neuroptera and Odonata (Pseudo-neuroptera) separately as they should be treated, and makes a place in which to discuss Thrips, a group of insects likely to need attention in many branches of tropical agriculture, without making too many orders for even an elementary course of study.

It will be noted that the answers to question 4 are the least satisfactory. This is to be regretted, as it is the one including field practice more than any other. No. 2, which is more a class-room question, stands highest in the averages.

H. A. BALLOU, B.Sc.
Entomologist to the Imperial Dept. of Agriculture.

January 26, 1905.

Report on Veterinary Science.

The candidates were examined by Dr. Gibb in Veterinary Science, and all obtained a high percentage of marks.

Goode	98%	Nethersole	80%
Sharp	92 "	Martinez	96 "
Lindo	98 "	Hewitt	80 "

Report on Practical Work.

The practical work of the students was not tested by examination but by a definite scheme of practical work that had to be efficiently carried out by each student. A schedule of the work is given below:—

PRACTICAL WORK FOR DIPLOMA.

Chemistry.

A Notebook showing results of deteterminations of :—

1. Lime in soils.
2. Purity and glucose ratio of cane juice.
3. Polarisation of sugar.
4. Obscuration of rum.
5. Starch in a commercial sample of starch.
6. Composition of Bat Guano :—

Moisture }
Organic matter }
Phosphoric Acid }

Agriculture.

1. Budding 6 trees.
2. Grafting 2 "
3. Raising from seed 12 economic plants for planting.

Surveying.

Plans from actual chain survey of single inclosure.

Botany.

Herbarium of dried specimens of—

1. Grasses } of agricultural importance.
2. Weeds }

Microscope.

Set of 6 micro-slides illustrative of agricultural application of the microscope.

Book-keeping.

A detailed account of the transactions on a property for one month, with an annual statement.

H. H. COUSINS, Island Chemist.

OBSERVATIONS ON THE MILK OF COWS IN JAMAICA.

By H. H. Cousins, Island Chemist.

Visitors and newcomers to this island are invariably struck with the comparative scarcity of fresh milk and butter, despite the large herds of cattle and the fine grazing lands to be seen all over the island. It is only natural that it should be considered a reflection upon our agricultural enterprise that some £60,000 worth of milk and butter should be imported annually from other countries although this must pay a duty of £10,000 before it is admitted into competition with the local article.

If this £70,000 could be spent in the island it would obviously be of great benefit and the sympathies of all intelligent Jamaicans must be drawn to those who are seeking to develop the dairy industry in the colony.

It is apparent that our cattle have been bred and handled for generations exclusively as a beef breed. Our penkeepers can at any rate say that they produce better beef than any tropical country in the world, and at a price which makes beef cheaper in Jamaica even than in free trade England. Beef and milk are not essentially incompatible, as witness the Dairy Shorthorn, but there is no doubt that in a country where cattle have to exist entirely upon grass, and this free from leguminous constituents, the milking of cows for dairy purposes would involve an injury to the calves, and thereby frustrate the quick production of saleable cattle.

It must be recognized that the raising of cattle under the conditions obtaining upon the average pen in Jamaica is that of producing flesh upon a working minimum of flesh-producing material. In other words, the law of food supply in the tropics holds with fodders as with human foodstuffs, viz.: the prolific production of carbohydrates is associated with a deficiency of albuminoids.

The tremendous energy of the tropical sun enables plants to produce big yields of sugars and starch; but this is, as a rule, not associated with a corresponding development of flesh-producing albuminoids.

The tropics can always outdo the temperate regions in the production of carbohydrates Acre for acre, the Sugar cane, Sweet potato and Cassava in the tropics are twice as productive of sugar and starch as their temperate competitors, Sugar-beet, Irish Potato and Maize.

Until a perennial leguminous forage crop can be found that will give yields to compare with that of Lucerne in temperate and sub-tropical countries, Jamaica could never develop a dairy industry—upon pastoral lines—that could compete with the foreigner.

Under present conditions, cows must be fed with imported meals and feeding stuffs, if any large yield of milk is to be obtained, and this greatly adds to the cost of production. I foresee that the development of the cotton and cassava industries will have a great influence upon the dairying interest, since the refuse 'bitty' of the cassava and the cotton seed would make an ideal food, in combination, for dairy cows. The seed from four acres of cotton and the dry residue from an acre of cassava, after being treated in the starch factory, would yield a mixed meal weighing 3 tons, and containing:

3,000 lbs. of digestible Carbohydrates = 50%
320 lbs. of Fat = 5·3%
440 lbs, of Albuminoids = 7·3%

Such a food should prove of the greatest service in the feeding of dairy cows in this country, as it could be produced at a low cost.

As no systematic analyses of the milk of Jamaica cows have been made up to the present, and I have been called upon to give evidence under the Adulteration Law as to samples of milk taken by the police, it seemed desirable in the public interest that such data should be obtained, so that a sound opinion upon the genuineness of local milk samples could be given. To this end, Mr. H. S. Hammond, F.C.S., of this department, personally visited all the chief dairies in the district and took samples of the milk of each cow and the mixed milk as sold to the public. Our best thanks are due to the proprietors of these dairies for the cordial way in which they assisted this investigation and for the full information they give as to the breeding and feeding of the cows.

The main results of the analyses may be tabulated as follows:—

Source.	Total Solids.	Fat.	Solids not Fat.	Ash.	Specific Gravity 60° F.
1. Average milk of 92 Jamaica Cows ...	13.83	5.1	8.69	0.70	1.028
2. Highest record of above (Barbadian Cow) ...	17.49	8.7	8.79	0.66	1.025
3. Lowest record of above (Holstein Cow) ...	10.10	2.9	7.20	0.70	1.025
4. Average of mixed milk from 7 dairies as sold to public ...	13.39	4.7	8.73	0.68	1.028
5. Average of 200,000 analyses by Richmond in England ...	12.9	3.9	9.0	0.75	
6. Legal standard of milk in U. K. ...	...	3.0	8.5		
7. Legal standard of milk in U. S. A. ...	12.0	3.25	8.5		
8. Proposed standard for Milk in Jamaica ...	11.75	3.5	8.25		

These results indicate that cow's milk in Jamaica is naturally richer in fat than the milk of similar cows in a temperate climate.

The average milk from the 7 Kingston dairies represents a very good standard and indicates over 20 per cent. more fat than that in average English milk. There would appear to be a lower standard of solids not fat, and in the case of individual cows these constituents are markedly low, A careful study of the records of the individual cows, as given in Mr. Hammond's report, will show the marked deterioration of the milk from cows of Holstein blood in this respect. In a tropical country the value of milk as a food for young children resides more in the content of albuminoids and mineral matter, the non-fatty solids which go to build up the body, than on the fat. Climatic conditions in Jamaica naturally favour a good proportion of fat in milk, and it is a serious matter as regards the public welfare that the recent craze for Holstein blood should result in such a serious depreciation of those constituents of milk most deficient under local conditions and most necessary in the food of young children. The records of certain selected creole cows in this list are excellent (see Dairy No. 2.) The Indian cross has enabled the Holstein strain to maintain a good standard of quality in two cases (Dairy No. 4. Nos. 5 and 20.)

Speaking generally, I am convinced that the Holstein breed is quite unsuited for Jamaica. I am informed that on large pens the calves are found delicate and the cross undesirable, while as regards the quality of milk the results are deplorable. The breeds producing rich milk, such as the Channel Islands breeds, are not of general utility for local purposes, and I see no need for producing milk of abnormal richness in fat in this country.

We want here a general purpose breed that will suit the butcher and also give good milk in quantity when used for dairy purposes. We have the foundation for this by making a rigid selection of our local cows. I believe individual creole cows hold the record for milk production in Jamaica, and if such animals were carefully selected for breeding, excellent results should follow. From experience of the splendid deep-milking qualities of a herd of dairy Shorthorns at Wye College in England, I am inclined to believe that the Dairy Shorthorn Bull should be most valuable in improving our creole dairy cows on safe and profitable lines.

The Holstein is doing great harm, and its general use would seriously deteriorate the quality of milk and also the butcher's value of our cattle.

Milks as sold in Kingston, 1905.

	Total Solids.	Fat.	Ash.	Solids not Fat.	Specific Gravity
No. 1* ...	11.44	3.45	0.63	7.99	1.028
No. 2* ...	10.59	3.05	0.56	7.54	1.025
No. 3* ...	11.69	3.95	0.53	7.74	—
No. 4 ...	11.97	3.20	0.76	8.77	1.032
No. 5 ...	15.24	4.90	0.68	10.34	1.033
No. 6* ...	11.34	3.1	0.56	8.24	1.032
No. 7 ...	12.35	3.9	0.65	8.45	1.030
No. 8 ...	12.35	3.7	0.69	8.65	1.031
No. 9* ...	10.37	2.6	0.62	7.77	1.030
No. 10 ...	13.02	4.4	0.67	8.62	1.031
No. 11 ...	11.64	3.5	0.64	8.14	—
No. 12 ...	11.76	3.8	0.70	7.96	1.030
No. 13 ...	11.60	3.3	0.70	8.30	1.031
No. 14 * ...	11.18	3.2	0.65	7.98	1.031

* Certified to be watered under Adulteration Act.

The above table gives the results of 14 samples of milk recently taken by the police under the Adulteration Law. Six of these were certified to be adulterated with water.

In one case the water used was very dirty, and evidence of *B. sporogenes enteritidis* was obtained markedly toxic to guinea-pigs. A comparison of these figures with those of genuine average milk from the 7 dairies shows that the police will act in the public interest to maintain a systematic check on the milk as sold in the city of Kingston.

Condensed Milk.

The following figures have been obtained in this Laboratory as to the composition of condensed milk sold in Kingston :—

Brand.	Total Solids.	Fat.	Ash.	Solids not Fat.	Sugars.
Milkmaid ...	75.88	10.00	1.99	65.88	55.85
Nestlé's ...	74.68	8.50	1.78	66.18	58.59
Cow's Head ...	71.91	11.25	3.53	60.66	37.48
Do. Unsweetened ...	43.40	9.0	2.12	34.40	21.78

These analyses were made on single tins only, and the results may not be representative of the bulk as imported into the island.

From these data it would appear that a 1lb. tin of good condensed milk selling at 5d. would be equal to 45oz. of Kingston milk. To compete with tinned milk, fresh cows milk, on this basis, would have to be sold at 4½d. per quart.

REPORT ON THE MILK OF JAMAICA COWS.

By H. S. HAMMOND, F.C.S., *Assistant Chemist.*

Dairy No. 1.—These cows are stall-fed, receiving oil-cakes and middlings, and guinea-grass. They are milked at 4, a.m. and 12, noon; these samples were taken at noon. The amount of total solids and of fat is high throughout; the ash in the case of No. 7 is low; the non-fatty solids are very low in the case of No. 2, and decidedly low in No. 7. The mixed milk, i.e, as sold to the public, is of excellent quality. These cows are mainly Barbadians, which are descendants of Channel Island cattle, famous for the richness of their milk, imported into Barbados several generations ago.

Reference Number of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk. Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
10	Barbadian ...	...	...	17.49	8.7	0.66	8 79	1 025
11	" ..	...	about 170	16.41	6.5	0.83	9.91	1.031
4	" ..	...	about 180	16.14	6.9	0.78	9.24	1.027
3	" ..	...	about 180	15.95	6.5	0.71	9.45	1.028
1	" ..	..	164	15.16	5.6	0.75	9.56	1.029
9	" ...	...	about 110	15.14	5.5	0 78	9.64	1.031
6	" ...	...	about 80	15.09	6.1	0.79	8 99	1.028
2	Native ¾ bred Jersey	1st Calf	65	14.86	7.6	0.72	7.26	1.026
5	Barbadian ...	...	about 180	14.80	5.4	0.72	9.40	1.030
8	" ..	...	about 140	14.74	5.8	0.69	8.94	1.029
7	Native ½ bred Holstein	.	about 140	12.66	4.5	0.64	8.16	1.028
	Average ..	.	...	15.31	6.3	0.72	9.03	1.028
	Mixed Milk ..	...	...	15 13	6.1	0.69	9.03	1.028

Dairy No. 2.—These are all native cows running at pasture and receiving no artificial food. They are milked (with the calf) at 5 a.m. and 1 p.m.; these samples were taken at 1 p.m. They are ordinary Jamaica cows; the richness of the milk is partly accounted for by the calves removing the first milk, which is the poorest.

The mixed milk is of very good quality and calls for no comment.

Reference Number of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk. Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
13	Jamaica ...	...	...	17.25	7.2	0.70	10.05	1 029
14	" ...	...	...	16.76	7.2	0.75	9.56	1 028
11	" ...	...	...	16.70	7.5	0.67	9.20	1.028
7	" ...	...	...	16 41	7.6	0.66	8.81	1.025
6	" ...	...	...	15.33	5.4	0.83	9.93	1.031
5	" ..	...	..	15.01	5 7	0.69	9 31	1.025
10	" ..	...	...	14.92	6.3	0.74	8.62	1.028
1	" ...	...	...	14.48	5.2	0.76	9.28	1.030
4	" ...	...	...	14.11	5.2	0.72	8.91	1 028
12	" ...	...	...	13.93	5 5	0.68	8.43	1.028
3	" ...	...	...	13 85	5.4	0.68	8.45	1 027
9	" ...	..	...	13 38	4.8	0.66	8.58	1.028
2	" ...	...	...	12.82	4.1	0.69	8.72	1.030
8	" ...	...	...	12.58	4.3	0.69	8.28	1 (28
	Average ...	...	...	14.82	5.8	0 71	9.01	1.028
	Mixed Milk ...	...	..	14.32	5 5	0 68	8 82	1.028

Dairy No. 3.—These cows are stall-fed, and receive guinea-grass, and a mixture of cornmeal, bean and cotton-seed meal. They are milked at 5 a.m. and 2 p.m. The milks call for no remarks. The mixed milk is of good quality.

Reference Number of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk.				
				Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
3	Imported ½ bred Jersey ...	..	297	16.28	6.5	0.72	9.78	1.030
2	Native ½ bred Holstein ...	...	184	15.06	5.9	0.75	9.16	1.028
9	Imported Jersey ...	...	194	15.02	6.1	0.70	8.92	1.028
6	Ordinary Native ...	...	135	14 93	5.6	0.66	9.33	1 030
5	Imported Jersey ...	...	165	13.87	4.6	0.75	9.27	1.030
10	Ayrshire and Jersey, native ..	...	..	13.36	4.7	0.72	8.66	1.029
8	Native ¾ bred Holstein ...	...	00	13.35	4.4	0.72	8.95	1.030
4	Native ½ bred Shorthorn ...	...	201	12.97	4.3	0.73	8 67	1.029
7	Imported Guernsey	...	255	12.51	4.2	0.76	8.31	1.027
1	Imported Ayrshire ...	...	100	12.[illegible]3	3.6	0.73	8.43	1 030
	Average ...	...	...	13.94	5.0	0 72	8.95	1.029
	Mixed Milk ...	...	...	13.47	4.4	0.69	9.07	1.030

Dairy No. 4.—These cows are all native-born; they are stall-fed, receiving 3 lbs. grain per day and guinea-grass.

They are milked at 3 a.m. and 1 p.m., and these samples were taken at 1 p.m.

In several cases, Nos. 12, 16, 13, 17, and 18, the ash is low; in Nos. 17, 2, 18, 15, 19, 14 the non-fatty solids are low.

The mixed milk is of good quality.

Reference Number of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk. Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
		Years						
5	Quarter-bred Holstein	3	244	16.89	7.0	0.80	9.89	1.030
4	Ordinary Native ...	12	261	16 76	7.2	0.74	9.56	1 028
20	Half-bred Holstein ...	10	9	15.64	5.0	0.66	10.64	1.029
3	" " ...	5	282	14.27	5.6	0.69	8.67	1.029
21	" " ...	4	5	14 22	4.7	0.70	9.52	1.031
7	" " ..	5	217	13.98	4.9	0.73	9.08	1 029
12	Ordinary Native .	13	150	13.86	4.9	0.63	8.96	1.028
1	Half-bred Holstein ...	7	413	13.82	5.0	0.67	8.82	1.028
10	" " ...	3	193	13.49	4 5	0.71	8.99	1.029
16	" " ...	3	112	13.25	4.3	0.64	8.95	1 029
11	" " ...	4	171	13.18	4.3	0.66	8.88	1.028
6	" " ...	9	221	13 10	4.2	0.66	8.90	1–028
13	" " ...	9	138	13.01	4.7	0.61	8.31	1.027
9	" " ...	3	200	12.83	4 2	0.71	8.63	1.028
17	Ordinary Native ...	10	64	12.45	4.3	0.60	8.15	1.028
2	Half-bred Holstein	5	305	12 14	4.0	0.65	8.14	1.028
18	" " ...	9	40	11.66	4.0	0 64	7.66	1.026
15	" " ...	10	113	11.63	4.0	0.72	7.63	1.0'6
19	" " ...	9	28	11.39	3.8	0.71	7.59	1.026
14	" " ...	5	120	10.95	3.4	0.73	7.55	1.027
	Average ..	.	...	13.43	4.7	0.69	8.73	1.028
	Mixed Milk ...	...	...	13.33	4.5	0.70	8.83	1.028

Dairy No. 5.—This herd consists mainly of imported cows; they are stall-fed, receiving cornmeal, bean and cotton-seed meal, and guinea grass. They are milked at 4 a.m., 12, noon, 4 p.m; these samples were taken at noon. Nos. 12 and 8 are low in fat; Nos. 15, 14, 10, 9, 18, 5, 7 and 12 are low in ash: Nos. 9, 4, 2, 1, 5, 19, 7, 12 and 8 are low in non-fatty solids. Nos. 12 and 8 are very poor milks.

The mixed milk is fairly good, though the figure for ash is low.

Reference Number of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk.				
				Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
13	Holstein, native born	...	214	14.97	5.5	0.67	9 47	1.029
15	Alderney, imported ..	...	...	14.79	5.7	0.61	9.09	1.028
16	Jersey, imported ..	..	about 169	14.76	5.4	0.69	9.36	1.028
14	Holstein, native born	.	273	14.70	5 5	0 61	9.20	1.029
10	Ordinary native ..	...	199	14.36	4 7	0.63	9.66	1.029
17	Guernsey, imported	...	...	13.45	4.4	0.69	9.05	1.030
11	Ordinary native ...	...	31	13.33	4.3	0.67	9.03	1.030
20	Jersey, imported ...	...	30	13.27	4.6	0 65	8 67	1.028
9	Native ¾ Holstein ...	...	187	13.17	4 8	0.59	8.37	1.026
4	Guernsey, imported	...	169	13.08	4.7	0.71	8.38	1.028
6	Holstein, imported ...	...	15	12.86	3 7	0.71	9.16	1 031
3	Native ¾ Holstein ...	...	141	12 73	4.0	0.67	8.73	1 029
18	Holstein, imported .	...	...	12.61	4.0	0.58	8.61	1.029
2	Ayrshire, imported ...	...	82	12.55	4 6	0 71	7.95	1.027
1	Holstein, imported ...	...	50	12.26	4.1	0.69	8.16	1.028
5	Alderney, imported...	...	...	12.02	4 3	0.61	7.72	1.026
19	Alderney, imported .	...	...	11.99	3.9	0.66	8.09	1.028
7	Holstein, imported ...	...	...	11.53	3.7	0.63	7.83	1.027
12	Holstein, native born	...	88	10.39	3.1	0.58	7.29	1.025
8	Holstein, imported ..	...	...	10.10	2.9	0.70	7.20	1.025
	Average ...	...	...	12 95	4.40	0.65	8.55	1.028
	Mixed Milk	...	...	12.88	4.2	0.63	8.68	1.028

Dairy No 6.—These cows are stall-fed, receiving cornmeal, bean and cotton-seed meal, or "Dairy Feed," (a mixture of ground barley, oats and corn.) They are milked at 4 a.m. 11 a.m. and 4 p.m.; the samples were taken at 11 a.m. The ash in No. 2 is low: the non-fatty solids in Nos. 4, 1 and 2, and also in the mixed milk, are low.

Reference No. of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk.				
				Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
4	Canadian, grade Hereford ..	...	180	13.93	6.4	0.69	7.53	1.023
3	Canadian, pure Guernsey ...	...	...	13.80	5.5	0.66	8.30	1.027
1	Canadian, grade Holstein ...	...	41	12.51	4.5	0.67	8.01	1.027
2	Canadian, pure Guernsey ..	...	...	12.27	4.5	0.64	7.77	1.026
5	Native, pure Holstein	..	16	12.02	3.7	0.66	8.32	1.029
	Average ...	..	.	12.91	4.9	0.66	7.99	1.026
	Mixed Milk ...	...	...	12 64	4.5	0 67	8.14	1.027

Dairy No 7.—These cows are all imported: they are stall-fed and receive bean and cornmeal and guinea grass. They are milked at 4 a.m. and 2 p.m.: these samples were taken at 2 p.m., with the exception of the mixed milk, which is the early morning milk. In the case of No. 9, the fat is low; in Nos. 4 and 6 the non-fatty solids are low. The mixed milk is slightly low in fat.

Reference No. of Cow.	Breed.	Age.	Days in Milk.	Analysis of Milk.				
				Total Solids.	Fat.	Ash.	Non-fatty Solids.	Specific Gravity.
7	Imported Ayrshire-Shorthorn ...	8 yrs.	247	15.01	6.3	0.75	8.71	1.028
3	Imported Ayrshire-Guernsey ...	9 "	32	14.85	6.5	0 68	8.35	1 027
10	Imported Holstein ...	9 "	109	14.31	5.5	0.73	8.81	1.028
2	Imported Jersey-Holstein .	6 "	312	14 19	5.6	0.77	8.59	1.028
8	English Shorthorn ...	4 "	180	13 73	4.9	0.74	8.83	1.029
1	Canadian Jersey-Ayrshire ...	6 "	21	13 70	5.2	0.69	8 50	1.028
5	Imported Holstein ..	10 "	242	13.59	5.0	0.79	8 59	1.028
12	Barbadian ...	4 "	38	13.58	4 7	0.75	8.88	1.029
11	Imported Holstein-Jersey ..	6 "	58	12.72	4.1	0 75	8.61	1.029
4	Imported Holstein ...	9 "	56	12.05	4 1	0.69	7.95	1.028
9	" Ayrshire ...	6 "	109	12 01	3 2	0 67	8.81	1.029
6	" Holstein ...	6 "	58	11.55	3 7	0.70	7.85	1.027
	Average ...	...	...	13.44	4.9	0.73	8.54	1.028
	Mixed Milk, taken	at 4 a.	m. ...	11.96	3.4	0.72	8.56	1.030

COMPARISON OF SACCHAROMETERS.

Specific gravity. 62° F.	Jamaica Saccharometer. lbs. per barrel.	Brix Saccharometer. lbs. per 100 lbs.
1·000	0·0	0·0
1.003	1.0	0.8
1.006	2.0	1.6
1.008	3.0	2.1
1.011	4.0	2.8
1.014	5.0	3.6
1.017	6.0	4.3
1.019	7.0	4.8
1.022	8.0	5.6
1.025	9.0	6.3
1.028	10.0	7.1
1.031	11.0	7.8
1.033	12.0	8.3
1.036	13.0	9.0
1.039	14.0	9.7
1.042	15.0	10.5
1.044	16.0	10.9
1.047	17.0	11.6
1.050	18.0	12.4
1.053	19.0	13.1
1.056	20.0	13.7
1.058	21.0	14.3
1.061	22.0	14.9
1.064	23.0	15.6
1.067	24.0	16.3
1.069	25.0	16.8
1.072	26.0	17.4
1.075	27.0	18.1
1.078	28.0	18.8
1.081	29.0	19.5
1.083	30.0	20.0

H. H. COUSINS.

THE BUD ROT OF THE COCONUT PALM IN THE WEST INDIES. (1)

By DR. ERWIN SMITH, U. S. Department of Agriculture. (2)

General attention was first called to this disease by the reports of army officers during the American occupation of Cuba. The

(1) In the *Bulletin of the Department of Agriculture, Jamaica*, March, 1905, there is a Note on this soft tissue disease, and a remedy proposed which has already arrested the disease in several cases. When it has, however, gone too far, the only plan is, as Dr. Smith suggests, to cut down the tree and burn the "cabbage." *Editor.*

(2) From *Science*.

coconut palms were said to be dying in large numbers of some mysterious disease which should be investigated. Mr. Busck was sent by the U. S. Department of Agriculture to eastern Cuba, and subsequently reported on the entomological aspects of the disease. Later Mr. F. S. Earle reported the occurrence of a bacterial bud rot of the coconut in Jamaica. ([3]) The writer has since heard of its occurrence on the mainland in Central America, so that it may be assumed to occur all round the Caribbean. It was studied by the writer at Baracoa, Mata and Yumuri in eastern Cuba in April, 1904.

The disease has made decided advances since it was studied by Mr. Busck in 1901, especially at Mata, and if it continues to spread as it has done during the past ten years it will inevitably destroy the coconut industry of the island, and that, too, within the next ten or fifteen years. Already many of the planters are discouraged and not setting any more trees, since it now attacks trees of all ages, including quite young ones and those on the hills as well as those close to the sea. The disease is frequently known as 'the fever,' and often one sees where the bases of the trunks have been scorched with an idea of preventing the development of the disease. The disease is not lodged in the roots, however, nor in the stem. These in all cases appear to be sound. The general symptoms are the yellowing and fall of the outer leaves, the shedding of the nuts, and some months later the death of the whole crown. The cause of this decline is not apparent until the tree is felled and the crown of leaves removed, including the wrappings of the strong terminal bud. The latter is then found to be the seat of the disease. This bud with its wrappings of young and tender leaves is found to be involved in the vilest sort of a bacterial soft rot—not unlike that of a decaying cabbage or potato, but smelling much worse, the stench resembling that of a slaughter-house. This rot, invisible until the numerous outer leaf-base wrappings are removed, often involves a diameter of several inches of soft tissues and a length of three or four feet, including flower buds and the whole of some of the soft fleshy white undeveloped leaves covering the bud and forming the so-called 'cabbage' of the palm. The rot stops very promptly with the harder tissues of the palm stem immediately under the bud and does not attack any of the developed leaves. It is a disease of the undeveloped tissues. When the tree is felled and opened up, carrion flies and vultures are promptly attracted by the horrible smell. Fly larvæ and various fungi were found in the parts most exposed to the air and longest diseased, but the advancing margin of the decay was occupied only by bacteria, of which there appeared to be several sorts. No yellow or green fluorescent bacteria were obtained from the rotting tissues. All were white organisms of the 'soft-rot' type, mostly plump short rods with rounded ends,

(3) See *Bulletin of the Department of Agriculture, Jamaica*, Feb., 1903, page 31.

but occasionally longer rods, all apparently gas producers. One of the commonest sorts formed round dense creamy white opalescent colonies on agar. Another formed thin gray-white iridescent colonies on agar. A terminal spore-bearing, tetanus-like organism was also often abundant in the decayed tissues, even close to the advancing margin of the rot, and this is probably an anaërobe as it was not obtained in any of the many cultures.

The picture of one diseased tree will answer for many. No fungi or insect injuries were found which could in the least account for the death of the tree. The disease is the result of a bacterial rot of the terminal bud and its wrappings, including the flower buds. The bacteria probably find their entrance through wounds of some sort, and their distribution is undoubtedly favoured by carrion creatures. The larva found deepest down in the rotting tissues was that of the common scavenger fly, *Hermetia illucens, L.* Occasionally the crown of a tree was found yellow from other causes, but if the youngest visible leaf (projecting five or six feet) was observed to be lopped over and wilting or shriveled, the soft rot was sure to be found on cutting down the tree and removing the close-wrapped leaf bases. No attempt has yet been made to produce the disease by pure cultures.

Diseased trees should be felled and the terminal bud burned or properly disinfected with sulphate of copper. Only the most energetic action is likely to avail.

THE TOBACCO OF JAMAICA, II.

The following correspondence relating to the development of the tobacco industry of Jamaica is published for general information :—

Extract from a letter from Professor W. R. Dunstan, Director of the Imperial Institute, to the Under-Secretary of State for the Colonies, dated December, 20, 1904.

The trade report made by Mr. Chalmers* on the tobacco of Jamaica is of considerable interest.

The fact is already appreciated in this country that Jamaica is able to produce cigars of excellent quality. The quality does not however, appear to be uniform. The subject is so important that no effort should be spared to take whatever steps are needed for the development of the industry. If the recommendations made by Mr. Chalmers in his report are to be followed, it would seem highly desirable to obtain expert advice with reference to the cultivation, picking, fermentation, and curing of tobacco suitable for the manufacture of cigars. This assistance could best be obtained from Cuba, or from Sumatra or Florida, where suitable varieties of tobacco are successfully produced.

This step has been recently taken in connection with the development of the tobacco industry in South Africa and also in Ireland.

* *Bulletin* for Dec., 1904, page 265.

Extract from a letter from the Board of Trade Commercial Department (Intelligence Branch)—to the Colonial Secretary, Jamaica, dated December 7, 1904.

In the report from the expert, referred to above, interesting information is (as you are aware) given, embodying the results of his inquiries and investigations into the growing of tobacco in your colony, and the possibility of the establishment of a very lucrative industry in connexion therewith, and there is no doubt that the particulars contained in this report would be of considerable interest to the representatives of the tobacco trade in this country. The value, however of the information given would be materially enhanced if the report itself were accompanied by samples of the various grades of tobacco produced, and such samples (if procured) could be exhibited at the Offices of this Branch in illustration of Mr. Chalmers' report, and could be retained here for examination by tobacco importers in this country, and afterwards sent to the Imperial Institute, or otherwise disposed of as might be directed.

I should be glad, therefore, if arrangements could be made for samples of such tobacco to be forwarded to this Branch for the purpose indicated.

Extract from Minute from the Director of Public Gardens and Plantations to the Colonial Secretary, Jamaica.

Professor Dunstan states that Jamaica Cigars are not of uniform quality. This fact is due to the trade being at present of only small dimensions, and there is no doubt that the quality will gradually become uniform as larger stocks of tobacco are used for an increased trade.

Expert advice would be of great assistance, as Professor Dunstan suggests, especially as to Sumatra tobacco, when it is possible for the Government to spare the necessary money.

The Department has, however, studied the problems of cultivation and curing with the help of trained Cubans, and has a practical school at Hope Gardens where any one is welcome to come and learn and where the apprentices are taught during their time of service. The attached leaflets are reprinted from the *Bulletin*, and may perhaps interest Professor Dunstan.

I have sent samples of tobacco to Mr. Worthington (of the Intelligence Branch of the Board of Trade), but I do not think that it is possible to do much at present in an export trade of leaf tobacco. The samples should not, therefore, be put forward as soliciting orders, but only as indicating what Jamaica can produce. All that is now grown is required for the cigar business, which is gradually growing, but large orders might lead again to a catastrophe in our trade. We should aim rather at quality than quantity.

Extract from a letter from Professor W. R. Dunstan, Director, Imperial Institute, to Director, Public Gardens and Plantations, Jamaica, dated 30th March, 1905.

I have received through the Colonial Office a copy of a memorandum prepared by you with reference to certain suggestions made by me in a letter, dated the 20th December, 1904, to the Under Secretary of State for the Colonies, as to the steps to be taken to improve the quality of the tobacco produced in Jamaica.

I also venture to suggest that it would be well if typical samples of the tobacco grown in Jamaica, and of products such as cigars or pipe tobaccos manufactured from them, could be sent here for exhibition in the Jamaica Court of the Imperial Institute.*

The samples should be accompanied by statistics of production and export, and information as to the prices at which products of similar quality could be delivered in this country, so that descriptive labels for the exhibits may be prepared and that we may be in a position to answer any enquiries received from merchants and others to whose notice the exhibits will be brought.

The Imperial Institute has paid special attention to the question of tobacco cultivation and examination, and would be ready to give any assistance in connection with this industry in Jamaica.

STACK ENSILAGE.†

By Alfred H. D'Costa.

Plant three acres of guinea corn, red dhurra or native corn and cultivate until the grains of corn are just soft enough to be crushed between your fingers—The corn is then in the best stage to make ensilage.

Erect eight poles ten feet high to outline your stack and wattle the sides to help even packing, A stack 16 feet by ten feet is a suitable size for three acres of corn. Leave two openings in the sides of the stack one at either side to be used as doors.

Start cutting the corn early in the morning, one man cutting, two men and two carts carting, and one man to pack and you remaining in the stack to direct the packing and give a help with the handing up of the corn.

Spread about a foot of grass on the ground and see that it is quite level.

With the first load of corn brought in by the carts start packing and pack as tightly and as level as you can, be sure and pack the sides tightly as the great object is to keep out the air and it is more likely to get in from the sides than anywhere else. Pack right up to the wattle and be sure that you leave no air spaces;

*The Director of Public Gardens will be happy to receive samples, and forward them to the Director of the Imperial Institute.

† An article on this subject was published in the *Bulletin of the Botanical Department, Jamaica*, March, April, May 1900, Vol. VII page 35.

wherever you notice a small hole, cut some of the corn and push it in and always pack level. Continue to pack evenly until you have used all your corn then cover the top with one foot of grass spread evenly and pile on all the stones and logs you can get on top to weigh down the stack.

After you have got on the weights take down the wattle and draw away the side poles and so leave the stack free to settle down.

The stacking of the corn may take from two to three days and the ensilage will be ready for use in about two months time.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, X.*

(Continued from Bulletin for April.)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

AGE AT WHICH PLANTED TREES MAY BE TAPPED.

The earliest age at which Castilloa trees may be tapped with safety and advantage has been stated all the way from four to twelve years, while from eight to ten years is the conservative estimate. At the same time it must be admitted that little in the way of positive knowledge exists on this point, and careful experiments may be necessary to determine whether, for example, the taking of half a pound of rubber from each treee in the sixth year will retard growth so as to diminish the yield of succeeding years. As the trees approach maturity and have occupied most of the available space, as much may be taken as will not weaken the tree and shorten its life.

The inferior quality of the rubber obtained from young trees also lessens the inducement for tapping them. It has been known for several years that the rubber and gutta-percha obtained from young plants or from the leaves and twigs of the trees is different from that yielded by a trunk of mature age, in that a smaller or larger percentage of rubber is replaced by non-elastic, brittle, or sticky substances commonly referred to as "resins." Dr. C. O. Weber has recently published the following results of analyses of samples of rubber from trees varying in age from two to eight years: †

Resins in rubber from trees—		Per cent.
2 years old	...	42.33
3 years old	...	35.02
4 years old	...	26.47
5 years old	...	18.18
7 years old	...	11.59
8 years old	...	7.21

* Extract from the U. S. Department of Agriculture, Bull. No. 49. Bureau of Plant Industry.

† Tropical Agriculturist, 22; 444. January, 1903.

The same writer also gives a table showing the varying amount of resin in samples from different parts of the same tree:

Resin in Rubber from—		Per cent.
Trunk	...	2.61
Largest branches	...	3.77
Medium branches	...	4.88
Young branches	...	5.86
Leaves	...	7.50

If these figures represent facts at all general, they lessen very distinctly the prospects of any plans which contemplate the tapping of very young trees, and it will be necessary to agree with Dr. Weber that eight years is the minimum age at which a plantation can be expected to furnish rubber for the market.

But as this point is one which has been brought into considerable prominence in recent years, and is being relied upon by some as a means by which the profits of rubber culture can be increased and hastened, it may be well to state that the inferiority of the rubber of young trees and growing parts has been determined by other competent investigators and especially by Mr. Parkin whose account of the matter furnishes several interesting details which supplement the figures furnished by Dr. Weber:

In the case of Hevea, the rubber collected from the young stems and leaves, as well as from the unripe capsules, is somewhat adhesive, and has less elasticity and strength than that from the trunk. In the Castilloa introduced into Ceylon the latex from the stems bearing leaves, as well as from the leaves themselves, moulds between the finger and thumb into a very sticky substance, wholly unlike the caoutchouc-containing latex of the trunk. It dries to a brittle material, which becomes viscous when warmed. The quality of the rubber from stems of this Castilloa, 12.5 to 25 centimeters (5 to 10 inches) in circumference, was likewise tested. It seemed to have properties intermediate between that of the shoots and the trunk, being slightly sticky and somewhat deficient in elasticity.

The climbing rubber plants, *Landolphia Kirkii* and *Urceola esculenta*, show a similar difference between the latex from the shoot and that from thick stems. *Ficus elastica* also exhibits this peculiarity.[a]

Attention was called to this in Ficus as far back as 1839, by Weinlung. He called the substance "viscin," and considered it intermediate between resin and caoutchouc.

Mr. Parkin further says:

In many plants this so-called viscin seems to occur throughout the laticiferous system, e.g., the common breadfruit (*Artocarpus incisa*) and jak (*A. integrifolia*), trees of the Tropics.

Most likely there are bodies which do not come within the categories of caoutchoucs and guttas, and yet are hydrocarbons with the same percentage composition. Probably some of these viscous substances are such Also it appears probable that all caoutchoucs are not identical, and that when prepared as pure as possible from the latex, as by the ingenious centrifugal method of Biffen, it may be found, for example, that the caoutchouc of Hevea has slightly different properties from that of Castilloa.[b]

(To be continued.)

a See Weiss, Trans. Linn. Soc. 111, 1892, p. 243.
b Parkin, Annals of Botany, 14: 203-204, 1900.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held on 11th April. Present: the Hon. the Colonial Secretary, Chairman, the Director of Public Gardens, the Agricultural Chemist, His Grace the Archbishop, the Hon. Thos. Capper, Messrs. C. E. deMercado, C. A. T. Fursdon, J. W. Middleton, G. D. Murray, and W. Harris, Acting Secretary.

Representative of the Agricultural Society—A letter was read from the Agricultural Society stating that Mr. Fursdon, who is already a Member of the Board, would also represent the Society.

Nomination of Members to fill vacancies—Letters were read from the Northside Sugar Planters' Association declining to nominate a member, also from the Hon. C. B. Vickers and Mr. P. H. Greg stating that it would not be convenient for them to accept seats on the Board.

Science Teaching in Secondary Schools—The correspondence on this subject was submitted, and was ordered to be circulated amongst the members.

Manurial experiments with Bananas at Burlington—A letter was presented from the Hon. H. Cork reporting the failure of these experiments, and a memorandum from the Agricultural Chemist dealing with the matter. It was decided to write to Mr. Cork the substance of the Chemist's memorandum.

Draft of Proposal re Sugar Experiment Committee—The Government submitted a proposal for the appointment of a Committee to co-operate with the Island Chemist in the management of the Sugar experiments. It was pointed out that the appointment of such a Committee was recommended by this Board in April 1904, and the proposal was generally approved. On the suggestion of the Archbishop it was recommended that the Committee should be styled an Advisory Committee.

Rotation of Crops in Cotton cultivation—A letter from Sir D. Morris with other correspondence on this subject was submitted. It was decided to circulate this correspondence.

Packing of Oranges and Grape Fruit—A letter from Mr. Joseph Darling addressed to H. E. the Governor was brought up for discussion. It was decided to reply to the Government that the Board is well aware of the evils that exist but it is unable to suggest a practical remedy.

Mr. E. J. Wortley as Assistant at the Crystal Palace Exhibition—Mr. Fursdon addressed a letter to the Chairman on this subject. It was agreed that the Government should be urged to grant the necessary leave which need not exceed five months.

His Grace the Archbishop and Mr. deMercado here left the meeting.

Experiment Station—Labour, and distribution of Canes—It was decided that the present area under Canes should not be reduced.

The Hon. Colonial Secretary left at this stage, and the Director of Public Gardens took the Chair.

It was agreed that the number of Apprentices should be reduced to 10, and in future only boys who can read and write well are to be employed.

(Mr. Capper here left the meeting.)

Moved by Mr. Murray, seconded by Mr. Fursdon, supported by Mr. Middleton and the Agricultural Chemist, it was decided that £30 of the Hope Gardens Vote for Transport, &c., be allocated for the distribution of Cane Tops for experiments. The Director of Public Gardens protested.

Reports from the Chemist—The following papers from the Chemist were ordered to be circulated

1. Applications from 18 distillers for £10—Scholarships..
2. Proposed arrangements as to admission of boys from Secondary Schools to Laboratory Lectures.
3. Fee to Consulting Engineer—Sugar Experiments.
4. Progress Report. Sugar Experiments.

Reports, &c., from the Director of Public Gardens, to be circulated :—

a. Hope Experiment Station.
b. Instructors' Reports.
c. Letters from Mr. Cradwick re School Gardens.
d. Proposed Itinerary for Mr. Thompson to end of June.
e. Proposed Itinerary for Mr. Cradwick.

Mr. Cradwick's assistance at Agricultural Show—A letter was read from Hon. R. P. Simmonds asking if the Board will allow Mr. Cradwick to assist during June in St. Mary in stirring up the people to take an interest in a Show to be held at Port Maria at the end of June, also to assist at the Show itself. It was agreed that Mr. Cradwick should do this in connexion with his instruction work in St. Mary.

Materials for spraying diseased Caco-nut trees—The Chairman asked for the approval of the Board for the purchase out of the Board's Petty Expenses of materials in order that the experiments in spraying diseased Coco-nut trees may be continued. This was agreed to.

A CORRECTION.

The following correction has been sent by Dr. Cousins :—

The note by Dr. Cousins appended to the papers on Rotation Crops for Cotton in the last number of this Bulletin (on p. 110) is incorrectly described as a 'note on foregoing papers.' Neither the original letter from the Colonial Secretary to the Director of Public Gardens nor the closing letter from the Chemist of the Leeward Islands (Dr. Francis Watts) had been referred to Dr. Cousins nor had he seen these papers until their publication in the Bulletin. The minute by the Island Chemist was not drafted for publication and was based upon the four rotations suggested for trial in Jamaica only.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. **JULY, 1905.** **Part 7.**

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

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KINGSTON, JAMAICA:
HOPE GARDENS.

1905.

JAMAICA.

BULLETIN

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DEPARTMENT OF AGRICULTURE.

Vol. III. JULY, 1905. Part 7.

THE SUGAR CANE SOILS OF JAMAICA.—III.*

By H. H. COUSINS, Island Chemist.

THE UPPER VERE PLAIN.

A series of twelve samples of soil from the chief lands of Denbigh Estate has been analysed and after careful comparison with the results from other soils and a consideration of the indications of manurial experiments, advice as to the practical treatment of each soil has been given. It will be noticed that every soil in the series is deficient in carbonate of lime and in some cases it was not possible to detect any carbonates at all.

I have arranged with G. W. Muirhead, Esq., that an acre of land on each piece shall be treated as recommended, so as to test the practical utility of advice based upon analytical and experimental data. The analytical work has been performed by Mr. H. S. Hammond, F.C.S., and the mechanical analyses are mainly the work of Mr. T. H. Sharp, Jr., B.S.A.

SOIL ANALYSIS—A.

Reference Number—100.
Source Details—Denbigh Estate. Wood Pasture. Old Cane Field.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.69	Fine Earth.
	Sand	...	1.38	
	Fine Sand	...	21.88	
	Silt	...	60.36	
Agricultural Clay	Fine Silt	...	1.38	
	Clay	...	9.16	
	Moisture	...	5.15	
	Total	...	100 00	
			Per Cent.	
Retentive Power for water		...	58.0	

*Part I. Bulletin 1903, pp. 76-93. Part II. Bulletin 1903, pp. 97-109.

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

		Per Cent
Insoluble Matter	...	67.93
Soluble in Hydrochloric Acid	...	32.07
Potash	...	0.333
Lime	...	0.614
Phosphoric Acid	...	0 0945
Carbonic Acid as Carbonate of Lime	...	Nil
Combined Water and organic matter		9.07
Humus (soluble in Ammonia)		0.875
Nitrogen	...	0.125
Hygroscopic Moisture	...	5.43

FERTILITY ANALYSIS.

Available Potash	...	0.0048
Available Phosphoric Acid	...	0.0143

OBSERVATIONS.

This soil is very similar in mechanical composition to some of the heavier soils in the lower area of the Vere Plain. It is a stiff, alluvial soil, well suited for cane cultivation. Although fairly porous, this soil should benefit from drainage.

Chemically, the following points call for notice :—

(1) The entire absence of carbonate of lime ;

(2) The rather low standard of humus and of nitrogen.

Recommendations—

(1) Apply 1 ton of lime per acre, or 4 tons of marl.

(2) Encourage all the humus-producing agencies of the estate, grow cow-peas and apply as much farmyard manure and vegetable refuse as possible.

(3) Apply a manure of 2 cwt. sulphate of ammonia and 1 cwt. sulphate of potash per acre, preceded by 5 cwt. of basic slag and lime or marl as already recommended.

SOIL ANALYSIS—B.

Reference Number—101.

Source Details—Denbigh Estate. Big Lime Savannah. Old Cane Land.

Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	1.71	Fine Earth.
	Sand	...	3.17	
	Fine Sand	...	4.41	
	Silt	...	66.59	
Agricultural Clay.	Fine Silt	...	14.92	
	Clay	...	3.07	
	Moisture	...	6.13	
	Total	...	100.00	

		Per Cent.
Retentive power for water	...	60

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	69.01
Soluble in Hydrochloric Acid	...	30.99
Potash	..	0.194
Lime	...	0.816
Phosphoric Acid	...	0.049
Carbonic Acid as Carbonate of Lime	...	Trace
Combined Water and organic matter		8.69
Humus (soluble in ammonia)		2.05
Nitrogen	...	0.123
Hygroscopic Moisture	...	6.53

FERTILITY ANALYSIS.

Available Potash	...	0.0637
Available Phosphoric Acid	...	0.0142

OBSERVATIONS.

This is an even heavier soil than the preceding and draining is important. It is deficient in carbonate of lime, but is in better heart than the previous sample. The standard of humus and nitrogen is good, and the potash and phosphoric acid satisfactory. I should not expect ordinary fertilisers to pay on this soil unless in a very good growing season or with irrigation. I advise applying lime or marl and the growing of cow-peas as the best practical treatment. This is good cane land, and should respond to deep tillage.

SOIL ANALYSIS—C.

Reference Number—102.
Source Details—Denbigh Estate. Murphy John. Old Cane Land.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	2.32	Fine Earth.
	Sand	...	2.94	
	Fine Sand	...	19.74	
	Silt	...	64.75	
Agricultural Clay.	Fine Silt	..	2.67	
	Clay	...	1.48	
	Moisture	...	6.10	
	Total	...	100.00	

		Per Cent.
Retentive Power for water	...	52

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	73.31
Soluble in Hydrochloric Acid	...	26.69
Potash	...	0.147
Lime	...	0.531
Phosphoric Acid	...	0.0736
Carbonic Acid as Carbonate of Lime	...	Trace
Combined Water and organic matter		6.26
Humus (soluble in Ammonia)		1.16
Nitrogen	...	0.086
Hygroscopic Moisture	...	6.50

Fertility Analysis.

Available Potash	...	0.0076
Available Phosphoric Acid	...	0.0165

Observations.

This is a lighter soil than the two previous samples and naturally more free draining. It is in fair heart, but is low in humus for first class cane land and is almost deficient of carbonate of lime.

This soil should receive lime and be helped with green dressings, pen manure and any compost or trash available.

I do not consider that fertilisers would offer any security for a profitable return under present conditions.

SOIL ANALYSIS—D.

Reference Number—103.

Source Details—Denbigh Estate. Big Shaddock. Old Cane Field.

Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	2.22	Fine Earth.
	Sand	...	0.91	
	Fine Sand	...	32.26	
	Silt	...	59.88	
Agricultural Clay.	Fine Silt	...	0.53	
	Clay	...	0.02	
	Moisture	...	4.18	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	52	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	71.24
Soluble in Hydrochloric Acid	...	28.76
Potash	...	0.231
Lime	...	1.53
Phosphoric Acid	...	0.1175
Carbonic Acid as Carbonate of Lime	...	Nil
Combined Water and organic matter		5.191
Humus (soluble in Ammonia)		0.877
Nitrogen	...	0.058
Hygroscopic Moisture	...	4.36

Fertility Analysis.

Available Potash	...	0.0116
Available Phosphoric Acid	...	0.0194

Observations.

This soil consists almost entirely of fine sand and silt and is naturally porous and free draining. It lacks humus and carbonate of lime. The phosphoric acid and potash are quite satisfactory.

Lime and vegetable refuse are needed to bring this soil up to a high standard of fertility. I do not recommend commercial fertilisers, except 1 cwt. per acre of sulphate of ammonia to the ratoons.

SOIL ANALYSIS—E.

Reference Number—104.
Source Details—Denbigh Estate. Congo Town. Old Cane Field.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.26	Fine Earth.
	Sand	...	0.22	
	Fine Sand	...	1.70	
	Silt	...	82.42	
Agricultural Clay.	Fine Silt	...	4.05	
	Clay	...	4.17	
	Moisture	...	7.18	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	57	

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	62.90
Soluble in Hydrochloric Acid	...	36.10
Potash	...	0.265
Lime	...	1.119
Phosphoric Acid	...	0.1185
Carbonic Acid as Carbonate of Lime	...	Trace
Combined Water and organic matter		9.201
Humus (soluble in Ammonia)		1.76
Nitrogen	...	0.0943
Hygroscopic Moisture	...	7.74

FERTILITY ANALYSIS.

Available Potash	...	0.0088
Available Phosphoric Acid		0.0223

OBSERVATIONS.

This soil consists of very fine particles and is on the heavy side. It presents all the factors for good cane land in very sound heart.

I am of opinion that a dressing of lime or marl on this soil would do wonders.

SOIL ANALYSIS—F.

Reference Number—105.
Source Details—Denbigh Estate. Hospital Piece. Old Cane Field.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.11	Fine Earth.
	Sand	...	0.11	
	Fine Sand	...	0.60	
	Silt	...	60.73	
Agricultural Clay	Fine Silt		22.68	
	Clay	...	5.95	
	Moisture	...	9.82	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	77	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	..	61.61
Soluble in Hydrochloric Acid	...	39.39
Potash	...	0.577
Lime	...	0.760
Phosphoric Acid	...	0 094
Carbonic Acid as Carbonate of Lime	...	Trace
Combined Water and organic matter		10.10
Humus (soluble in Ammonia)		2.096
Nitrogen	...	0.140
Hygroscopic Moisture	...	10.89

Fertility Analysis.

Available Potash	...	0.0079
Available Phosphoric Acid	...	0.0251

Observations.

This is rather a heavy piece of land, but of good quality. Drainage should be studied. Humus and nitrogen very good. Potash and phosphoric acid satisfactory. In great need of lime.

SOIL ANALYSIS—G.

Reference Number—106.
Source Details—Denbigh Estate. Dudley Content. New land.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	1.11	Fine Earth.
	Sand	...	1.43	Fine Earth.
	Fine Sand	...	13.80	Fine Earth.
	Silt	...	66 13	Fine Earth.
Agricultural Clay	Fine Silt	...	2.65	Fine Earth.
Agricultural Clay	Clay	...	7.88	Fine Earth.
	Moisture	...	7.00	Fine Earth.
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	62.0	

Chemical Analysis.

(Soil paased through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	70.01
Soluble in Hydrochloric Acid	...	29.99
Potash	...	0.229
Lime	...	0 614
Phosphoric Acid	...	0 413
Carbonic Acid as Carbonate of Lime	...	Trace
Combined Water and organic matter		7.04
Humus (soluble in Ammonia)		1.46
Nitrogen	...	0.072
Hygroscopic Moisture	...	7.53

Fertility Analysis.

Available Potash	...	0.0082
Available Phosphoric Acid	...	0.0088

Observations.

Average cane land, rather below par in available fertility. I recommend (1) liming ; (2) for plant canes 4 or 5 cwt. basic slag followed by 2 cwt. sulphate of ammonia, 1 cwt. sulphate of potash; (3) to the ratoons ½ ton lime before first cultivation and a top-dressing of 2 cwt. sulphate of ammonia later.

SOIL ANALYSIS—H.

Reference Number—107.
Source Details—Denbigh Estate. Dike Piece. Old Cane Field.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.35	Fine Earth.
	Sand	...	3.48	
	Fine Sand	...	4.55	
	Silt	...	83.44	
Agricultural Clay	Fine Silt	...	1.92	
	Clay	...	Trace	
	Moisture	...	7.47	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	55.0	

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	61.95
Soluble in Hydrochloric Acid	...	38.05
Potash	...	0.431
Lime	...	0.857
Phosphoric Acid	...	0.0995
Carbonic Acid as Carbonate of Lime	...	Trace
Combined water and organic matter		9.48
Humus (soluble in Ammonia)		1.589
Nitrogen	...	0.117
Hygroscopic Moisture	...	8.07

FERTILITY ANALYSIS.

Available Potash	...	0.0102
Available Phosphoric Acid	...	0.0178

OBSERVATIONS.

Good cane land of medium texture. I recommend (a) liming; (b) for ratoons, 2 cwt. sulphate of ammonia per acre.

SOIL ANALYSIS—I.

Reference Number—108.
Source Details—Denbigh Estate. Coates Piece. Old Cane Field
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.15	Fine Earth.
	Sand	...	0.41	
	Fine Sand	...	1.90	
	Silt	...	89.06	
Agricultural Clay	Fine Silt	...	1.75	
	Clay	...	Trace	
	Moisture	...	7.02	
	Total	...	100.00	
Retentive power for water		...	54.0	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter ...	64.05
Soluble in Hydrochloric Acid ...	35.95
Potash ...	0.4556
Lime ...	0.959
Phosphoric Acid ...	0.1128
Carbonic Acid as Carbonate of Lime ...	Trace
Combined water and organic matter	8.739
Humus (soluble in Ammonia)	1.656
Nitrogen ...	0.1317
Hygroscopic Moisture ...	7.545

Fertility Analysis.

Available Potash ...	0.0129
Available Phosphoric Acid ...	0.0231

Observations.

Good cane land. Almost pure silt. In good heart, but lacks lime. Probably this is all that is needed to grow a full crop for the season's possibilities.

SOIL ANALYSIS—J.

Reference Number—109.
Source Details—Denbigh Estate. Fattening Pasture.
Depth of Sample—9 inches.

Physical Analysis.

		Per Cent.	
	Stones ...	Nil	
	Gravel ...	1.17	Fine Earth.
	Sand ...	2.49	Fine Earth.
	Fine Sand ...	13.41	Fine Earth.
	Silt ...	76.39	Fine Earth.
Agricultural Clay	Fine Silt ..	1.04	Fine Earth.
Agricultural Clay	Clay ...	0.98	Fine Earth.
	Moisture ...	4.52	Fine Earth.
	Total ...	100.00	

	Per Cent.
Retentive power for water ..	53.0

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter ...	69 67
Soluble in Hydrochloric Acid ...	30.33
Potash ...	0.2814
Lime ...	1 184
Phosphoric Acid ...	0.1205
Carbonic Acid as Carbonate of Lime ...	Trace
Combined water and organic matter	7 267
Humus (soluble in Ammonia)	2 042
Nitrogen ...	0.1356
Hygroscopic moisture ...	4 73

Fertility Analysis.

Availabie Potosh ...	0.0092
Available Phosphoric Acid ...	0.0453

Observations.

This soil, described as Fattening Pasture, is the finest of the series and indicates a high standard of fertility. Retentive, and yet containing little clay, it presents a high standard of all the elements of fertility, with the single exception of carbonate of lime. This is not entirely deficient, as in some of the other soils of this series, but is so small in amount that a dressing of lime or marl should be of decided benefit.

SOIL ANALYSIS—K.

Reference Number—110.
Source Details—Denbigh Estate. Dick Piece. Old Cane Field.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.28	Fine Earth.
	Sand	...	0.87	
	Fine Sand	...	2.32	
	Silt	...	86.42	
Agricultural Clay	Fine Silt	...	2.25	
	Clay	...	2.31	
	Moisture	...	5.55	
	Total	...	100 00	
			Per Cent.	
Retentive power for water		...	54.0	

CHEMICAL ANALYSIS.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	66.67
Soluble in Hydrochloric Acid	...	33·33
Potash	...	0 379
Lime	...	1.186
Phosphoric Acid	...	0.122
Carbonic Acid as Carbonate of Lime	...	Trace
Combined water and organic matter		7.77
Humus (soluble in Ammonia)		1.525
Nitrogen	...	0.089
Hygroscopic Moisture	...	5.872

FERTILITY ANALYSIS.

Available Potash	...	0.0134
Available Phosphoric Acid	...	0.0500

OBSERVATIONS.

This represents good cane land of medium stiffness. Very rich in available phosphoric acid and potash, but somewhat low in humus and nitrogen and deficient in carbonate of lime.

I recommend liming or marling. Increase humus by cow-peas or pen manure. Apply 2 cwt. per acre of sulphate of ammonia to the ratoons. Neither phosphates nor potash are required.

SOIL ANALYSIS—L.

Reference Number—99.
Source Details—Denbigh Estate. Williams Piece. New land.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	Nil	
	Gravel	...	0.29	Fine Earth.
	Sand	...	0.69	
	Fine Sand	...	11.33	
	Silt	..	28 30	
Agricultural Clay	Fine Silt	...	49.36	
	Clay	...	1.67	
	Moisture	...	8.36	
	Total	...	100.00	
			Per Cent.	
Retentive power for water		...	65.5	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble matter	...	64.36
Soluble in Hydrochloric Acid	...	35.64
Potash	...	0.261
Lime	...	0.504
Phosphoric Acid	...	0.145
Carbonic Acid as Carbonate of Lime	..	0.010
Combined water and organic matter		9.94
Humus (soluble in Ammonia)		1.189
Nitrogen	...	0.111
Hygroscopic Moisture	...	9.12

Fertility Analysis.

Available Potash	...	0.0058
Available Phosphoric Acid	...	0.0239

Observations.

This soil will become lighter with cultivation. The high amount of fine silt is remarkable, making this soil a heavy one as first turned up. The constants of fertility are normal. The humus is not very high and might be increased to advantage. Lime is also needed; otherwise this soil presents all the factors for excellent cane land. I recommend a ton of lime per acre and systematic use of green dressings. I do not advise chemical manures for this soil.

TOBACCO OF JAMAICA, III.*

JAMAICA SHADE-GROWN TOBACCO FROM SUMATRA SEED.

By Wm. M. Cunningham, Assistant Superintendent and Agricultural Instructor, Hope Experiment Station.

The experiment in the growing and curing of wrapper tobacco from Sumatra seed under shade cloth at the Hope Experiment Station, has been successfully carried out. The texture and the elasticity of the leaf are all that can be desired, while the colour is perfect.

The cigar manufacturers who have examined the leaf pronounce it of a high quality, and the colour equal to that imported from

* For previous papers on tobacco, see *Bulletin* for September & December, 1904, & June, 1905.

Sumatra. The local value of the product after being classed in the proper sizes and colours, pressed and baled, is from 4/ to 6/ per lb.

A very lucrative industry is thus open for Jamaica even although the initial cost is high.

Notes on the experiment in growing and curing Sumatra wrapper tobacco under shade cloth.

A quarter of an acre was laid out on a site previously occupied by Havana tobacco the tent being erected over two distinct kinds of soil ; one a heavy black loam, and the other a sandy or gritty loam. The plants grew equally well upon both soils, reaching a height of 9 feet in 58 days ; the leaf from the sandy loam is of a thinner and of a finer texture than that from the black loam, from latter the leaf is heavier, and cured with a gummy substance on the surface.

In the progress of the experiment many methods were tried, and much experience has been gained, and it is not supposed that improvements cannot be made in the future. There will naturally be many ideas developed as to improvements that can be made, e.g., that the plants should have been topped, the picking should have been done a little earlier, or a little later to get the best results.

It is well known by all tobacco growers that different soils and different districts require different treatment. The production of the leaf, and the relation of the different soils to the character of the leaf, and the necessities of cultivation must be further studied, and will unquestionably be beneficial.

Preparation of the seed beds.

No special plan was adopted in the preparation of the seed beds, the methods in common use being adopted. It is very important that in the preparation of the seed beds an ample supply of seed should be sown, and provision being made by successive sowings every 7 or 10 days, so that when the planting season comes round the supply of plants suitable for transplanting will be ample for the purpose, and the supply should be maintained throughout the period in which the planting is to be done. After the seeds are sown, the beds should be watered, and kept continuously moist, but not too wet, until the seedlings are planted out.

On a commercial scale an ounce of seed is used for an acre of land, this insures an abundance of plants, and in favourable seasons there will be more than enough, but it is poor economy to have scant seed beds and to wait for plants.

Land best adapted for wrapper leaf.

There is no longer any question but that a sandy loam is the best, the subsoil, either clay or sand, the latter being preferable for growing leaf of the finest texture, also the climate must be warm and humid, for wrapper leaf requires a humid atmosphere from the seed to the cigar, and the reverse is deleterious. Without a proper soil, suitable climatic conditions and environments, the best results need not be expected; fine thin wrapper leaf only is desirable, climate is essential to the growing of wrapper leaf, and as this cannot be modified by artificial means, we must seek a district where the temperature and moisture are similar to that of Sumatra– warm and humid. We have such districts in Jamaica in Temple Hall and Upper Clarendon, where it is safe to advocate the cultivation of this valuable crop.

Time for Planting.

Sumatra wrapper tobacco should be grown in the ordinary tobacco season, November and December to March and April. At Hope the seeds were sown on the 2nd September, 1904, under cloth, the seedlings planted out under the tent from the 1st November, were moulded from the 18th November, and reached a height of 9 feet in 58 days. The first ripe leaves were picked on the 11th January, 1905, 131 days from date of sowing, the average maximum temperature in the tent during the growth of the plants was 90° taken daily at 3 p.m., the minimum temperature taken at 7 a.m. daily was 66°. Planting should commence not earlier than 3 o'clock in the afternoon on sunny days, but on a cloudy, light showery day, planting should be carried on during the whole day. If there is no rain when planting begins, sufficient water must be poured into each hole, and the newly planted seedlings should be watered every day after sunset. The plants are set out at a distance of 15 inches apart, in rows 3 feet apart, running from north to south. At distances of 3 feet by 15 inches, an acre should contain 11,600 plants.

Cultivation.

Plants require 5 or 6 days to take root, after which cultivation should be begun and continued frequently until the plants get so large that further cultivation is liable to damage the leaves. In order to insure rapid growth the ground should be constantly stirred, cultivation will stop about the time the plants begin to button, at this stage the soil is so shaded that it will not become baked hindering the feeding of the surface roots.

Harvesting.

When the plants are not topped they grow to the height of the tent, and the blossoms often push up the shade cloth at a height of 9 feet from the ground; suckers should be removed, so as to throw the strength into the main plant. Wrapper leaf tobacco should be primed, i.e. the leaves gathered as they ripen; this needs considerable judgment and practice on the part of the grower; the leaves ought to be pulled when slight indications of a brownish colour appear round the edges of the leaf, and on the tip, occasional spots will appear at other places on the surface. The ordinary indications of ripeness which governs tobacco grown in the open fields,—such as yellow blotches, curling of the leaf, and the snapping of the midrib when bent, will not apply to shade grown tobacco. By experiment at Hope it is advised to harvest the leaf at an early stage of ripeness. By going over the field in this way and picking the leaves as they ripen, the leaves are of a uniform degree of ripeness, and this is a very desirable object. At the same time there is danger in harvesting too green, as in such cases the leaf has an uneven colour when cured. If allowed to ripen fully, its texture and toughness, and its delicate pea-green hue will be spoiled.

Three or four leaves are generally taken off in the first priming, then an interval of several days will elapse before another priming can be made. It is usual to make 5 or 6 primings of a crop, which occupies a period of from four to six weeks. As the leaves are picked off the stalk they should be kept straight, placing them back to face, and laying them in baskets 36 inches by 18 inches and 12 inches deep, lined with shade-cloth with the butts to the ends of the basket, and the tips to the centre; they are carried in these baskets to the curing house. Never pick the leaves while the dew or rain-drops remain on them as spots will result. It is preferable to cut in the afternoon as the sun is getting weaker; in the forenoon, unless cloudy, there is a danger of sunburn.

Curing.

When the leaves are taken to the curing house 30 or 40 are threaded on a string, each end of which is fastened to a lath 4 feet 3 inches long by $\frac{3}{4}$ inch thick. The leaves are placed on the string face to face and back to back to prevent curling; the laths are put closely in the bottom barraderas where they may remain from 48 to 72 hours according to the moisture in the house, then carried up and adjusted on the upper barraderas, the laths put about 6 inches apart. The drying of the leaf in the curing house is entirely governed by the conditions of the weather, however, in a general way if the house be filled with green tobacco, and the weather is hot and dry, the house should be tightly closed for about 3 days, by which time the tobacco will turn yellow; the house should then be opened at night, and kept closed during the day; this is done to prevent rapid curing which gives a green and uneven colour. To obtain the best results the tobacco should become fairly moist and fairly dried out once in every twenty-four hours. The opening and closing of the house requires to be done with judgment because it is by the process of allowing the tobacco to becomealternately soft and dry that the leaf is properly cured. If the season during which the tobacco is being cured is excessively hot and dry, as was the case in curing this crop, means must be found to keep the house moist. In this case it was found necessary to hang cloth round the inside of the house to retain moisture, also instead of threading the leaves on string and fastening to the laths immediately on being brought into the house, the leaves were partly sweated on the floor of the curing house, spread in lots of 12 leaves one above the other, back to back, and face to face, covered with green banana leaves. If the floor of the house is made of earth it is necessary to spread old shade cloth or bags beneath the leaves to keep them off the damp floor, otherwise the bottom leaves will get black and discoloured; particular care must be taken not to sweat the leaves when damp with wet or moisture.

Allow them to remain in this position for 48 hours, or until the edges of the leaves turn a yellow colour, the remainder of the leaf will also be of a slightly yellow shade; when this colour is attained, thread as previously described, put the laths on the bottom barraderas for 24 hours, allowing the leaves on each lath to touch one another, shut the house during the day, and open at night.

Great care must be taken to prevent excessive moisture, as pole sweat, mould, and other damage to the leaf arises in that case, which must be prevented. The curing of the tobacco is completed when the mid-ribs of the leaves are brown and soft. The time for curing the tobacco that has been primed is from twenty to twenty-two days, at which time it is ready to be fermented, or the laths may be adjusted on the top barraderas of the house, and there remain until such time as sufficient dry tobacco is ready for fermenting. To get the tobacco in condition to handle, all the doors and ventilators must be kept open during the night previous to putting into the press. The next morning the tobacco will be in what is called "good case," that is it should have taken up sufficient moisture to have become soft and pliable. The tobacco should contain at least 25 per cent. of moisture before being put in the bulk (press) then the process of fermentation gives the leaf a light brown colour. If the tobacco contained 25 per cent. of moisture when bulked, and the curing house be kept at a temperature at from 75° to 85° F. the tobacco will generate sufficient heat to cause a daily rise in temperature of from 8° to 10° F. For determining the temperature of the bulk of tobacco, during the process of fermentation, a thermometer was placed in the centre of the bulk; the following record of temperature (in degrees Fahrenheit) during the first fermentation process is given as follows:—April 12th tobacco put in bulk (press), 13th at 7 a.m. 80°, at 3 p.m. 89°, 14th at 7 a.m. 96°, at 3 p.m. 102°, 15th at 7 a.m. 110°, at 3 p.m. 114°, 16th at 7 a.m. 119°, at 3 p.m. 122°, 17th at 7 a.m. 125°, tobacco taken out of bulk and put in a second bulk (press). The second bulk should be allowed to remain 15 to 20 days by which time the tobacco will have warmed up considerably, though it will not reach as high a temperature as in the first bulk. If the tobacco did not contain an overabundance of moisture when first bulked, it will be dried off by this time and the temperature will fall to about 96° or 100° F. The tobacco will now be thoroughly cured and ready for assorting and baling.

Sizing and Assorting.

When the tobacco has been thoroughly cured it is ready to size, assort, and to be baled or boxed. The sizing is the first work, the various lengths of the tobacco represent its various characteristics and types of the leaf, making 5 lengths from 10 to 12 inches, 12 to 14 inches, 14 to 16 inches, 16 to 18 inches, and over 18 inches. After this work is completed the assorting or shading is completed, making claro or very light brown, colorado claro, light brown colorado maduro, brown, and dark brown, and light and dark broken leaves, with the last named all leaves of uneven colour or those which are in any way imperfect are included. The tobacco is tied in "hands" fan shaped of from 30 to 40 leaves each, these are tied with fibre, and the tobacco is ready to be baled.

Cost of Tobacco grown under Shade.

Estimates of the cost were published in the *Bulletin* for last December, to which the reader is referred. Calculating on the woodwork lasting for 5 years, putting on new cloth each year, and including cultivation and curing, the cost of the tobacco to the grower varies from 2s. to 2s. 2½d. per lb.

SUN GROWN TOBACCO FROM SUMATRA SEED.

A small experiment plot was planted in the open field, to test the quality of cigar wrapper leaf from out-door cultivation.

A local cigar expert who examined the cured crop thinks very highly of it, and was so favourably impressed by the quality, that he intends growing it on a large scale. He valued the best grade leaf at from 5/ per lb., about ten per cent. could safely be relied on as being of first grade leaf.

The plot was planted on the 16th November, 1904, the first ripe leaves were picked on the 7th February, 1905, 159 days from date of sowing; the average maximum temperature in the shade during the growth of the plants was 86° F. taken daily at 3 p.m., the minimum average temperature taken at 7 a.m., was 67° F.

The crop was cultivated, harvested, and cured in the same manner as that grown under shade.

Effect of priming sun grown wrapper leaf.

It was noticed in connection with this experiment that priming had a marked effect on the growth of the upper leaves, removal of the lower leaves causing an increased growth and thickness in the upper leaves, and with it an increased percentage of nicotine. The quality of the product is thus somewhat lowered, hence the small percentage of first grade wrapper leaf.

The priming of tobacco is more expensive than cutting the stalks as more labour is required, but the improvement in quality and the percentage of high grade wrapper leaf fully warrants this additional cost. It has this advantage that the leaves are uniformly matured when they are hung in the curing house, and the finished crop is therefore of a more uniform character,

Influence of distance in planting on the yield and thickness of the leaf.

A small experiment plot to study the relation of distance in planting to yield and thickness of the leaf was planted on the 16th November, 1904, harvested and cured in the same manner as the previous experiment.

Close planting increases the yield per acre, and plants nearest together in the row produced a thinner leaf than the plants set farther apart, the size of the leaf, thickness, elasticity, and size of the veins may all be more or less modified by close planting.

On heavy soils, efforts should be directed to the production of a highly flavoured leaf. These are qualities which can be sensibly affected by the distance of planting, and the time and manner of growing.

BANANA SUCKERS.

By W. CRADWICK, Travelling Instructor.

It is of the greatest importance that banana growers should know how long a banana sucker takes to shoot. I find that the small settler in the western end of the island is totally ignorant of the time required by a ratoon sucker and not by any means certain of the time taken by plant suckers. I have been careful to explain that cultivation, natural adaptability of the soil to banana growing, as well as the distances of planting are all important factors in the time which a plant or ratoon sucker will take to bring fruit to the state when it can be cut. I have strongly advised all the planters both large and small with whom I have come in contact to carefully note when a piece is planted and when the fruit is fit to cut, and base the time of planting the next year's crop on the results of these observations.

With regard to ratoon suckers, I am now advising planters to take 12 to 24 good hard wood pegs and drive them in beside an equal number of ratoon suckers of heights ranging from 6 inches to 2 feet, making the peg the same height in every case as the sucker, record the date of putting in the pegs, and then in 1906 they will be able to see the proper time for leaving suckers for the spring crops.

People in the west all complain of the poor price paid in the autumn for fruit, and yet have done practically nothing to try to get a larger quantity in during the months when prices always rule high. As far as my observations go, a ratoon sucker under fairly favourable conditions takes about 17 months to mature fruit, but on account of the unsettled weather of the past year, my observations are hardly reliable.

CASSAVA TRIALS IN 1905.

By H. H. COUSINS, Island Chemist.

To test the agricultural yield of the various Cassavas now in cuitivation in Jamaica, a series of $\frac{1}{10}$ acre plots of some 23 native varieties were planted at the Hope Experiment Station in April 1904. After 12 months' growth, a portion of each plot was reaped and the tubers sampled for analysis. A second reaping at 15 months,' and a third at 18 months' growth will be made. As the public were anxious to obtain early information as to the yield of tubers and of starch per acre, it is considered desirable to publish the first results based upon 12 months' growth without waiting for the completion of the trials. The yield per acre is much lower than it should have been owing to a severe attack of red-spider last August which denuded the plants of all foliage so that no growth was made until after the October rains when fresh foliage was developed. These plants really represent 9 months' actual growth, if allowance for the red-spider attack be made. Experience shows that Cassava is very subject to this pest in the Liguanea plain; I have not observed it in other parts of the island.

Experiments in spraying with paraffin-naphthalene emulsion and liver of sulphur are to be tried at Hope, but it would appear that the plant ultimately recovers from the attack of this pest and the net result is only a prolongation of the period required for full development of tubers. The starch content of the tubers was quite satisfactory and most varieties were in a fit state for the use of the starch manufacturer at the end of the first 12 months.

The leading variety of the series is "*White Top*" with $10\frac{1}{2}$ tons tubers per acre containing 33·6% of starch equal to 7,902 lbs. starch per acre. This is a bitter variety yielding rough-coated tubers of a dark colour and was obtained from the peasants of St. Elizabeth by Mr. W. Cradwick.

The variety that comes next is one called "Long Leaf, Blue Bud" yielding 6,552 lbs. of starch per acre. This is a variety with light brown tubers and white flesh which we obtained from the Hon. T. H. Sharp and is largely grown by the peasantry in the Inverness district of Clarendon. The highest percentage of starch was found in "Silver Stick" also obtained through Mr. Sharp from the same district; this contained 35 per cent of starch.

The variety "Brown Stick" which is well thought of in many districts gave a poor yield at Hope, although the starch-content was good.

We have established the fact that the specific gravity of a Cassava tuber bears a fairly close relation to the starch-content of the tubers. With the Sweet Potato we found little variation in gravity and many varieties containing a good deal of starch were of practically the same density as water. With the Cassava it is quite different and we are preparing data from which it is hoped that a factory will be able to estimate the starch-content of cassava tubers by means of a Cassava Balance.

By weighing 50 lbs. of tubers in air and again in water the loss of weight represents the weight of a volume of water equal to that of the tubers. The specific gravity of the tubers—at the temperature of observation—will then be the ratio of 50 lbs. to the loss in weight recorded.

A table is being constructed in which if 50 lbs. cassava tubers are taken, the weight when immersed in water will be referred to an approximate percentage of starch in the tubers.

It is obvious that this factor would only be an approximate guide to the starch-content, but its use should enable a factory to pay for tubers a price based upon a presumptive content of starch.

The tables set forth the appearance and habit of each variety as determined by Mr. W. M. Cunningham of the Experiment Station which may enable planters to identify local varieties grown under a different name with those appearing in our list. A description of the tubers and finally a table giving the yield of tubers per acre, their composition and the total indicated starch per acre from the 23 varieties are also appended.

Trial of Cassava Varieties. Hope Experiment Station.

(Period of growth = 12 Months.)

No.	Variety.	Tubers — Tons per Acre.	Moisture.	Total Solids.	Sugars.	Starch.	Specific Gravity. 80° F.	Starch per acre, lbs.
1	White Top	10·5	57·9	42·1	0·80	32·59	1·149	7,902
2	Long Leaf Blue Bud	9 0	54·9	45 1	0 87	32 53	1·176	6,552
3	Blue Top ...	8·25	59·0	41·0	0·63	30·50	1·129	5,636
4	Smalling ..	7·5	58 2	41·8	0·67	32 71	1·125	5,494
5	Rodney ...	7·5	59·3	40·7	0·69	31·77	1·131	5,337
6	Luana, Sweet ...	6 75	56 0	44 0	0 80	35 20	1 180	5,322
7	Black Stick ...	6·5	54 6	45 4	0 91	35·49	1 163	4,878
8	Bobby Hanson ..	6·25	59·1	40·9	0·80	34·12	1·152	4,777
9	Black, Long Leaf Blue Bud	6·00	55·2	44·8	0·67	33 20	1·171	4,462
10	Mullings ...	5·75	60 1	39 9	0 61	32 30	1 134	4,160
11	Duff House ...	5 5	59·1	40 9	0 57	33·30	1·153	4,107
12	White Bunch of Keys	5·25	57·4	42·6	0·87	34 58	1·161	4,069
13	Fustic, Sweet	5 00	61·4	38·6	0·71	28.84	1·102	3,226
14	New Green ...	5·25	68 7	3[illegible]·3	0·91	27·14	1·139	3,192
15	Mass Jack ...	4.25	62.0	38·0	0·91	30·66	1·133	3,091
16	Luana, Bitter ...	4·25	56·1	43·9	0·63	32·28	1·169	3.075
17	Silver Stick ...	3·5	57·4	42·6	1·0	35·0	1.167	2,744
18	Prize or Silver Stick	3·5	56·4	43·6	0·83	33 57	1·163	2,634
19	White Stick ...	3·25	54 3	45·7	0·80	34·64	1·147	2,522
20	White Smooth Bitter	3·25	56·2	43·8	1·11	33·80	1·159	2,460
21	Black Bunch of Keys.	3·25	59 8	40·2	0 59	32·79	1·135	2,388
22	Brown Stick ..	3·25	58·3	41·7	0.63	32 75	1·064	2,384
23	Yellow Belly ...	3·5	61·4	38·6	0 74	29·58	1·147	2,321

DESCRIPTION OF JAMAICA CASSAVAS.

Name.	Colour of Stem.	Colour of Stalk.	Leaves.	Habit.	Growth.	Description of Tubers.	Cuttings received from
White Stick "sweet" ...	Grey	Light green	6 and 7 lobed	Erect	Very vigorous	White, long, stout	St. Elizabeth per W. Cradwick, Esq.
Brown Stick "bitter" ...	Brown	Dark purple	5 and 7 lobed	Spreading	Very vigorous	Short, thick, rough dark skin	do.
Black bunch of keys "bitter"	Greyish-brown	Purple	7 lobed	Erect	Vigorous	Dark, rough medium	do.
Rodney "bitter" ...	Grey	Light purple	7 lobed	Spreading	Very vigorous	Large, smooth, white skin	do.
Bobby Hanson "bitter" ...	Greyish-brown	Light green	7 lobed	Erect	Very vigorous	Large, long, rough, dark skin	do.
Luana "sweet" ...	Dark-brown	Purple	7 lobed	Spreading	Vigorous	Brown, rough long medium tubers	J. T. Palache, Esq.
Luana "bitter" ...	Greyish-brown	Pea green	5 and 7 lobed	Erect	Vigorous	Shape conical colour brown, flesh white	Quintin Logan, Esq., Four Paths
White Smooth "bitter" ..	Grey	Purple	7 lobed	Spreading	Vigorous	Smooth, long, very large white tubers	Hon. T. H. Sharp
Fustie "sweet" ..	Orange-brown	Sage green	5, 6 and 7 lobed	Spreading	Very vigorous	Light, long, stout	J. T. Palache, Esq.
Black bitter long leaf blue bud 'bitter"	Dark-grey	Pea green	6 and 7 lobed	Erect	Vigorous	Dark, rough, very long and large tubers	Hon. T. H. Sharp
Duff House "bitter" ..	Brown	Pea green	5, 6 and 7 lobed	Erect	Vigorous	Shape conical, colour dark brown, flesh white	J. T. Palache, Esq.
Mullings "bitter" ...	Brown	Dark Purple	7 lobed	Spreading	Vigorous	Shape cylindrical, colour brown, flesh white	do.
Blue Top "sweet" ...	Dark-brown	Green	7 lobed	Erect	Vigorous	Light colour, slender	do.
Mass Jack "sweet" ...	Grey-brown	Light green	7 lobed	Erect	Very vigorous	Brown, long, slender	do.
New Green "bitter" ...	Brownish grey	Light Green	7 lobed	Spreading	Very vigorous	Brown, irregular medium size	do.
Yellow Belly "sweet" ...	Dark-brown	Green	5, 6 and 7 lobed	Erect	Very vigorous	Brown, rough, small	do.
Smalling 'bitter" ...	Brownish-grey	Sage green	7 lobed	Erect	Vigorous	Shape conical, colour light brown, flesh white	J. Wallace, Esq., N. Market, Blk. River
Cotton tree "sweet" ...	...	...	...	...	...	Pinkish, smooth long medium tubers	Hon. T. H. Sharp
Silver Stick "bitter" ..	Greyish-brown	Purple	5, 6 and 7 lobed	Erect	Vigorous	Smooth, pinkish, medium length and size of tubers	do.
Long leaf blue bud "bitter"	Dark brown	Purple	7 lobed	Spreading	Very vigorous	Shape cylindrical colour light brown, flesh white	do.
White Top "bitter" ...	Dark-brown	Green	5 and 7 lobed	Erect	Very vigorous	Small, rough, dark skin	St. Elizabeth per W. Cradwick, Esq.
White bunch of keys "bitter"	Greyish-white	Purple	7 lobed	Erect	Vigorous	Long, narrow white smooth skin	do.
Prize or Silver Stick "bitter"	Whitish-grey	Purple	7 lobed	Erect	Vigorous	...	Hon. T. H. Sharp
Black Stick "sweet" ...	Brownish-grey	Light Green	5, 6 and 7 lobed	Spreading	Vigorous	Brown, rough, long	J. T. Palache, Esq.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, XI.*

(*Continued from Bulletin for June.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

DIRECTION AND SHAPE OF INCISIONS.

The tubes which produce the milk of Castilloa and other rubber trees are so slender and thread-like that the creamy liquid would not flow from their cut ends if it were not forced out by pressure. Some writers seem to have assumed that the liquid is actually compressed inside the tubes, or that the walls of the tubes are stretched by the liquid they take up. A more probable view is that recently advocated by M. Lecomte, † that the pressure is due to the tension of the bark, and that it is mostly exerted in a transverse direction. If we add to this the fact that nearly all the tubes extend lengthwise, a transverse cut would reach the maximum number of these and would thus for two important reasons secure more milk than one of the same length in any other direction. A cut along the trunk would be the worst, since it would reach the fewest tubes and relieve the tension of the bark most. Oblique cuts are intermediate, the more horizontal the better. M. Lecomte hesitates to recommend transverse cuts lest they may prove injurious to the tree; but if a short transverse cut will bring as much milk as a longer oblique gash there seems to be no real reason why it should be more harmful, providing, of course, the tree be not girdled, or too much bark be not cut away at one level. The practical difficulty with transverse cuts lies in the fact that it would be much more difficult to collect the milk, some of which will stay in the cuts, while the surplus will run down the trunk of the tree in many driblets instead of being brought together at the point of the V-shaped incisions generally used. The desirability of making the cuts as nearly transverse as possible should, however, be considered, and in districts where, as in eastern Guatemala, dependence is placed entirely on the "scrap" rubber, most of which coagulates in the cuts or on the surface of the trunk of the tree, it may be feasible to make the cuts nearly or quite transverse. Indeed, this is what Dr. Preuss describes as customary on the El Baul plantation in Guatemala.

> For tapping they use an instrument made out of a bush knife (machete). The end of the blade is for this purpose bent back until a groove is formed about broad enough to lay a finger in. The cutting edge of this groove is well sharpened. With this instrument the workmen tear *horizontal* gashes in the bark of the trees, and indeed over a half or three-quarters of the circumference of the trunk. The grooves are cut at distances of 1½ feet, one above another, up to the principal branches. The milk at first flows out in drops, which fall to the ground. They let these go to waste because the quantity is only small and this milk is very watery. But in a minute or two the dropping ceases and the milk which then oozes out is pulpy and remains in the furrows, where it hardens into strips of rubber. In two days these strips are pulled out, washed, and dried in the shade,

* Extract from the U. S. Dept. of Agriculture, Bul. No. 49. Bureau of Plant Industry.

† Journ. d'Agri. Tropicale 10: 100. Translated in Agriculture Bul. Straits and Federated Malay States, 1: 382.

and are then ready for market. Drying in the sun causes the rubber to become sticky and should be strictly avoided. The trees are tapped four times a year; each time another side of the trunk is operated on. The yield each time is half a pound of rubber, or one kilogram (2.2 pounds) in a year. I was informed that the horizontal grooves made with the instrument described require only a quarter as much time to fill up as the broad diagonal wounds made with the machete. The former are completely closed in three months' time, and the tree recovers very rapidly.

Parkin's experiments in tapping Hevea in Ceylon gave results much in favour of oblique incisions over either horizontal or vertical. He says:

In both cases the oblique incision yields about double that of the other. There seems little difference between the amount collectible from a vertical and a horizontal incision. Although there is a greater output of latex from the horizontal cut, yet much more dries on the wound than in the case of the vertical, consequently the amount which drops into the receiver comes to about the same in the two cases.*

With Hevea it was found that two oblique incisions joined below to make a letter V gave nearly twice as much latex as one alone. In case of Castilloa, however, where the milk flows so much more freely, it was concluded that the most milk could be secured with the least injury to the tree by means of separate oblique incisions. Such cuts would certainly heal more readily than V-shaped wounds, since the bark frequently receives its worst injuries at the junction of the two incisions.

TAPPING INSTRUMENTS.

That improved methods and tools are to be used for cultivated trees is one of the points on which all the rubber planters agree, but as yet none of the many improvements suggested has attained any popularity, and it is at least doubtful whether any of the devices brought forward at this time is to be looked upon as a practical solution of the problem. Some inventors have worked on the erroneous idea that the rubber comes from the sap, like sugar from the maple, and have thus completely wasted their time.

An enumeration of some of the features essential for a good tapping instrument may save further labour on wrong lines.

The cutting edge must be keen, and must therefore be easy to sharpen. A thick or blunt edge bruises the wood and milk tubes, and this interferes with the flow of milk.

There should be a means by which the depth of the cut can be regulated, since it is important to cut deep enough to reach the milk and yet not so deep as to reach into the wood, but axes and chisels with shoulders to prevent too deep penetration are not promising because the thickness of the outer bark is variable. The shoulders also bruise the bark if the cutting is by blows. In British India it is thought that the best instrument for tapping the Para rubber trees is an ordinary carpenter's gouge.

MULTIPLE TAPPING.

By far the most important recent discovery in connection with the culture of Para rubber in the East Indies is what may be called multiple tapping, or the repeated cutting of the edges of the wound to induce a renewed flow of milk. This is, it is true, by no means

*Circular Royal Botanic Gardens, Ceylon, June, 1899, p. 121.

a new idea, since it seems to have been the regular practice of the rubber gatherers of Brazil; but their idea that the tree gave more milk after it had become accustomed to the operation seemed so childishly fanciful to Europeans that it has only recently been put to a practical test, and now there is much surprise to find that it is very decidedly correct. Perhaps the most striking instance is that described very recently from Selangor, where a single Para rubber tree, 25 years old, yielded 18 pounds of rubber in a period of two months.* A single ounce was obtained the first day, and 1½ pounds in the next five days. For 10 days the daily average was more than half a pound, and on the twelfth day a maximum of 12 ounces was obtained. A second tree yielded a total of 12 pounds 10 ounces of rubber. It was estimated that about seventy hours of labour was required to collect about 30 pounds of rubber from the two trees, orover two hours for each pound of rubber, which may be noted as an indication that the collection of rubber by this method will be expensive in proportion as it is carefully done, since it will require intelligent and somewhat skilful cutting to avoid too serious injury to the trees.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on 16th May 1905, the following members being present: the Hon. the Colonial Secretary, Chairman, the Director of Public Gardens and Plantations, the Agricultural Chemist, the Hon. Thos. Capper, Hon. Thos. H. Sharp, Mr. C. A. T. Fursdon, and Mr. W. Harris, Acting Secretary. Mr. Geo. D. Murray telegraphed that owing to heavy rains he was unable to attend.

Appointment of Member—A letter from the Colonial Secretary was read intimating that the Governor had appointed Mr. Thos. H. Sharp to act as a member of the Board during leave of absence granted from the 1st May to His Grace the Archbishop of the West Indies.

Crops for rotation with Cotton—The Chairman mentioned that as this subject was of considerable importance, and in order to save time he had decided to publish the correspondence in the Bulletin and he now asked for the concurrence of the Board. This was approved.

Applications to attend Distillers' Course at the Laboratory—Twenty applications were received and considered, and ten were selected.

Arrangements as to admission of boys from Secondary Schools to Agricultural Lectures at the Laboratory—The Board decided that boys from Secondary Schools who may be selected to attend the lectures in Agricultural Science at the Laboratory, such lectures to occupy twelve hours per week, should pay a fee of 30/ per term.

School Gardens—The Director of Public Gardens submitted two reports by Mr. Cradwick on School Gardens, (a) at Titchfield, and (b) on School Gardens generally and points to be observed by Teachers.

*Agricultural Bulletin of the Straits and Federated Malay States, I., 556, November, 1902.

The Agricultural Chemist suggested that a pamphlet on 'Hints on School Gardens' should be prepared.

Law for the prevention and spread of contagious diseases among animals—The Colonial Secretary in a letter dated 9th March, 1905, forwarded a copy of this Bill for the consideration of the Board. It was decided that as at present advised the Board is of opinion that the matter should remain in abeyance until such time as the finances of the island are in a position to strengthen the law by the appointment of an Inspector and to provide funds for compensation to owners of animals destroyed under the law.

Jamaica Scholarship for Agricultural Students—The correspondence on the subject of making the Jamaica Scholarship and the £60 Scholarship available to Agricultural Students was brought up for consideration. The Agricultural Chemist proposed, seconded by Mr. Sharp and carried by a majority:—

"That this Board desires to direct the attention of the Government to the Scholarships available to boys on leaving the Secondary Schools of Jamaica, including the Rhodes Scholarship, and suggests that the possibility of making the Jamaica Scholarship of direct benefit in encouraging Agricultural Education in Jamaica should be considered by the Government."

Visit of Sir Daniel Morris—A letter from the Colonial Secretary, with a copy or a letter from Sir D. Morris stating that the Imperial Commissioner of Agriculture desires to pay an official visit to the colony in June, July or August next when he would discuss matters of agricultural interest and make preliminary arrangements in connection with the Agricultural Conference to be held here in January next came up for consideration. The Board was of opinion that on general grounds, and particularly in the interests of the Cotton Industry, the month of June would on the whole be the best time for the visit.

Selected Cotton Seed for 1905—The Colonial Secretary wrote inviting the attention of the Board to the publication in the Gazette of an extract from the "Agricultural News" of the Imperial Department of Agriculture for the West Indies headed "Selected Cotton Seed for 1905", and stating that directions for the publication of the notice to the end of May. The Director of Public Gardens and Plantations stated that this is also being published in the Bulletin.

Cultivation of bananas in Hanover and Westmoreland—The Colonial Secretary wrote informing the Board that the Inspector of Police for Hanover in reporting on that parish for the past quarter called attention to the suitability of the soil in the country extending from Green Island in Hanover to Grange Hill in Westmoreland for the cultivation of bananas, but pointing out that the small settlers there are ignorant of the proper methods of planting and culture of this crop, and suggesting the desirability of one of the Agricultural Instructors visiting the district for the purpose of giving the necessary instructions to the people. The Director of Public Gardens and Plantations stated that Mr. Cradwick is now in that neighbourhood and he will be asked to give his attention to this matter.

Withdrawal of Imperial Grants in aid of Agriculture in the West Indies—The Colonial Secretary wrote informing the Board that the Governor has received a despatch from the Secretary of State intimating that the Imperial Grants in aid of Agriculture in the West Indies will be gradually withdrawn, and that the sum of £250 allowed for the salary of the lecturer in Agricultural Science at Jamaica will be discontinued after the 31st March, 1906. It was decided to postpone discussion of this matter until Sir Daniel Morris visits the island.

Letter re Ramie Fibre—A letter from Dr. Greshoff on this subject was laid on the table. The Secretary reported that the circular issued by the "Ramie Union" referred to by Dr. Greshoff had not been received and another copy has been asked for.

Locked Still at Denbigh—The Chemist read an extract from a letter from Mr. G. W. Muirhead of Denbigh reporting that the locked still was now working under lock and that the additional butt for low wines had been completed. The waste or 'deleterious matter,' as it had been called, was now being returned to the still as had always been the practice. When the fittings being made at the railway works were attached and the retort cocks connected by a pipe with the dunder drain as planned, Mr. Muirhead considered that the system would be perfect. In his opinion a great check had been effected on rum stealing.

Application for Mr. Cradwick's services—An application from the Secretary of the Port Royal Mountain Agricultural Society for Mr. Cradwick's services at the Show to be held in July was considered; as well as a suggestion from the Director of Public Gardens and Plantations that he should be instructed to travel in Clarendon in connection with the Prize Holdings Scheme during July, and for longer if it was found necessary. It was decided that Mr. Cradwick may assist at the Port Royal Mountain Show on the day before and during the day of the Show, and that he should travel in Clarendon as suggested by the Director of Public Gardens.

The following papers were presented and it was decided that they should be circulated—

From the Chemist—

1. Manurial experiments on cotton at Inverness.
2. Report of work done for Easter Term 1905.
3. Report on visit to Trelawny by the Fermentation Chemist.

From the Director of Public Gardens and Plantations—

1. Report on Experiment Station at Hope.
2. Suggested arrangements for Mr. Cradwick's work to the 9th June.
3. Reports from Travelling Instructors.
4. Letter from Rev. J. Duff re Mr. Cradwick's services at the Montpelier Agricultural Show.

Cattle Tick Pest—The Secretary was instructed to forward the correspondence on this subject to the Agricultural Society.

[Issued 7th July, 1905.]

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. **AUGUST, 1905.** **Part 8.**

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1905.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. AUGUST, 1905. Part 8.

THE TOBACCO OF JAMAICA, IV.*

The following reports from experts on tobacco grown at Hope Gardens will interest those who are thinking of taking up the cultivation of tobacco from Sumatra seed.

The result of the small experiment with sun-grown tobacco from Sumatra seed is especially important as indicating that it is possible to produce good wrapper equal to Sumatra without the aid of shade-cloth.

From Mr. F. V. Chalmers, London, to Director of Public Gardens and Plantations.

13 Devonshire Square,
Bishopsgate Street, London, E.C.,
8th June, 1905.

Dear Sir,

I have your favour of the 23rd of May, also the type samples of tobacco, and as requested, I give you a prompt opinion upon them.

Sample No. 1—Sumatra wrapper tobacco, shade-grown, is a beautiful tobacco, both in flavour and texture, but inclined to be veiny, and from some ill defined cause, in every leaf, the mid-rib and veins are zig-zag and irregular. Apart from this, a few spots, and a little dullness of colour, I consider that tobacco perfect.

Sample No. 2—Sumatra wrapper tobacco sun-grown and primed is equal to No. 1 and the same remarks apply, except that I like the complexion of this tobacco better, one red leaf excepted, and unless the difference of cost and production is very small, I see no reason to go on with the shade.

Sample No. 3—Sumatra wrapper tobacco sun-grown topped and cut on the stalk, is equal to the two previous, except that the

* For previous papers on tobacco see *Bulletin* for September and December, 1904, and June and July, 1905.

growth is stunted, and the flavour a little stronger, and the leaf is not in such good proportion as to stalk as the two previous, so I do not consider that so desirable, which, of course, only applies where duty is paid, although it must always be remembered, in cutting wrappers for a cigar, it is desirable that each side of the leaf shall cut into so many wrappers, without leaving a remnant, which has to be used as a filler.

Sample No. 4—Havana tobacco shade-grown, is a useful tobacco but has the same objection as to veins, stalk and spots. It is the best production, of the three Havanas, but lacks good complexion.

Sample No. 5—Havana tobacco sun-grown and primed, should make a useful tobacco for bunch or filler, but being strong it would have to be used with considerable caution.

Sample No. 6—Havana tobacco sun-grown topped and cut on the stalk, the same remarks apply to this.

Looking at the types generally, I think very highly of them and I hope that someone will be induced to go in largely for production on these lines, but the two I pin my faith to most, are the outside grown Sumatra, and the shade-grown Havana, that is to say, for the purposes of wrapper.

The outside Havana is a very desirable growth for filler.

The tobacco at the present time is not fully fermented, and will undoubtedly improve, but there ought not to be any difficulty now in Jamaica grown tobacco, on these lines, competing with Sumatra, Borneo, and Havana.

The flavour of all the tobaccos is unsurpassable, when fully fermented.

I am perfectly confident, in my own mind, there is a large fortune waiting for somebody, if they will only produce this tobacco, as herein indicated.

I shall be very pleased to hear that someone is taking the matter in hand at once, and going to ship some thousands of bales to England.

Yours truly,

F. V. Chalmers.

Mr. M. Fornaris, Montpelier Cigar Factory, to Director of Public Gardens and Plantations.

Kingston, June 8th, 1905.

Dear Sir,

In reply to your letter of the 31st ult., I beg to say that I have tested the samples of Sumatra Tobacco grown at Hope, which you submitted to me. I find that they are of good and even colour and that they burn well with good flavour. I consider them to be much superior to the samples submitted to me last year. Of course it is impossible for me to express an opinion on your whole crop from the few samples I have had the pleasure of testing.

Yours faithfully,

M. Fornaris,

From Mr. M. Fornaris, Montpelier Cigar Factory, Kingston, to Director of Public Gardens.

Kingston, 7th June, 1905.

Dear Sir,

Your valued favour of the 6th inst., is duly received. The value of the tobacco is approximately 6/ per lb., provided that all of it is of the same quality as that which I pointed out to you from among the sample leaves submitted.

If, on the other hand, the quality is not the same throughout, the value would not be more than 4/ per lb. It must be carefully remembered that the tobacco will only be worth 6/ per lb. if the leaf keeps its colour after due attention to curing and so forth.

I should be glad to get from you as many seeds of this Sumatra Tobacco as can be spared in order that the experiment can be tried on a larger scale than you have yet been able to direct.

With my regards,

I remain,

Yours faithfully,

M. FORNARIS.

Mr. R. W. Bradley, Montpelier Cigar Factory, to Director of Public Gardens and Plantations.

Kingston, 5th June, 1905.

Dear Sir,

Mr. Milholland has handed to us your valued favour of the 3rd inst., with reference to cigars to be sent to the Imperial Institute. We need hardly say that your suggestions shall have our best attention and we take this opportunity of thanking you for the interest which you have shown in the matter.

You will be glad to learn that owing to your efforts in the growth of Sumatra, the signer has been able to induce a gentleman to enter, in co-operation with a Cuban of experience, upon the cultivation of this leaf upon a somewhat larger scale than has been hitherto attempted.

With the assurance of our regards,

We are,

Yours faithfully,

R. W. BRADLEY,

ppr. Montpelier Cigar Factory.

COTTON: ROTATION OF CROPS, II.

The following observations were made by the Island Chemist after considering the whole correspondence published in this Bulletin, May, pp. 104-110.

The Island and Agricultural Chemist to the Honble. the Colonial Secretary.

The Hon. The Colonial Secretary,

With reference to Ratooning Cotton in Jamaica I have been in correspondence with Sir D. Morris on the subject and have finally arrived at an understanding with him as to what is meant by 'Ratoon Cotton.'

At the conference meeting, a report of which you have referred to me, Messrs. Ronaldson and Sharp both upheld that it would be a mistake to limit the cotton crop in Jamaica to one picking only. They understood Mr. Oliver's warning to imply that the second flush of cotton obtainable in Jamaica within a year, owing to the recurrent periods of rain and drought twice yearly, was held to be an inferior product and its marketing in England detrimental to West Indian Cotton.

Mr. Oliver obviously had no agricultural experience of Jamaica and it was hardly fair to ask him to pronounce upon a matter that was really beyond his knowledge.* To test the point as to the quality of their so-called ratoon cotton Messrs. Ronaldson and Sharp, I am told, submitted to Mr. Oliver samples of first and 'ratoon' pickings from the same plants with the result that Mr. Oliver found the samples from the ratoons to be better than from the plants.

I now understand from Sir D. Morris that he does not consider a second crop grown within a year to be a ratoon and that the cotton hitherto called ratoon cotton in Jamaica does not come under the catogory of 'ratoon' as understood in the other West Indian Islands.

Owing to the peculiarity of our climate which is accentuated in the natural cotton-growing districts, it is apparent that cotton must be sown so as to catch the rains and establish itself in full growth before the dry period in which the fruiting and harvest takes place.

After the first crop the old plant pushes forth fresh shoots on the advent of the next growing season and if pruned back will give a fresh growth from which a second crop of cotton will be obtainable within, say, 11 months of sowing the seed.

I think experience has fortified the position originally adopted by the planters here and that it is now established that two crops of cotton are to be expected here each year. Under certain conditions the second crop may exceed the first in both yield and value.

As to quality—I am told that the second crop is of longer staple than the first but that the proportion of seed to lint is greater.

* For Mr. Oliver's amended opinion see *Bulletin*, January, 1905, page 5, "Cotton from Ratoon Plants." *Editor.*

I fully agree with the recommendation not to ratoon cotton over the first year, having observed serious ravages on young cotton from caterpillars derived from old plants that should have been destroyed at the end of the year.

The gist of the matter to my mind is as follows:—

(1) Plant the cotton at the natural season, so that rains may keep it growing until it has attained size and then dry weather will follow for the crop. Cotton planted late is stunted and unhealthy. It is very subject to fungoid disease and is severely attacked by caterpillars. It is very apt to ripen seed prematurely so that when the rains come the seeds germinate in the green pods and the whole contents turn black. I am speaking from personal observation here of a large area planted late with the above result.

(2) Cotton planted at the right time will ripen in about 5 months and if the old plants be trimmed back, a second flush will follow and a picking of second crop cotton be obtained so that the whole can be cleared off the ground in 11 months. I consider that it is very desirable to uproot the old plants and having gathered them into heaps to burn them, so as to destroy the eggs, caterpillars and cocoons of the cotton worm. The land can then be prepared for the next planting.

Local experience as to corn planting seems to be a safe guide as to the correct time to plant cotton. This permits of a narrow margin and must be strictly complied with if failure is to be avoided.

(3) Under these conditions, I think the lands in Vere and St. Catherine where cotton has grown well this year would grow it in continuous annual crops for a long period of years without rotation of crop.

(4) With reference to rotation crops for cotton it must be recognized that corn (maize) does not pay to grow in the plains. Leguminous crops can only be grown as snatch crops. Tobacco can only be grown on a limited area owing to the great demand for labour—Further, tobacco barely pays expenses in Jamaica.

Cassava would do admirably, but here again there must be a factory on hand to deal with it. I have been trying to establish data as to the cassava industry and there is no doubt it would pay even better than cotton.

Under present conditions, I think cow-peas might be planted between the rows of cotton after the first crop and be ploughed in when preparing for the new planting. It should be remembered that our cotton land N.W. of the irrigation area in St. Catherine and the light lands in Vere are practically virgin soil and very rich in fertility. Ten crops should not exhaust these lands.

(5) I am trying manures on the cotton at Inverness on 8 acres. This is the poorest soil at present in cotton, I believe, but I quite expect to find that fertilisers produce no result whatever. The rainfall dominates the crops on these soils as a rule.

29.5.'05. H. H. COUSINS.

EXHIBITS FOR THE COLONIAL EXHIBITION AT THE CRYSTAL PALACE, LONDON.

Exhibits of living economic plants in tubs, and of fruits with leaves, and flowers where possible, either in formalin solution or in alcohol and naphthalin, were sent from the Public Gardens, Jamaica, at the instance of the local Exhibition Committee.

It may be useful to give a list of these with a note of their condition on arrival at the Crystal Palace.

Some of the plants went by the Royal Mail Steamer "Orinoco," and some by the Direct Line Steamer "Bornu," and cordial thanks are due to the respective Companies, their Captains, Chief Officers, and others concerned, for the great care and attention bestowed on the plants during transit and in loading and unloading.

The plants that went by the "Orinoco" were reported by the Secretary, Mr. J. Barclay, to have arrived at Southampton in excellent condition, but the weather happened to be frosty on the night after arrival and ten of the plants were killed.

The "Bornu" went later, and fortunately escaped frost. Some of these plants are reported by Mr. Barclay to have arrived in very good order, and the coffee trees in splendid condition.

The following is a list of the living plants that were sent :—

LIVING PLANTS.

Name of Plant.	Height of plant with tub. Ft.	In.	Condition on arrival at Crystal Palace.
Mango	8	10	Very good
Liberian Coffee	11	3	Withered but alive
Avocado Pear	12	1	" " "
Pimento	15	4	" " "
Lace Bark Tree	5		Withered but alive, of no use for show
Nutmeg	8	4	
Ippa-appa	8	5	Withered but used
Kola Nut	5		" " "
Arabian Coffee	6	11	Splendid condition
Citrus	9	10	Leafless but will soon sprout again
Cinnamon	9	5	Of little use
Guava	6	11	Poor

Name of Plant.	Height of plant with Tub. Ft.	In.	Condition on arrival at Crystal Palace.
Lemon or Fever Grass	4	8	Good
Pomegranate	5	1	Dead at top but may spring
Red Banana	8		Only stem left
Red Banana	13	6	" " "
Jamaica or Martinique Banana	9	4	" " "
Jamaica or Martinique Banana	7	2	" " "
Chinese Banana	8	10	" " "
Chinese Banana	4	11	" " "
Breadfruit	5	2	Dead
Sugar Cane "Jamaica Seedling" 12 months old	11	4	Fair
Sugar Cane "Jamaica Seedling" 12 months old	11	4	"
Camphor	7	3	"
Cocoe, Common Black	3	3	"
Cocoe, Common White	5	7	"
Cocoa	5	2	Dead
Sour Sop	4	4	"
Vanilla	6	11	Very good
Cananga	5	7	Withered but alive
Citronella Grass	4	2	Good
Khus Khus Grass	6	5	"
Cassava	5	5	Fair
Pine-apple Green Ripley	4	8	"
" Cayenne	4	7	Good
Sugar Cane B. 208	8		"
" D. 95	8	2	"
Coco-nut	6	3	Fair
Pine-apple Red Ripley	4	11	Dead—heart rotted out
" Cayenne	4	10	Dead—heart rotted out due to chill
Sweet Potato Muffard	2	8	Dead
" " white Gilkes	2	8	"
Tobacco Havana	3	8	"
" Sumatra	3	2	"
Cotton, Sea Island	2	8	"
Yam	3	8	Fair
Cassava	3	4	"
Papaw	7		Dead
Tamarind	5	8	No good

The following is a list of the fruits with leaves and flowers where possible :—

FRUITS IN NAPHTHALIN AND SPIRIT.

Name of plant.	Condition when put in "tin."	Condition on arrival.
Achras Sapota (Naseberry)	Green	1 lot stained with juice 1 lot very good
Blighia sapida (Akee)	Green & ripe	Good but lost colour
Tamarindus indica (Tamarind).	Green	Very good
Passiflora ligularis (Sweet Cup)	Green	Good
Anona reticulata (Custard Apple)	Green	Very good
Theobroma Cacao (Cocoa)	Green & ripe	First rate
Anona muricata (Sour Sop)	Green	Good
Coffea arabica (Arabian Coffee)	Ripe	Rather poor but lost colour
Elaeis guineensis (African Oil Palm)	Green	Fair
Mangifera indica (Mango)	Green & ripe	Very good
Myristica fragrans (Nutmeg)	" "	Very good
Phyllanthus distichus (Jimbling, Otaheite Gooseberry)	Green	Good
Carica Papaya (Papaw)	Green	Magnificent appearance
Coffea liberica (Liberian Coffee)	Ripe	Good
Plantain	Ripe	Perfect—just as appear in market
Star Apple	Ripe	Half true—half lost colour
Breadfruit	Green	Splendid—perfectly natural
Arrowroot		Perfect in root,—leaves olive coloured

FRUITS IN FORMALIN.

Name of plant.	Condition when put in "tin."	Condition on arrival.
Garden Egg	Ripe	Partly lost colour, but otherwise very good
Tangierine Orange	Ripe	Magnificent
Tamarind	Green	Perfect
Liberian Coffee	Ripe	Fair
Cocoa	Green & ripe	Fair
Star Apple	Ripe	Fair but some lost colour
Mango	Green & ripe	Fair
Cho-cho		Fruits perfect, leaves light olive in colour
Custard Apple	Green	Very good
Shaddock	Ripe	Splendid
Arrowroot		Good
Breadfruit		Perfect
Mammee Sapota		Fair
Shaddock		Perfect
Cho-cho		Perfect

Mr. Barclay reports :—

" All these have been prepared for exhibition by Dr. Burt, British Botanical Association, York, and put up in large and striking-looking jars, making a most attractive exhibit. They occupy the side of the office which faces the main entrance to the exhibition, and the fruit are on the fruit stall."

NOTE ON THE GUANGO.*

By R. H. B. HOTCHKIN.

I find that for the first three years very good banana fruit may be grown under the Guango trees if planted wide and the trees are lofty. The Guango is, however, very impatient of too much water and so, in course of time, the branches decay and of course cause havoc amongst the fruit,—I shall have to do away with mine I grieve to say for this reason.

As a timber it is rather like poplar in that it cannot be used outside unless well tarred ;—for furniture it is good and it makes nice flooring, but it is at present very little used, as imported lumber is far cheaper. For its beans it is of course invaluable and should I think be found very useful in cocoa growing as a shade. In Canada there would be an opening for importation there of the Guango Bean.

* Pithecolobium Saman.

CO-OPERATIVE SAVINGS AND CREDIT SOCIETIES IN CANADA.*

Co-operative savings and credit societies in Canada, owe their existence to the altruistic purpose and able initiative of Mr. Alphonse Desjardins, a resident of the city of Lévis, Quebec, and one of the officials of the House of Commons, Ottawa. For over ten years Mr. Desjardins has been a careful student of co-operation, and has watched with interest the progress of the co-operative movement in England, France, Germany, Italy, Belgium, Austria and other countries. One form of co-operation, in particular, has appealed strongly to him, impressed as he has been, with the need of encouraging thrift amongst his fellow-townsmen and countrymen, and of finding for the financially feeble some means of effectively supplying the need of personal credit, where merit and circumstances alike warrant and opportunity alone is lacking. The form is spoken of as co-operative credit.

This form of co-operation has found expression in the several countries of Europe in credit societies and people's banks, extending to the number of several hundred and even thousands. In France *Les Banques Populaires* and *Les Caisses Rurales,* as they are called, number over 2,000. In Germany there are 12,000 and more, co-operative credit societies and loan banks. In Italy the *Banche Popolare* (*Banques Populaires*), the *Casse Rurale* (*Caisses Rurales*) and the 'Catholic' banks, number over 2,500; in Belgium over 300; and in Austria nearly 5,000. In Russia the number of similar institutions is over 5,500. In England the people's banks and co-operative credit societies are also numerous and have been increasing yearly in number.

All these institutions have this in common; they aim through the encouragement of thrift to create a capital out of the savings of persons of very limited means, which capital may be profitably invested and opportunity thereby afforded such persons of securing advances and loans at reasonable rates, where otherwise loans might be obtainable only at usurious rates, or not obtainable at all.

Origin of the Levis Society.

Mr. Desjardins undertook, in 1900, to establish among the people of his own locality a co-operative savings and credit society, or people's bank. In September of that year he brought together at his residence a dozen of his fellow-townsmen whom he had interested in the project, and carefully outlined his plan. During the course of the following three months they drafted a constitution, subscribed a number of shares at $5 a share, which were subsequently paid in instalments, and established what they designated as 'La Caisse Populaire de Lévis'—a co-operative savings and credit association, with a variable capital and limited liability. As members of this co-operative society they had henceforth the right to share in the direction of its affairs,

* From the Labour Gazette, issued by the Department of Labour, Dominion of Canada, March, 1905.

participate in its profits, and on complying with its requirements to obtain credit in limited amounts.

On December 6, 1900, the number of shareholders of La Caisse Populaire de Lévis was 100, and the number of shares subscribed, 500. The institution grew steadily in favour and in the confidence of the people on whose behalf it had been established. In a year the number of shareholders more than doubled. By December, 1902, the number was 450. At the beginning of the present year (January, 1905) the list of shareholders included over 900 names, representing over 5,500 shares.

OBJECTS OF THE LEVIS SOCIETY.

The objects of the savings and credit society are more far-reaching and important than is suggested by the name, though its objects are disclosed in part therein. Broadly speaking, they may be said to be in their nature, moral, economic and educational, in that, supreme among its purposes, is the encouragement of thrift and the promotion of honesty and honour, the furtherance of self-reliance and economic independence; and the fostering of an appreciation of business principles, and a practical knowledge of business relations. In a general way, the society also aims at serving the industrial needs of the community in which it is established, by providing a means to less fortunate members of carrying on work or enterprises which but for its assistance could not be undertaken.

The several objects are set forth in detail in the constitution of 'La Caisse Populaire de Lévis.' Stating, precisely and concisely as they do, the objects of this particular and similar institutions, they may be quoted at length.

The objects of the association are:—

1. To protect its members against reverses of fortune, the results of enforced idleness, sickness and want, by teaching them the inappreciable benefits of wise providential measures based on mutual assistance and co-operation, and, in particular, by instilling and developing in them the taste for and the constant and energetic practice of economy even on the most modest scale;

2. To aid them by a wise and prudent system of credit in the shape of loans and advances, the proposed employment whereof must be communicated to the association, be approved by it, and be in accordance with the spirit in which it is founded;

3. To enable persons devoid of fortune but who are industrious, honest and laborious, to form part of the association by granting them facilities for paying up their shares in the capital stock by means of very small weekly instalments;

4. To secure the practice of the Christian and social virtues that mark the good citizen, the honest, laborious and honourable worker, by exacting above all moral warranties of highest order from the shareholders who borrow from the association;

5. To combat usury by means of co-operation and mutual assistance by providing all who are deserving of the same, through their fondness for work, their skill and the integrity of their conduct, with the moneys they require for carrying on their business or occupation, and which they cannot obtain from existing financial institutions owing to the insufficiency of the present system; thereby making them independent of lenders who levy exorbitant commission or interest, or of those who impose too onerous conditions in connection with credit;

6. To foster the spirit of enterprise and promote local works, whether of an industrial or agricultural character, by the prudent use of the savings effected within the district covered by the association's operations;

7. To spread amongst its members a practical knowledge of the elementary principles of economic science and to teach them respect for their engagements established by their signatures, as also the advantages inevitably derived by those who faithfully fulfil the obligations they have undertaken ;

8. To create and foster mutual confidence between shareholders by means of economic relations based on the security of warranties of a high character, inasmuch as they are founded in a very great measure, on morality, honesty, order, love of work and prudence;

9. To gradually procure them—by persevering efforts towards securing economy and consequently a just measure of credit—that economic independence which inspires and fosters the feelings of personal dignity and convinces one of the need of relying above all upon oneself to improve one's position and raise oneself in the social scale.

OPERATIONS OF THE LEVIS SOCIETY.

The objects of the society are sufficient to indicate the nature of its primary functions. In the first place it encourages savings by the formation of a capital made up of shares which are small in amount, payable in weekly or monthly instalments, and on the basis of which the division of the year's profits is made. Secondly, it receives from its members deposits of any amount of not less than 5 cents, on which interest is allowed; and, thirdly, it grants loans, makes discounts and advances to members on their own signature and the personal security of other members of the society. The society is restricted in its operations to doing business with its members only, and the membership is restricted to a certain area.

SHARES AND SHAREHOLDING.

To become a shareholder and thereby a member of the society, persons desiring to become such must be accepted by the society in the first instance. Applications for allotment of stock are required to be submitted to a council of administration appointed at a general meeting of members of the society, which council may require every application to be seconded by two shareholders. Every shareholder must be reputed as of good habits, sober and punctual in payments. Either men or women may become shareholders, but female shareholders are not allowed to hold office. Shareholders are liable for the debts of the society only to the amount of their shares, and each share entitles the holder to a proportion of the yearly profits. The shares are of the value of $5 each and amounts may be paid in weekly or monthly instalments, and until the full amount of the share has been paid off, the holder is not entitled to participate in profits. A fee of 10 cents is charged as an entrance tax on each share subscribed for.

Any shareholder may cease to belong to the society and withdraw the instalments he has paid on the shares subscribed by him by giving a written notice of thirty days to the council of administration, and a member may be expelled if he becomes bankrupt or insolvent or his property is liquidated judicially because of refusal to pay his debts, or failure punctually to fulfil obligations he has undertaken towards the society, or has in other ways attempted to abuse the privileges of the society or deceive its officers. Instalments paid by a shareholder up to his expulsion are repaid him, minus the interest for the current year and entrance fees. The quality if shareholding is forfeited by resignation, by death, expulsion, or for any cause which would have prevented a shareholder's admission to the society.

DEPOSITS.

Savings deposits of as small an amount as 5 cents may be made, and may be received, repayable on demand, or after notice, at a specified date. Interest on savings deposits of all kind is fixed by the council of administration, which has authority to adopt special measures in connection with savings deposits and deposits payable at a specified date, by allowing a higher rate of interest on the latter, according to the length of the period at which they are repayable. Every shareholder making a deposit is given a pass-book. The rate of interest on the savings deposits is fixed by the board of management and is posted up in the office. It is paid and capitalized at the end of each year. The society receives deposits to afford facilities to its shareholders for the payment of their rent, contributions to mutual benefit societies, life and fire insurance premiums, &c., which deposits are repayable only at the date specified by the shareholder in opening his account.

LOANS AND ADVANCES.

The society may make loans or advances on simple notes or acknowledgments, but only such loans and advances as can yield a profit or a saving for the beneficiary are allowed. All applications for loans or advances are forwarded to the manager, who is obliged to submit the applications to a committee on credit and management, which committee decides whether the application is to be granted or refused, and all decisions of the committee with regard to applications must be adopted unanimously. Members of this committee are not allowed to borrow from the society nor become security for any loan or advance. In the event of a refusal by the committee on credit and management to grant a loan or advance, the interested shareholder may appeal to the council of administration, who, after hearing the members of the committee as well as the shareholder, give their decision according to the majority of the votes. The council of administration determines the rate of commission and interest to be charged, as well as the duration of loans and advances. Small loans and advances are always to receive preference over large ones, when the security for repayment is equal.

It is generally agreed that the repayment of loans and advances shall be by instalments which are as far as possible, of equal amounts and are payable weekly, fortnightly or otherwise as agreed upon. These instalments as paid are entered as deposits which bear interest at the rate provided; or, as instalments are paid in, the interest charged on the loan is reduced in proportion to the amount of the loan paid up. For example, a man borrowing $100 for five months, repayable in monthly instalments of $20 each, will receive interest on the first instalment paid in for four months, on the second instalment for three months, &c., in each case the instalment paid in on account of loan being treated as if it were a new deposit. Or supposing the loan to have been made subject to the right of repayment in two instalments, at any or specified dates, the interest on part of the loan to the extent of the amount covered by the first instalment would terminate with its payment, and the interest of the balance with the payment of the second instalment.

As a rule, the loans and advances are secured by the signature of two solvent sureties who must be shareholders, but in addition to these signatures the committee of credit and management is obliged to inquire carefully into the personal financial standing and condition of the borrower, and ascertain whether reasonable confidence may be placed in his promptness to repay the loan. Above all, they are obliged to obtain accurate information with regard to the honour, the spirit of order, activity, honesty and ability of the borrower, and the latter is always bound to state in his application for credit the use he intends to make of the moneys asked for. The society may open credits on current accounts, with or without security, but the amount due is not at any time allowed to exceed $100.

ADMINISTRATION AND MANAGEMENT.

The affairs and management of the society are under the direction of a council of administration, a committee of credit and management and a committee of supervision, whose powers and action are determined by the shareholders as a whole, in general meeting assembled.

To preserve the democratic nature of the institution, and to further successfully its main objects, two principles have been regarded throughout as fundamental. In the first place, the number of shares to be acquired by any one person is limited, by the general meeting of shareholders, and in the second place, in the management and direction of affairs, the votes have been on the basis of membership rather than on the basis of the number of shares held—one associate, one vote. In this way the controlling interest of all the members has been made dominant over an otherwise possible cumulative interest of a few. Another fundamental principle is the local control, no branch system being admitted.

THE GENERAL MEETING.

A general meeting of shareholders is held annually, and where occasion demands, extraordinary general meetings may be called. At the general meeting the officers of the society and the members of the various committees are elected. No shareholder is allowed more than one vote, whatever may be the number of shares he owns, and no one can vote unless he has been a shareholder for at least three months, and is in good standing with the association. Decisions are adopted by the majority of the votes. The general meeting receives the reports of the council of administration and the committees of credit and management and the committee of supervision, which reports it examines, approves or rejects. It determines, subject to the provisions of the bye-laws of the society, the dividends to be paid, and the maximum of advance to be given to a single shareholder.

THE COUNCIL OF ADMINISTRATION.

The *council of administration* consists of nine members chosen from amongst the shareholders by the general meeting. Its members are known as directors, and are elected for three years, three members retiring at the expiration of each year.

The council thus elected chooses a president, vice-president and secretary, who are likewise the president, vice-president and secretary of the society. This council meets at least twice a month and as often as may be necessary in the interest of the society. Its powers are most extensive, including the admission and refusal of admission of shareholders, the expulsion of members, the filling of vacancies in the council and the several committees, the appointment and removal of employees, together with the fixation of their duties, salaries, &c.; the making of agreements and regulating of transfers and withdrawal of shares, the making out of balance sheets and dividends to be paid, the manner in which moneys, reserve, provident and other funds are to be employed, and generally, the taking of all measures that may be deemed advisable in the interests of the society. They also appoint and remove the manager of the society and determine the expense of management. They may borrow money on the credit of the society from one or more shareholders to meet applications for loans and advances when the available funds are insufficient. To the same end they may rediscount securities on hand, though their power to borrow for this purpose is restricted to $300, except by special authorization from the general meeting of shareholders, and their power to rediscount, to $500, without the same authorization. They determine the rate of interest to be allowed on savings deposits, and the conditions connected with the calculation and payment thereof; also fix the rate of commission and interest on loans and advances, and determine the duration of the latter and of conditions respecting renewals.

The members of the council of the society incur no personal or joint liability in connection with the operations of the society. They are responsible solely for the execution of their duties.

THE MANAGER.

The management is entrusted to a salaried official called *the manager*, who represents the society, under the immediate supervision of the council of administration. He has full control over the staff and proposes the appointment or suspension and dismissal of employees to the council of administration, who decide finally.

The manager, under the superintendence of the committee of credit and management draws up daily, weekly, monthly, or yearly, statements of the society, and submits a general report of its operations, the statements show the position of affairs from the beginning of the year to date, and are placed at the disposal of the shareholders by being posted in the office or otherwise. The manager, moreover, makes an inventory at the end of each fiscal year, and this, with a report showing the exact position of the society's affairs, is communicated to the annual meeting.

THE COMMITTEE OF CREDIT MANAGEMENT.

The president and other shareholders chosen for the purpose at the general meeting, constitute *a committee of credit and management,* the shareholders so appointed not being allowed to belong to the council of administration or to another committee. Their term of office is two years, one-half retiring each year. No transaction in connection with the loan or advances can be made by the society without the previous approval of the committee of credit and management, and its decision must be unanimously adopted by the members present—the presence of three members, at least, being required to render decisions valid. They cannot borrow from the society. Should their decision not be unanimous in any matter, it is brought before the council of the society, whose decision is final.

The services of the officers and various members comprising the council of administration, the committee of credit and management and the committee of supervision, who are charged with the administration of the operations of the society, are gratuitous. They are, however, entitled to travelling expenses when necessary, as well as expenses necessitated by the performance of special duties entrusted to them.

THE COMMITTEE OF SUPERVISION.

The general meeting selects yearly from amongst the shareholders, three members who, constitute *a committee of supervision.* This committee watches over all the operations of the society and frequently checks the cash, investments and securities ; sees to the carrying out of the by-laws and regulations and decisions of the committee of credit and direction, especially as regards loans, renewals and advances. They must ascertain frequently and at least once a month, the exact value of the securities in hand, and have the right to examine and audit all the books of the society. Where urgency demands it, they have power to suspend officers and to call a general meeting of the shareholders.

The members of this committee must be chosen from amongst the shareholders, other than those who are upon other committees, and are not allowed to borrow from the society. They must meet at least once every month and draw up a minute of their checking and auditing and submit a written report to every annual general meeting.

FUNDS AND RESOURCES OF THE SOCIETY.

In carrying on its business the society has, by way of funds and resources : (1.) the entrance fees paid by each shareholder, which amounts to 10 cents per share ; (2.) the capital represented by the shares subscribed and paid up by the shareholders (shares being of the value of $5 each); (3.) the reserve fund, the provident fund, and such other funds as may be established ; (4.) instalments paid on shares not yet fully paid ; (5.) the moneys at any time deposited by shareholders, and the resources obtained by temporary loans or by rediscounts.

A reserve fund is established to secure the soundness of the institution, and to have ample security for deposits made. This fund is made up from (1) the entrance fee of 10 cents on each share ; (2.) an assessment of 25 per cent. of the net profits of the year until the fund amounts to at least double the maximum obtained by the paid up capital at any time ; (3.) the interest on investments effected with the resources pertaining to such fund ; and (4.) the amounts received from the subsequent payment of debts written off as loss on a previous year's account. This fund so established remains the exclusive property of the society, which is obliged by its constitution not to adopt any decision calculated to weaken the fund so established. The resources of this fund are laid out and invested at the discretion of the council of administration to the best advantage for the interests of the society. As it is established chiefly for the securing of deposits and for assuring a proper working of the society, it is affected only by extraordinary losses extending beyond other resources at the disposal of the society.

A *provident fund* is established to cover extraordinary losses resulting from the operations of the society. It is constituted by means of an assessment of 5 per cent. on the net profits of the year until the fund is equal to at least one-half of the paid up capital.

Speculation by the society in stocks and all hazardous operations are formally prohibited.

PROFITS.

After providing for all the costs of management and for losses, the net yearly profits are divided as follows :—

(1.) Twenty-five (25) per cent. to the reserve fund ; (subject to previous provision.)

(2.) Five (5) per cent. to the provident fund.

(3.) Five (5) per cent. to local benevolent or charitable works.

(4.) Four (4) per cent. in the discretion of the council of administration as additional remuneration to the salaried employees of the association as a reward for good conduct in the performance of their duties.

The balance is divided amongst the shareholders in proportion to the period and amount of paid up shares. This amount is not to exceed 8 per cent. until the reserve fund reaches double the maximum attained by the capital at any time.

FINANCIAL SITUATION OF LEVIS SOCIETY.

To show the practical working and financial condition of 'La Caisse Populaire de Lévis', a statement may be given of the situation of this institution as it stood on February 14 of the present year. On that date the amount of paid up subscribed capital was $24,584.62 ; the amount of savings deposits, $5,529.70 ; amount interest still to be paid on savings unpaid, $34.81 ; amount of dividends unpaid, $408.20, making in all a total of $30,557.33. The amount paid as entrance fees on shares subscribed from December 1 to February 14, 1905, amounted to $40.90. The reserve fund amounted to $1,306.76, the provident fund to $130.05, these together with a surplus of $236.42, making a grand total in addition to the capital of $1,714.13 for the protection of deposits, &c.

The profits from December 1, 1904, to February 14, 1905, amounted to $296.09. The grand total of liabilities on February 14 was, therefore, $32,567.55.

Of the assets of the society there were loans to the amount of $25,631.18, general expenses $15.50, cash in hand $6,920.87, the whole making a grand total of $32,567.55.

As shown in the monthly statement of the manager of the society these amounts appear as follows :—

FINANCIAL STATEMENT OF THE 'CAISSE POPULAIRE DE LEVIS' ON FEBRUARY 14, 1905.

Assets.

Loans	...		$25,631 18
General expenses	..		15 50
Cash on hand	...		6,920 87
			32,567 55

Liabilities.

Paid-up capital	...		$24,584 62
Deposits	...		5,529 70
Interest upon deposits	...		34 81
Dividends (unpaid)	...		408 20
Total liabilities	...		30,557 33
Entrance fees		$ 40 90	
Reserve fund		1,306 76	
Provident fund		130 05	
Surplus		236 42	
			1,714 13
Profits	...		296 09
			32,567 55

Certified correct,
Lévis, February, 15, 1905.

(Sgd.) ALPHONSE DESJARDINS,
President-Manager.

BUSINESS DONE BY LEVIS SOCIETY.

The following figures will show the amount of business done by the society from the time of its establishment in December, 1900, up to February 14, 1905. The total amount received on account of capital subscribed has amounted to $29,943.10. Comparing this amount with the total amount of paid up capital on hand on February 14, it would appear that since the commencement of the society, $5,358.48 has been reimbursed to shareholders who for different reasons desired to withdraw their shares. The total amount paid on account of entrance fees (being 10 cents per share on shares subscribed) was $693.90, which would indicate that in all 6,939 shares have been subscribed. The total amount received in profits on account of loans, &c., has been $3,326.50. This amount, added to the amount on account of entrance fees, makes a total of $4,020.40, which total has been divided as follows :—

To the reserve fund	...	$1,306 76
To the provident fund	...	130 05
On account of surplus	...	236 42
As interest on deposits	...	240 01
On dividends distributed among shareholders		1,598 02
On account of general expenses	...	187 65
Amounts not as yet appropriated	...	321 49

The total amount received on account of deposits, from the establishment of the society up to February 14, was $12,257.27, out of which the sum of $6,727.57 has been reimbursed to the depositors, leaving the amount on account of deposits at the present time, $5,529.70. Since the inception of the society to February 14, 1905, a total of $104,554.94 has been loaned, of which the borrowers have repaid $78,923.56, leaving a balance of loans outstanding of $25,631.18. Taking a general survey of the entire business of the society from its establishment it appears that the society has handled funds amounting in all to $125,144.33

Set forth in statistical form, as presented in the semi-monthly statement of the manager of the society, these amounts appear as follows :—

FINANCIAL STATEMENT OF BUSINESS OF 'LA CAISSE POPULAIRE DE LEVIS,' FROM JANUARY 23, 1901, TO FEBRUARY 14, 1905.

Receipts.

Paid-up capital	...		$29,943 10
Entrance fees	..	$ 693 90	
Profits	..	3,326 50	4,020 40
These two last amounts being divided as follows :—			
Reserve fund	...	$1,306 76	
Provident fund	...	130 05	
Surplus	..	236 42	
Interest on deposits	..	240 01	
Dividends	..	1,598 02	
General expenses	...	187 65	
Unappropriated amounts	...	321 49	
		4,020 40	
Savings deposits	.		12,257 27
Loans repaid	...		78,923 56
			125,144 33

Disbursements

Withdrawals of shares	...	$ 5,358 48
Withdrawals on deposits	...	6,727 52
Loans	...	104,554 94
Interest on deposits	...	205 20
Dividends	...	1,189 82
General expenses	...	187 65
Cash on hand	.	6,920 87
		125,144 33

Certified correct,
Lévis, February 15, 1905.

(Sgd.) Alphonse Desjardins,
President-Manager.

BENEFITS DERIVED BY SHAREHOLDERS AND COMMUNITY.

Mr. Desjardins, the president and manager of the society, states that the great majority of the shareholders of 'La Caisse Populaire de Lévis', are workingmen, most of whom hold two or three shares each. Nearly 700 different loans have been made since the establishment of the society, to about 100 different borrowers, in sums varying in amounts from $1 to $500, the majority averaging from $50 to $100. Most of the loans have been made for a period of four months, and have been to small traders, mechanics, farmers, and others, to enable them to make advantageous purchases, to tide over temporary difficulties and to meet pressing demands. Of all the loans made not a single borrower has failed to make payment of the amounts advanced.

It is, so Mr. Desjardins states, the general consensus of opinion of the shareholders that but for the establishment of this savings and credit society not $2,000 out of the $32,500 which has been deposited in the bank in the form of shares and deposits would have been saved. Among the shareholders are many young men who are apprentices or mechanics and who commenced with taking only one share, and have at the present time as much as $200 laid aside in the form of paid-up shares or deposits. These amounts have been accumulated chiefly through the opportunity afforded of acquiring shares by the payment of small amounts in weekly or monthly instalments. Having commenced by making a weekly deposit of 10 cents, many have acquired the habit of depositing regularly with the bank and have shown a disposition to increase the amount of their deposits from month to month and year to year.

Not only have the members of the society received assistance by way of advances and acquired habits of thrift from the practice of making regular deposits, but not a few have been saved from serious embarassment and from extortion at the hands of usurers.

The operations of 'La Caisse Populaire de Lévis' are restricted to the town of Lévis and the parishes of St. David and St. Louis, the total population of the area being about 7,500. To serve the financial needs of this locality, there are four large banks, as well as the post office savings bank.

Up to the present time the business of 'La Caisse Populaire de Lévis' has been conducted almost entirely by Mr. Desjardins himself. He has given his services gratuitously and has had the office of the society in his own residence. For the convenience of the working classes, an office has been opened on Saturday nights in a central part of the city, at which office, deposits are made by working men after the receipt by them of their weekly wages. The business of the society has grown so considerably and rapidly that the necessity of having a regular office with paid assistants is becoming more and more urgent.

OTHER CO-OPERATIVE SOCIETIES.

After the formation of 'La Caisse Populaire de Lévis', a similar co-operative savings and credit society was organized at St. Joseph de Lévis, an adjoining parish. This society, which is in a rural parish, has been formed on identical lines with 'La Caisse Populaire de Lévis,' and has at the present time about 100 shareholders. In September, 1903, a third co-operative credit society was organised at Hull, Que., also after the model of 'La Caisse Populaire de Lévis.' It has at the present time about 80 shareholders. The last society to be formed was organized in January of the present year at St. Malo in Quebec East. Notwithstanding the very short time since its establishment, this society has already a membership of over 200.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, XII,*

(*Continued from Bulletin for July.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

METHODS OF COAGULATING THE LATEX OF CASTILLOA.

COAGULATION BY CREAMING.

The separation of rubber from the latex, a process commonly called coagulation, is in a somewhat more advanced state of investigation than the subject of tapping, if, indeed, the recent experiments of Dr. Weber do not mean that a final and satisfactory conclusion has been reached. Dr. Weber finds that by the simple expedient of diluting the fresh latex of Castilloa with five times its volume of boiling water and adding 8 ounces of formaldehyde to each barrel of the resulting fluid, all the impurities to which the inferiority of Castilloa rubber are due can be removed, since they will remain in solution, while after twenty-four hours the clean rubber will be found in a "snow-white-cake" which can be lifted off the top. Dr. Weber contends that rubber prepared in this way is "absolutely free from solid impurities of any description. * * * either soluble or insoluble, organic or inorganic," and that it is equal or superior to the finest brands

* Extract from the U. S. Department of Agriculture, Bull. No. 49. Bureau of Plant Industry.

of Para rubber. The process is simple and inexpensive, and if the mechanical qualities of the rubber meet Dr. Weber's expectations when the practical tests of manufacturing have been applied, it would seem that the essential requirements of the problem have been met, and in any case valuable progress has been made. It seems, moreover, from the investigations made by Parkin in Ceylon that this method is capable of still further simplification.

When the latex of Castilloa is mixed with water and allowed to stand, in the course of an hour or two the caoutchouc particles have all floated to the top in the form of a thick cream. The diluted latex of Hevea, on the contrary, shows no signs of creaming, even when submitted to a low temperature. The difference is most likely due to the larger size of the caoutchouc globule in the case of Castilloa as compared with that of Hevea.*

Parkin found, however, an interesting difference between the latex of Castilloa in Ceylon and that described from tropical America by Biffen, in whose results Weber may be said to acquiesce, since he holds that the albumens of Castilloa latex are readily coagulated by alkaline solutions.

The proteid of the latex of *Castilloa elastica* has also been investigated to some extent by Biffen. He found that the latex gives an acid reaction, and that on the addition of a little alkali it is coagulated. This he considered to be due to the nature of the proteid which exists as acid albumen in the latex ; on neutralization it comes out of solution and gathers together the caoutchouc particles into clots.

Now, the latex of the Castilloa introduced into Ceylon (*C. Markhamiana*) does not behave like this. On the very gradual addition of alkali to the latex or to the filtrate (the liquid part of the latex without the globules of caoutchouc) no coagulation or precipitation occurs. Alcohol causes a coagulation of the latex and a copious precipitate in the filtrate, which is quite soluble again in water. Proteid is present in considerable quantity, about 4 per cent. being indicated by analysis. Coagulation is brought about neither by acids nor by boiling. Thus it looks as if the proteid belongs to the class of albumoses. At any rate the type of Castilloa introduced into Ceylon differs in this respect strikingly from that of the true *Castilloa elastica* examined by Biffen.

These facts are of interest, not only from their bearing upon coagulation and function of latex, but because they indicate the extent to which the latex and its constituents may vary under different conditions of growth. Parkin is probably in error in the idea that the latex with which he experimented belonged to *Castilloa Markhamiana.* The tree which was introduced by Cross from Panama to Ceylon is more likely to be the same as that with which Weber experimented in Colombia.

DISCOLOURATION OF CASTILLOA LATEX.

Incidental to his principal discovery Dr. Weber reports several observations of much interest, not alone in their practical significance, but also as illustrations of the mistakes which can be made in a subject so difficult of investigation as rubber. Thus it is found that the milk of Castilloa contains not a trace of tannic acid, the presence of which has often been inferred, presumably because ferric chlorid produces the same colour reaction with latex as with tannic acid, turning it dark green. This reaction Dr. Weber finds to be due to the presence of a glucoside, which also gives the latex its intensely bitter taste. The addition of tannic acid precipitates

* Parkin, Annals of Botany, 14: 198, 1900.

the albumens of the latex, so that the presence of albumens is itself deemed a sufficient evidence of the absence of tannic acid in latex of any kind.

The rapid colour change of the milk of Castilloa on exposure to the air is found to be due to an enzym or oxydizing ferment (oxydase) which is probably destroyed by the boiling water, as suggested by Parkin to whose work Dr. Weber does not refer, although in this part of the subject it had covered the same ground.

Parkin reported as follows :

Several latices, which are pure white when they first issue from a wound on the plant, rapidly darken on exposure to the air. This is due to the presence of an oxydizing ferment, or oxydase, which with the aid of the oxygen of the air acts on some constituent of the latex, changing it to a deep brown colouring matter.

The latex of Castilloa is a good example. It rapidly darkens on exposure and dries to an almost black rubber. By creaming the caoutchouc particles can be separated from the dark beer-like liquid and made into a sheet of nearly colourless rubber. By quickly heating the collected latex the darkening is arrested owing to the destruction of the enzyme.

The latex of Hevea collected from the tree trunk does not darken at all on exposure to the air, and provided that moulds and putrefactive organisms are kept, away, rubber prepared from it remains indefinitely of a light colour. On the other hand, the latex from the wall of the unripe capsule (fruit) changes on exposure from milk-white to black. The darkening is wholly prevented if the latex is quickly subjected to heat. No doubt there is an oxydase present in the latex of the capsule. (*a*)

The expression "coagulation of rubber" appears objectionable to Dr. Weber because he finds that it is the albuminous substances of the latex which coagulate and not the rubber itself, but this objection seems rather over-technical, since, even in Dr. Weber's method, the rubber is collected and compacted, and for this process a name is still required. It is the albuminous substances incorporated in Castilloa rubber which continue to ferment and putrefy, or otherwise contribute to the deterioration of the rubber, both crude and manufactured. In other words, it is the albumens rather than the resins which determine the inferiority of rubber, and the amount of resin contained in the latex of adult Castilloa trees is held to be "entirely innocuous" and "absolutely unobjectionable." Dr. Weber continues :

I am quite aware that now and then all sorts of sinister actions are ascribed to the presence of resins in india rubber, but there is not the least particle of evidence to show that they are intrinsically detrimental. As a matter of fact, in the manufacture of quite a number of rubber goods, resins are deliberately added to the mixings. (*b*)

BOARD OF AGRICULTURE.

Extracts from Minutes.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on the 13th June. Present :—the Hon. the Colonial Secretary, Chairman, the Director of Public Gardens and Plantations, the Agricultural Chemist, Mr. C. A. T. Fursdon,

(*a*) Parkin, Annals of Botany, 14 ; 199-200. 1900.

(*b*) Tropical Agriculturist, 22 : 444, January, 1903.

and Mr. W. Harris, Acting Secretary, Mr. Geo. D. Murray telegraphed that owing to very heavy rains he was unable to attend the meeting.

Annual Report—A draft copy of the Annual Report on the work of the Board was brought up for consideration. It was decided that the Agricultural Chemist should prepare a summary report on the Agricultural and Educational work of his Department for the past financial year to be presented at next meeting of the Board, at which meeting the Annual Report of the Director of Public Gardens and Plantations will also be presented, when all these reports will be considered together.

Pamphlet on School Gardens—The Director of Public Gardens presented a draft copy of the first part of a pamphlet on School Gardens which had been prepared by the Assistant Superintendent of Hope Gardens.

This was ordered to be circulated.

Letters from the President of the Sav.-la-Mar Agricultnral Society re Mr. Cradwick's Services—The Director of Public Gardens forwarded letters from the President of the Sav.-la-Mar Agricultural Society asking that Mr. Cradwick should be allowed to act as Assistant Secretary of the annual show held in connection with the Society.

The Board decided that in this, as in similar cases, Mr. Cradwick may assist in his capacity as Travelling Instructor in persuading the people in the districts in which Agricultural Shows are to be held to take an interest in such shows, but it objects to his undertaking secretarial or other duties which were not within the scope of his work as a Travelling Agricultural Instructor.

Cocoa dying in St. Mary—The papers on this subject were brought up for final consideration, and the Director of Public Gardens was requested to edit them and publish in the Bulletin anything bearing on the subject which is likely to prove useful.

Samples of Tobacco asked for by Board of Trade—The Colonial Secretary forwarded, for the information of the Board, a copy of a reply sent to the Board of Trade, London, stating that at present there is no tobacco leaf available for export and, therefore, there is no use in sending samples, but that samples of cigars, etc., would be sent to Prof. Dunstan, by the Montpelier Cigar Factory and Messrs. Machado Bros., for exhibition in the Imperial Institute, also that Mr. Haas, who made enquiries, may obtain information on the subject at the Jamaica Court at the Crystal Palace Exhibition.

The following reports were presented and ordered to be circulated :—

From the Director of Public Gardens and Plantations :—

Report on Hope Experiment Station.

Reports from Messrs. W. Cradwick & W. J. Thompson. Travelling Instructors.

[Issued 9th August, 1905.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. **SEPTEMBER, 1905.** **Part 9.**

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name a· address to the Director of Public Gardens and Plantations, Kingston P.O

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1905.

JAMAICA.

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COCOA AT THE AGRICULTURAL CONFERENCE, 1905, AT TRINIDAD. I.*

EXPERIMENTS IN IMPROVING THE HEALTH AND PRODUCTIVENESS OF COCOA TREES.

Mr. J. H. Hart (Trinidad): Our experiments have only just been initiated and have hardly reached a stage to justify saying anything about them. One or two things have, however, been brought to the notice of planters, and have, I am glad to say, been taken advantage of with considerable success. The first is the method of dealing with the pod disease. The methods suggested by me to the Trinidad Agricultural Society, and also by the Imperial Department of Agriculture, which consist in the burning, burying, and disinfecting of diseased pods, have been especially successful in dealing with the disease called *Phytopthora*, and I was agreeably surprised to be told recently that, as the result of their adoption on one of the largest estates in the island, the proprietors expected to get 25 per cent. more cocoa than he otherwise would have done. Mr. deGannes has also adopted similar treatment with equal success. Another thing which we have been trying to impress upon small planters especially is the desirability of pruning cocoa trees so as not to leave wounds which cause rot of the centre of the stem. Again, where wounds and holes occur we strongly recommend a system of cleaning them and filling them with a mixture made of ordinary cement and sand. This gives the trees renewed vigour and prolongs their life for many years. Tar is also recommended for use in pruning and I am glad to say the practice has been adopted on a large number of estates. Few manurial experiments have as yet been carried out, but those recomended are being adopted, and I shall be able to report on them at a later period.

Mr. J. G. DEGANNES (Trinidad): With few exceptions the cocoa cultivation in this Island has received, up to a year or two ago, little attention beyond the ordinary method of upkeep handed down by our forefathers, but it seems now as though the cocoa planters are realizing the necessity of higher cultivation. So far, artificial manures have not been extensively made use of, but where they are being tried, the results are encouraging. Basic slag is the manure most generally applied. Some very good re-

* Reprinted from W. I. Bulletin, Vol. VI., No. 1, 1905, page 65.

sults are obtained by the use of pen manure prepared with gypsum, and on some very old properties its use, and that of sheep manure forked in, have been remarkable in improving the health and productiveness of the cocoa trees. The island has had up to now, thank God, few cocoa diseases to contend with, the 'Brown Rot' and 'Canker' being the only two. The measures successfully adopted to combat them, have been the treatment suggested, I believe, by the Imperial Department of Agriculture, and with the advice and assistance of Mr. Hart, the Superintendent of the Botanic Gardens here, they are kept under control. The cocoa trees of the plantations situate in the valleys suffer considerably from 'moss' on account, I presume, of the excessive moisture, and it would be desirable if some other and more efficacious means than the brush or the hand—the 'knapsack' sprayer having totally failed for the purpose—should be found to deal with it. There are several patent cocoa dryers of different patterns used for the curing of the cocoa bean and I am informed that they give satisfaction, but personally I shall adhere to the opinion that the sun-dried article is preferable. With regard to green dressing I am not aware that it is resorted to to any great extent. I gave it a trial on one of my properties in October last, and so far I have not noticed a very marked change in the look of the trees. In conclusion, I regret that, owing to the short time since experiments have been started in the colony, I have no statistics to offer.

The PRESIDENT: With the object of assisting the cocoa industry in Grenada, St. Lucia and Dominica, we undertook a series of what we called sample plots of cocoa; that is to say, we took over plots of land, about 1 acre in extent, near the public road from proprietors who were willing to allow us the use of the land, and to assist in the cultivation. These plots were labelled 'Imperial Department Plots.' In most cases they consisted of cocoa which was not in good health. The Department paid the expense of cultivation, the Agricultural Instructor visited these plots, which became central points for giving information to cultivators in the district. The planter who gave the use of the plot became the agent of the Department in his district, so that when the Agricultural Instructor visited the plot he would see the planter and discuss with him the best way of utilizing his time while in the district. Sometimes it was suggested that a meeting would be held at which the cocoa growers in the district should be present. After the Instructor had been introduced to them by a person they knew, they were ultimately willing to receive and hear the Instructor and follow his advise. Some people might regard the establishment of sample plots as giving assistance to the large proprietors by taking a portion of their land and cultivating it for them. However, we are quite satisfied with the results, as the feeling that has been created among small proprietors by our taking an interest in their cultivations has more than repaid us for the trouble and expense which the establishments of these plots has occasioned. As the result of sample plots in Grenada, a paper in connection with one of these has been circulated among members of the Conference. Peasant proprietors who had scouted the idea are now making drains and pruning their trees, applying manures and fully carrying out the recommendations of the Department. I believe these sample plots have been very beneficial. We have gone through our first series and should now begin another. The plots in Dominica I hope to place under the supervision of Dr. Watts, so that he can make experiments with chemical manures and carry on the work more closely on scientific lines. Mr. Hudson has had charge of the plot in St. Lucia and he will be able to tell you himself what is being done there.

COCOA MANURIAL EXPERIMENTS AT GRENADA.

The following report and table, showing the results of the working of the cocoa experiment plot at Nianganfoix estate, Grenada, were forwarded by the proprietor for publication (see *Agricultural News*, Vol, III, p, 347):—

This plot was handed over on September 30, 1903, by the Department of Agriculture to the proprietor who still carries on the experiments, in order to obtain the highest possible yield from an acre of land by the use of fertilizers and green soiling.* The plot measures 1 acre and was divided into four sections of $\frac{1}{4}$ acre each.

During the period, extending over four crops from April 1, 1900, to September, 30, 1904, two applications of manures were made, as shown in the table, the first during the first crop 1900-1901, and the second application in the spring and summer of 1902 just before the third crop.

A., the pen manure section, is the wettest section of the plot, and it will be noticed that, notwithstanding the heavy application of manure in May 1902, the yield fell below the two preceding crops, and only recovered after several rods of new drains had been added to those already existing—and dug diagonally across the slope. This illustrates the value of drains in a wet clay soil, without which manure is at a discount.

The potash section D. has steadily advanced and, unlike sections B. and C., which unaccountably fell off by $\frac{1}{8}$ to $\frac{1}{4}$ bag, held its own during the crop 1902-3. The cost of production for the first two years averaged £1 per bag of cocoa, and for the second two years 12s. per bag, or an all-round average of 16s. per bag for four years' working.

When the results of the fifth year's working are known, the cost of production will be considerable reduced.

The following figures show the gradual improvement in yield :—

Crop 1900–1 = 5¼ bags per acre
Crop 1901–2 = 7 " "
Crop 1902–3 = 7 " "
Crop 1903–4 = 8 " "

Full particulars are given in the following table as to the details of the treatment accorded to the various sections :—

* The sections have been bedded twice yearly.

Section.	Manures applied (with dates).	Crop 1900-1.		Crop 1901-2.		Crop 1902-3.		Crop 1903-4.	
		Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.
A. $\frac{1}{4}$ acre.	June 1900— Pen manure, 3 baskets per tree, 15 tons per acre May 1902— ditto [Extra drains dug, August 1902.]	1,036	$5\frac{5}{8}$	868	$4\frac{2}{3}$	808	$4\frac{1}{2}$	1,184	$6\frac{1}{3}$
B. $\frac{1}{4}$ acre.	August 1900— Basic slag, 8 cwt. per acre February 1901— Sulphate of ammonia, $1\frac{1}{2}$ cwt. per acre May 1902— Basic slag, 8 cwt. per acre August 1902— Sulphate of ammonia, $1\frac{1}{2}$ cwt. per acre	1,112	6	1,572	$8\frac{1}{2}$	1,512	$8\frac{1}{4}$	1,648	9

Section.	Manures applied (with dates).	Crop 1900-1.		Crop 1901-2.		Crop 1902-3.		Crop 1903-4.	
		Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.	Dry Cocoa per sectional acre (pounds).	Bags per acre.
C. $\frac{1}{4}$ acre.	August 1900— Basic slag, 8 cwt. per acre February 1901— Nitrate of soda, $1\frac{1}{2}$ cwt. per acre May 1902— Basic slag, 8 cwt. per acre August 1902— Nitrate of soda, $1\frac{1}{2}$ cwt. per acre	888	$4\frac{3}{4}$	1,324	$7\frac{1}{8}$	1,309	7	1,492	8
D. $\frac{1}{4}$ acre.	August 1900— Basic slag, 8 cwt. per acre, and sulphate of potash, 1 cwt. per acre, (mixed) May 1902— ditto	860	$4\frac{2}{3}$	1,472	8	1,488	8	1,612	$8\frac{3}{4}$

Mr. J. H. HART: We have established in Trinidad one experiment plot on the same lines as the Grenada plots. It is at Brasso and in charge of Mr. Carl de Verteuil. It was only started a few months ago, and the results will not be available for some time.

Mr. G. S. HUDSON: (St. Lucia): Experiments in improving the health and productiveness of cocoa trees have been carried on in St. Lucia under the Imperial Department of Agriculture now for five years. Our method, as Sir Daniel Morris has said, has been that of taking up the most unhealthy portions of cocoa we can find adjoining the main-roads, so as to bring our work as much as possible before passers-by. The results have been exceedingly satisfactory. In many cases the trees had actually stopped bearing; in others, the yield was only 56 lb of dry cocoa per acre when the plots were taken over. In three years the yield had been increased to 7 bags. The policy is, as soon as we attain that standard of improvement, to hand the plot over to the owner and take a new plot in the same or another district. In our five years' experience we find we get the best results from the following method: forking throughout the plantation in January; then applying broadcast eight cwt. of basic slag between January and April; that is followed by draining where necessary, and then thorough pruning. We find pruning to be of very great importance as it admits sunlight. After this, thorough cleanliness throughout the year. Three to four weedings are usually sufficient, but sometimes as many as six have been found necessary. In August or September we apply sulphate of ammonia to each tree. I observe from the results of the experiments in Grenada that the best results there have been obtained from an application of sulphate of potash. In 1902 we applied nothing but potash to a 6- or 7-acre plot, and the results were negative in every case. I may mention, however, that, in combination with basic slag, the experiment has proved very valuable; but the best results were obtained from a combination of slag and nitrogen. We have also tried superphosphate but have not found it advantageous. We have obtained good results from ground bone, but that is rather expensive. Pen manure is undoubtedly the best system of manuring, but the difficulties of transportation prevent its general use. Chemical manures yielded as good results and at less cost. The only fear in the application of chemical manures is that too much nitrogen may be applied to certain soils, but in light soils, there is nothing to fear. Many planters seemed to fear forking, on the ground that it injured the trees, but I have never seen any bad results from careful forking. On the contrary, the results have been excellent. As the result of the experiment plots, planters in St. Lucia are now importing basic slag and sulphate of ammonia—a thing unheard of before—and pruning and forking have now become a recognized part of cocoa cultivation. As a rule, we do not find it necessary to use tar or cement except in cases where a fungus disease is affecting the trees.

Dr. H. A. A. NICHOLLS (Dominica): Until the last quarter of a century the exports of cocoa from Dominica were very small, as it was produced only by peasant proprietors. When, however, the crisis overtook the sugar industry, many of the sugar planters, feeling the effects of the hard times, planted up portions of their estates in cocoa and limes, and so from that time the exports of cocoa began to increase. The Treasurer of the island has very kindly furnished me with certain returns which include the exports of cocoa for the last ten years, which are as follows:—

EXPORTS OF COCOA FROM DOMINICA.

Year	Export	Year	Export
1894-5	851,334 ℔	1899-1900	968,740 ℔
1895-6	499,113 "	1900-1	992,586 "
1896-7	946,393 "	1901-2	1,052,693 "
1897-8	885,024 "	1902-3	1,309,577 "
1898-9	1,082,851 "	1903-4	1,285,245 "*

From this return I observe that in 1895-6 there were half a milpounds of cocoa exported; but when we come to 1902-3 it is found that the exports had increased to one and a third million pounds. Last year, that is, 1903-4, there was a decrease owing to the hurricane, which although not directly striking Dominica, seriously affected the crop. But notwithstanding this the exports of cocoa reached one and a quarter million pounds. During the last few years a good deal of attention has been directed to Dominica: a new road, opening up the rich land of the interior, has been made with money granted by the Imperial Parliament and it has appropriately been called the Imperial Road. We have young Englishmen with moderate capital constantly coming out, and some of them have gone into the interior, cut down forest, and created estates, and in many instances they have planted cocoa. It must, however, be borne in mind that the increase in exports to which I have referred is not due to the new planters, but entirely to the older planters, who, seeing that sugar had failed, set their energies to work in another direction; therefore, it is the industry and enterprise of the older planters—the men who have borne the heat and burden of the hard times—that have brought about the dawning prosperity of Dominica. When, however, the new settlers' estates begin to bear, then it will be found that Dominica will make a sudden leap forward along the path of progress. Coming to the cocoa tree itself, I should like to make a few observations in regard to the facts brought before us by former speakers. Taking the case of pruning, I would thoroughly commend the remarks made by Mr. Hart, just as I would deprecate those made by Mr. Hudson. If you wish a cocoa tree to do well and to bear well you must perform the operation of pruning with great care. I think the Mycologist of the Department will tell you that if you cut off the branches and limbs of trees and do not tar the wound, you will probably get fungus diseases in the wood; the Entomologist

* Gale in August and par ial failure of crops.

of the Department will also tell you that there could not be a better site for the entry of boring beetles and such like insect pests than the unprotected wounds left by bad pruning. The more intelligent planters in Dominica use tar, and also fill up with clay any holes or deep depressions that may be found in the tree whereby water might collect or insects get shelter. As regards manure, in days gone by the greater part of the exports of Dominica came from the peasant proprietors who had not the advantage of having brought before them as in the case now, the scientific and technical knowledge of the Imperial Department of Agriculture; they allowed their trees to grow as they might, and did not manure them, with the result that the trees have deteriorated very considerably. The manure that is found most useful in regard to cocoa cultivation is exactly the same that is found most useful in cane, and indeed in almost any, cultivation, that is farmyard manure. There can be no better manure, not only from its chemical constituents, but also its mechanical effects : it improves the soil whilst it provides food for the trees. But where you have estates far in the interior or on steep hillsides, and with a few animals, it is almost impossible to obtain sufficient farmyard manure, and in such instances it is necessary that artificial manure should be used. Hence the Dominica estates used basic slag, which contains phosphate and some free lime, and nitrogenous manures in the form of nitrate of soda or sulphate of ammonia. But in regard to nitrogenous manures it must be remembered that in Dominica, St. Lucia and other such Islands an immense quantity can be got in the forest lands by using dead leaves, lopped shrubs, and grass as a mulch for trees, and afterwards by forking this decayed vegetation into the soil. There is also a loss of nitrogen attendant on the cultivation of land in the tropics, and it must be restored by the use of farmyard manure, by green dressing, or in some other way. Mr. Hudson recommends keeping a cocoa plantation thoroughly cleared of weeds. That is opening up the question brought before the last Conference by Dr. Watts who advised that in cocoa and similar cultivations the land should not be kept entirely free of weeds, but that the weeds should be allowed to grow for a time and then cut down ; so that the cultivation would practically get a green dressing. That is the system that has been universally adopted in Dominica for many years, and it would appear to me to be the one best suited to local conditions. There is a matter which I omitted to allude to and which may be regarded as one of the main causes of the small crops now got from peasant holdings. In removing the pod from a cocoa tree it is necessary that a portion of the stem attached should be left on the tree, but the ignorant peasant, instead of cutting the pod, wrings it off, with the result that the little bud at the end of the stem which will supply the future pod is torn off, so that in time the bearing portions of the stem are materially reduced in number. This is a matter to which Agricultural Instructors in Dominica and other islands should call the attention of peasant proprietors.

The Rev. Dr. MORTON (Trinidad): I go about among many peasant proprietors in Trinidad, and I know that the teaching of the botanist, the chemist, and the analyst has had a great effect upon them in the matter of cultivating their land. One matter referred to by Dr. Nicholls is of great importance to them, and that is the application of manures. They should be urged to use the natural manures which they can get without laying out money. Sometimes they have no money. The names of artificial manures are all new to them, but they know pen manure; and some of them from Barbados know the value of it, and the distinction made between pen manure that has been kept covered or been trampled, and pen manure that has been exposed to the sun or washed out by rain. We see in our villages to-day, as the result of cane-farming, the peasant proprietor's cart going out every morning half-loaded with manure, to be returned to the soil. Not only is that the case with the ordinary manure made in the village, but the peasant proprietor has also taken to the use of liquid manure. At the Government Stock Farm where the stalls are concreted, the liquid manure which collects in little wells is daily removed by peasant proprietors. This practice is also carried out in St. Joseph and has resulted in an improved sanitary condition. What Dr. Nicholls has said in reference to weeds and shrubs is perfectly true. In some cases, such as rice cultivation, the only manure which goes into the soil is the grass and weeds which grow for six months during the dry season. The practice is also valuable in connexion with cocoa estates.

The Hon. WM. FAWCETT (Jamaica): I have listened with a great deal of interest to the discussion that has taken place on the cultivation of cocoa. The cocoa industry in Jamaica is of considerable importance, although rather overshadowed by the banana industry. There we do not look upon it as you do in Trinidad and Grenada, as one of your great industries; it is rather a subsidiary industry in Jamaica: but I hope it will become in time one of our great industries. The reason why it has not advanced quicker is that the banana has been so very important. But now the planters, seeing the bad effects of hurricanes, are gradually beginning to plant their banana estates with cocoa, and some have turned their banana estates altogether into cocoa estates. So we wish to get hints as to the cultivation, pruning, curing and especially shade. We owe a great deal to Mr. Hart for having written such an excellent handbook on cocoa; we in Jamaica consider it a very practical and important book. With reference to Criollo cocoa and Forastero cocoa, we have been much exercised in Jamaica for some time as to which is better to plant. Some planters do not think Criollo a robust plant, asserting that it is subject to disease and pests at all times. I should like to get some information from planters in Trinidad on that point. In Venezuela, where they have large estates of Criollo, some trees have died out, and attempts have been made to supply their places with Criollo, but without success, although Forastero will grow. The estates are therefore deteriorating. I should like to know whether this has been found to be the case also in Trinidad. Do you find you can plant Criollo and keep it up, or have you gradually to revert to Forastero? We have in Jamaica a considerable tract of land in the western part where the remains of cocoa are still found growing, and almost without exception the variety is Criollo. Some of these trees are said to be 100 years old and yet they are bearing heavily and doing well. But the question is whether the seeds from these trees can be utilized for establishing new estates of pure Criollo. With reference to the question of Criollo growing well and being supplied where it is already established, I wonder whether a system of budding on strong stocks would not apply. For instance, on estates in Venezuela, where they found they could not successfully establish Criollo in vacant places and have had to plant Forastero instead, would it not be possible to bud on the Forastero from their Criollo trees? We have been experimenting with budding and found we can do it with success. Again, in our cocoa estates we find many of the trees do not bear anything like as well as other trees, and we want to know whether we cannot improve them. Will it not be advisable to cut down those trees and bud on the shoot that springs up, from one of the more valuable trees on the estate? Another matter we do not understand is shade. That seems to me to be a very complicated question. In Grenada they do not use any shade, and in Trinidad they use shade everywhere and find they cannot do without it. What is the reason? Is the shade wanted for the trees or the soil? If it is wanted for the soil, then you do not want shade trees, as the cocoa will provide its own shade. Is it necessary to have shade at all, or is it a question rather of cultivation? Do the roots of shade trees keep the ground open, or might that be overcome by the use of cultivators? One of our most practical agriculturists in Jamaica started five or six years ago a cocoa estate in the middle of the island, and he is convinced in his own mind that there it is necessary to have shade. But on the north side of the island it has been proved that shade is not required. I am inclined to think that shade produces moss on the trees and leads to fungus disease which might otherwise be avoided, and that the more sun you can reasonably allow to the cocoa trees, the heavier the crops will prove.

Dr. H. A. A. NICHOLLS: The practice in Dominica is not to use shade, but trees are planted, in some cases running along lines, so as to serve as wind-breaks. I remember that fourteen years ago when I made my second visit to Trinidad I was told that shade was necessary; so I obtained seeds of Bois Immortel from a friend and planted them among my cocoa. I was very sorry I did so; but the hurricane, which did so much damage to the cocoa estates in Dominica, did me some good in throwing down my Bois Immortel. The experience of the Dominica planter is that cocoa grows better without shade than with it. I was exercised in mind a good deal by remarks made to me some years ago as to the advantages of a tree which is used here as shade. I was gravely told by some planters that the Bois Immortel is very beneficial, inasmuch as it gives out water from its roots during the dry season. We can well understand that such trees do good, but in a different way; their roots naturally would go further into the subsoil than the roots of cocoa, and they draw from the subsoil certain constituents which will later on be shed upon the land in the shape of dead leaves and twigs and flowers, and much nitrogenous matter would be supplied to the land in the form of humus. But we must also remember that these plants belong to the order called *Leguminosae*, which have nodules on the roots, and in these nodules are micro-organisms called bacteria, which have the power of drawing the nitrogen from the air and fixing it in the soil, and in that way nitrogen is supplied to the surrounding plants. It appears to me, therefore, that the benefits of the shade trees in Trinidad are not due so much to the shade, but to the manure they give to the soil.

Mr. E. M. DEFREITAS (Grenada): At one time we planted a great deal of shade trees in our cocoa estates in Grenada. In fact we adopted the Trinidad system. After a time we found that the trees which were not shaded gave better results. Then about ten years ago planters began to cut down their shade trees, and at the present time, with perhaps one exception, I do not believe there is an estate in the island on which shade trees are grown. I have always been puzzled to know why in Trinidad cocoa cannot be grown without shade. The soil here is somewhat different to that in Grenada; it is a stronger soil and has more clay. Having regard to the value of cocoa cultivation, amounting to £900,000, and in view of the great difference between the yield here and in Grenada where we do not use shade, I think it would be advisable for the Imperial Department of Agriculture to carry out experiments in Trinidad with the view of finding out whether they cannot grow cocoa here, as we do in Grenada, without shade. With regard to the question of improving the health of trees, we use sheep manure. We raise sheep not for mutton, but for the manure which commands a very high price on the local market.

The PRESIDENT: There is one point of difference between the cocoa trees in Grenada and those in Trinidad. The trees in Grenada are much smaller and planted closer. The question is one of great importance—not for the Department—but for the planters of Trinidad. The Department will be happy to assist Trinidad in the same manner and to the same extent as the other islands. The wide question which Mr. Fawcett has brought up—whether as a general principle shade trees are necessary in cocoa cultivation, can only be answered by trying to find out whether in Jamaica they want shade trees at all, or want shelter belts. It would be useless to follow blindly the experience of Grenada and Trinidad, because the circumstances of the two places are so different from those of Jamaica. In Jamaica they are liable to hurricanes, whereas in Trinidad and Grenada they are not. I believe in Dominca and the Northern Islands they grow the Pois doux (*Inga dulcis.*)

Dr. H. A. A. NICHOLLS: They use it for shelter belts, not as a shade tree.

The PRESIDENT: I should like to ask Mr. deGannes what he regards as an average yield either per tree or per thousand trees in Trinidad?

Mr. J. G. DEGANNES: Twelve bags, of 170 lb. each, to each thousand trees planted 12 feet apart.

Mr. E. M. DEFREITAS: The average yield in Grenada is 4 bags, of 196 lb. each, per acre.

The PRESIDENT: So far, we have had no experience as to the relative values of Criollo and Forastero.

Mr. J. G. DEGANNES: Criollo was put aside altogether because the yield was poor: it is a delicate tree for Trinidad. I understand that even in Venezuela there are certain parts of the country where it does not thrive at all.

The PRESIDENT: Would it be any advantage to graft the Criollo on to the Forastero stock?

Mr. J. G. DEGANNES: It might be tested on a practical scale.

Mr. J. H. HART: Our experience with grafting is very small at present. The Forastero is the strongest-growing cocoa, but the Criollo produces a cocoa of the highest quality. The question of shade, I think, might be usefully gone into. I have discussed it many times and have come to the conclusion that shade is absolutely necessary for Trinidad. I am equally certain that shade is not necessary for Grenada. I have heard the story of a Grenada planter who came to Trinidad to teach the planters here how to grow cocoa without shade. He bought an estate and carried out the experiment by cutting down all the shade trees with the result that he had to replant them, as he found it impossible to grow cocoa here without shade. If ever you see a bad patch of cocoa here the planters' explanation is that the trees have not sufficient shade.

The PRESIDENT: I should like to suggest for the consideration of the Agricultural Society whether during next year they could put an acre of the Criollo variety of cocoa in cultivation. The results might be sufficiently reliable to justify an extension of it later on, or to abandon it altogether. I know Mr. Hart would be willing to join in an experiment of that sort, and it would be useful to the colony.

Dr. H. A. A. NICHOLLS: Mr. Hart has declared, *ex cathedra,* that cocoa cannot be grown in Trinidad without shade trees. I do not think the argument used by him fully warrants that declaration, because one can very well understand that cutting down shade trees from among cocoa trees brought up with shade, is very different to growing cocoa trees up to maturity and then cutting down the shade. The proper test as to whether cocoa can best be grown in Trinidad with or without shade, is to endeavour to grow cocoa with and without shade right from the seed. I do not think that has been done as yet in Trinidad.

Professor P. CARMODY (Trinidad): I would like to make a few remarks in connexion with this subject as I have given a little scientific attention to the shade tree used in Trinidad. Mr. deGannes, who is an experienced planter and works his estate himself, will tell you that cocoa cannot be grown in Trinidad without shade. It is natural to assume that when cocoa trees were first planted here no shade was tried, but it was subsequently resorted to in consequence of failure. It seems to me unreasonable to suppose that a man would begin to plant Immortel trees before he knew they were required and then plant cocoa. I incline to the opinion of Mr. Howell Jones, that the question of shade or no shade depends upon local circumstances. From analyses of the flowers of the Immortel tree made in 1901, I ascertained that some of them contained as much as 6 per cent, of nitrogen calculated on the *dry* flowers. This large percentage naturally attracted my attention and further investigation was made which led to a report to the Government

Mr. J. G. DEGANNES: About forty years ago a gentleman came here and started cocoa cultivation. His idea was that we were making a mistake in planting shade trees. He planted cocoa, raised with temporary shade, and then cut down the shade. When the shade was removed the cocoa trees stopped growing and he lost everything.

Dr. VAN HALL (Dutch Guiana): In the question of shade trees we are just in the same position as planters are here in Trinidad. There is a general idea that cocoa cannot be grown without shade in Surinam. There is only one estate where it is grown without shade. One thing of great importance with that estate is that it can be irrigated in the dry season. On other estates, where attempts have been made to grow cocoa without shade, the trees generally suffer very much when the dry season comes. In my opinion it is very difficult to grow cocoa without shade in Trinidad; when grown without shade it must be cultivated in another way. First your soil must be better tilled when no shade tree is used, because the shade tree is an improver of the soil and when you lose such an improver you must do yourself what is more or less done by the tree. Another thing planters do not understand is this: the shade tree is also a windbreak, and when you remove the shade you must take care that your trees are in sheltered position. Then the question of irrigation is, in our country also, a matter of importance. If you do not use shade trees and do not till your soil better, the soil suffers from drought in the dry season, and irrigation will be necessary to keep your cocoa trees alive. It is not necessary in plantations where there are shade trees. These and similar matters are often overlooked by planters who try to grow cocoa without shade. Another thing is this. As in our country, where the wet season is followed by three very dry months, you have to remove your shade trees not at once but gradually; and that is perhaps one reason why the experiments which some planters tried were unsuccessful. My Department is now trying an experiment with young trees. We have removed the shade from a field of about 2 acres, leaving some wind-breaks, and the first year, at any rate, this was a success, because, contrary to the expectation of many planters, when the dry season came, none of the trees suffered. In the second year, however, we had a very bad dry season and the trees suffered more or less. Yet planters were very astonished that they were still in good condition. It seems to me that once shade is properly removed, cocoa can be grown in Surinam without shade.

COCOA CULTIVATION AND GREEN DRESSING.

Dr. FRANCIS WATTS (Leeward Islands): The question of the treatment of orchard soils was brought up at the previous Conference, when I put forward views urging in substitution for excessive tillage and keeping the land clean in orchards, the adoption of a system of green dressing, or the use of weeds and shrubs for manures. This has all along existed in Dominica. The weeds are allowed to grow, and at intervals these are cut down without materially disturbing the surface soil; the cuttings are either used as a mulch, or they are treated as a green dressing and bedded in. The crop that has been found most useful so far appears to have been woolly pyrol. I have had some experiments made with other plants, but not to a very great extent. I have recently put forward some analyses which I believe will appear in the next issue of the *West India Bulletin* [Vol. V. pp. 287-8] showing the proportion of manurial constituents which may be returned to the soil on each cutting. This is very largely practised in Dominica, especially where it is shown that the amount returned is very considerable. I have had occasion at certain times to examine soils. I will take one case, namely, Frenches, where Mr. Scully follows this system of cultivation. Around each tree he keeps a space of about 10 feet perfectly free from weeds; the remainder of the land remains largely untilled; the weeds are cut down and either are left as a mulch to find their way into the soil, or are at once dug in. I think it would be wrong to allow the formation of anything approaching a permanent grass sod, and perhaps that is the point where I find the greatest conflict of opinion. I think all agree that the surface of the soil must be light, loose, and free—nothing like a definite grass sod. There are some places in Dominica where in cutting down into the soil, one finds the conditions of natural virgin soil: the condition of tilth is maintained thoroughly. The great point is draining. On that subject I may have more to say at a future period. In Dominica it is a recognised method of cultivation, a cheap one, and a very thorough one, and I think it would be found better in practice, and tend to solve some of those difficulties to which Mr. Fawcett has referred,* than keeping the soil absolutely clean. I have seen

[* W. Indian Bulletin, Vol. II., 1901, page 99. Bulletin of Department of Agriculture, Jamaica, Vol I., 1903, page 126. Editor Bull. Dept. Agri., Jamaica.]

many cases where attempts have been made to keep the land perfectly clean and where the highest perfection used to be the absence of every weed; but in most cases I think that has been found to be most disastrous; the soil bakes hard and then a system of forking has to be resorted to.

ARTIFICIAL DRYING OF COCOA.

The desirability of drying cocoa by artificial heat, thereby rendering the planter more or less independent of atmospheric conditions, has long been realised in the West Indies. During wet seasons and in certain elevated districts of some of the cocoa-producing islands considerable loss is frequently occasioned by 'mildew.'

Mr. G. Whitfield Smith, then Travelling Superintendent of the Imperial Department of Agriculture, gave a brief sketch in the *West Indian Bullitin* (Vol. II, pp. 171-4) of the efforts that had been made in Grenada to dry cocoa by artificial heat, and gave, also a description of a cocoa drier since erected by the Department at the Botanic Station, Dominica. A further description of this drier will be found in the *Agricultural News* (Vol. I, p. 19) where it is stated:—

'The essential feature of this drier is the arrangement by which the hot air, on entering the drying box, is conducted along an air-tight flue or channel, and *is compelled to pass over and around the trays in succession*, beginning with the lowest. In this respect it is a great improvement on driers of a similar pattern used in Grenada and elsewhere, which have no interior divisions. In such driers it is found that the hot air on entering the single drying chamber naturally rises to the top, with the result that the beans on the upper tray were too quickly dried, while those on the lower tiers were only partially dried or, in some cases, remained moist.

'The drier above described is capable of dealing with 5 bags of cocoa at a time, and its original cost, including shed, stove, and fan, was £127. Where, however, the planter is able to utilize a spare building in which to place the drying box and stove, the cost might be reduced by about one half.

'For the information of those desirous of erecting a similar drier, it may be mentioned that the fan (18 inches) with belt and driving wheel might be obtained from the Blackman Ventilating Company, Limited, Head Office, 63 Fore Street, London E.C., at a cost of £9 6s., and the stove (Motts' Comet No. 28) from the I. L. Mott Iron Works, New York and Chicago, at a cost of £10 17s. 3d. The latter is surrounded by a galvanized iron jacket to confine the hot air and to discharge it through the cowl into the drying box. The fuel may be wood, coke, or coal, as found most convenient.'

Subsequent trials have shown that cocoa can be dried within twenty-four hours of being placed in the drier without the fan being worked after 9 o'clock at night. The best results were obtained by maintaining a temperature of 110° to 120°F., with a good draught passing over the beans. Similar driers have been erected on private estates and have proved thoroughly successful. As many as 9 bags have been cured in twenty-four hours.

The members of the West Indian Agricultural Conference of 1905 had an opportunity of inspecting a patent cocoa-drying apparatus erected by Mr. Hoadley at Chaguanas, Trinidad. The following is a description of this drier:—

The cocoa-drying apparatus consists of an ordinary room 34 feet square, with 25 feet perforated circular drying floor, upon which cocoa is placed direct from the fermenting box. In the centre of the drying tray is a vertical axe from which project four arms which are revolved once in ten minutes. To each arm are attached six ploughs, the operations of which are equal to the work of twelve coolies in keeping the cocoa in constant motion. Hot air is generated by exhaust steam, which is passed into 1,100 feet of piping enclosed in a box, over which cold air is drawn by a powerful fan which makes from 600 to 700 revolutions per minute. The air in its passage becomes heated to any desired point up to 150° and is forced up through the drying floor. The machine will dry from 12 to 15 bags of cocoa in thirty to thirty-six hours. The cost of installing the system is said to be between £300 to £400.

After drying, the cocoa is passed through a machine which clays and polishes, or merely polishes to suit the markets, and thereby saves the costly process of dancing.

The cocoa is fermented in cylindrical drums, which are partially turned every night and morning for ten to eleven days.

COTTON.

I.*

By HON. T. H. SHARP.

Fungi and Insect Pests.

The Cercospora fungus is the only one that is to be found in every cotton field, but it only attains serious proportions when the conditions are favourable, such as during droughts when the plant is weak or on sour spots of land. I find that by my picking off the leaves badly affected and burning them and applying Bordeaux mixture I have been able to exterminate this disease. It does not attack the cotton bolls or stems as readily as the leaves and so when it makes its appearance on some weak spot I find that by cultivating and altering the favourable conditions for its development together with the treatment above mentioned, I am able to keep it in check.

As far as insect pests are concerned, the cotton worm is certainly very plentiful and represents about the most serious item to be dealt with. Fortunately it may be avoided to a large extent by planting at the correct time. The months that the worm gives most trouble are March, April, May, November and December: the best time to plant is from the 15th March to 15th April, and again from 15th August to 15th September. The trees will then

* These Notes (I & II) on Pests are published by direction of the Board of Agriculture.

be very young and small during the worm season and so can easily be hand picked and poisoned with Paris Green.

The Cotton Stainer (Dysdercus andreae) is found generally in all cotton fields more or less, but it does not seem to like cotton more than the surrounding vegetation. It is seldom that it is found in large quantities except in small areas. It does very little harm to Sea Island Cotton, whereas it seems to like the Upland Cotton more and stains it considerably. I have noticed this on a few trees which got into my Sea Island fields.

By laying down a few half rotten boards on the ground on the affected spots they act as a trap : early in the morning turn them over and apply hot water. By holding a small pan with a little Jeyes' fluid in it immediately under the cotton bolls, as they first open, while the insects are eating the vegetable wax, and shaking the boll over the pan, two children in one day will clean out any affected spot. I attach very little importance to this pest as the means for destroying it are very cheap and ready at hand.

But the cotton worm is a serious matter and information is badly required as to its life history and best modes of treatment at its different stages.

Time of Planting

There is such a marked difference in the quality of the Sea Island Cotton which is planted and reaped in the proper months, against that planted out of season, that is quite astonishing, and I think that we should do all in our power to impress this on the community. I planted twenty acres in December and January : it fruited heavily : the dry weather in February and March brought it to the ripe stage prematurely and the showers in April caused the sap to flow into the bolls. This created a tendency to germinate with the result that I had to cut down the twenty acres.

It would seem to me that the planting of cotton should be done as nearly as possible at the same time that corn is best planted.

II.

By S. STRICKER.

I beg to report that the pests that did the most damage to the experimental fields of cotton grown on this estate, were the Cotton and Cut worms.

Cotton Worms—I say cotton worms for there were several varieties but chiefly the usual green cotton worm, and a larger caterpiller covered thickly with black hairs and with a red head. I found the moth of the cotton worms, described in the A. B. C. of Cotton Planting, also a yellow moth, a pink moth with white spots, and a pure white moth. There were others but not as numerous as those mentioned.

The field had to be carefully watched for entire invasion, after showers of rain, and invasion of patches of the field, after the plants were fully matured, too. In practice, I found that sprinkling with Paris Green suspended in water was ineffective, for the reason that the under surfaces of the leaves could not be reached by the spray, and that plants so treated would have to be powdered during the same week. The Department of Agriculture may be in a position to suggest a way of applying a solution of Paris Green in an effective manner, by a suitable machine. Powdering on Paris Green is at best a wasteful process, as the high winds prevalent on this seaboard soon blow it off the leaves.

Cut Worms—The cut worms also did considerable damage. Plants 18 inches high and in flower were in many instances ringed below earth surface by two chocolate coloured worms, one 1½ ins. long, striped longitudinally with dark lines, and the other ringed laterally with rings of a lighter shade of the same colour, but of larger bulk of body than the other. Mr. Fawcett, Director of Public Gardens and Plantations, advised me to use a mixture of Paris Green and Cornflour* at the roots of the plants. This proved very effective in destroying these worms. The young plants were also attacked when they were about 9 inches high by a light green cut worm about 1 inch long. An application of Paris Green and Lime was made at the roots, which also was of use in destroying this pest, but the lime caked after a shower.

It would be impossible to grow cotton on this place without the free use of Paris Green, yet a mile and a half nearer the sea the villagers have succeeded in doing so without the use of any insecticide. The moths seek the grasses and leguminous plants that thrive along the intervals of the property for their breeding ground. The village is surrounded by woods that do not provide food for the newly hatched caterpillars.

Canes planted in Fall and Spring, especially the Spring, are attacked after the rains, when the leaves are tender, by these worms, and very often denuded of leaves. It is imperative that not the fields only but all the intervals must be kept free of grasses and plants that provide breeding places for moths and food for caterpillars.

Stainer Bugs—Leeward Islands variety with white X and black dots are described in the A. B. C. of Cotton Growing. These appeared in large numbers as soon as the cotton bolls were formed, made colonies at the roots of the plants, but did not damage the lint to any appreciable extent. I tried to get rid of them by putting in a gang to gather them into buckets in which kerosene oil was floated on water. This was of no use, the colonies being too strong, and the cotton having burst, the kerosene spray could not be used.

Aphis—There were not many to be seen. This district is well provided with red lady-birds which made short work of them.

Leaf Spot—This was observed in December on the lower leaves but it had to be looked for. The upper leaves, in fact the foliage of the field, was very luxuriant and vigorous.

No other disease was apparent, such as are mentioned in the Commissioner's letter. Bolls came to maturity without being affected with "Rot" or "Pink spot" and burst well.

* 1 part Paris Green to 30lbs cornflour

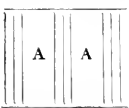
This experimental field, of 45 acres, gave 730lbs seed cotton per acre, of excellent lint, and would have given a better return if the plants were put in less space (15 square feet) as other experiments, made in this parish, have proved.

Both Seabrook's and River's varieties of Sea Island Cotton were planted. The Stainer Bugs frequented the Seabrook's plants more than they did the River's, and stained the former more than the latter.

I forward you some Stainer Bugs, and will collect and accurately describe the moths and caterpillars later on in the year.

NOTE BY DR. COUSINS.

I am convinced that Paris Green would be far more effective where it is not possible to apply it in powder owing to the breeze and the dry foliage of the plants preventing its adherence, if a proper spraying outfit were employed. I suggest a 40-gallon barrel machine drawn by a mule with one man to work the pump and two leads so that two rows could be sprayed at once. It might be well to plant every fourth row half as wide again as the rest to allow free room for the machine to go up and down in the intervals and permit of the underside of the foliage being thoroughly sprayed with a double cyclone nozzle.



A = Interval.

H. H. COUSINS.
5.6.05.

NOTE BY EDITOR.

No danger from the cotton worm is to be feared, if some one is sent through the fields at day dawn every second day, whose duty it is, as soon as the spots eaten out by the young worm are noticed, to shake a bag containing dry Paris Green over the plant attacked. If applied before the worm has grown longer than a quarter of an inch, Paris Green is quite effective, but it is wasted if applied at a later period of its growth, or on plants that are not attacked. In the other West Indian Islands lime is mixed in the proportion of 6lbs. to 1lb. with the Paris Green ; but the lime is not of any use except as evidence of dusting over the plant, and has been discontinued in the Sea Islands of S. Carolina. It has been suggested that a small reward might be given in addition to the ordinary pay for each discovery of an attack. For method of application of Paris Green, see letter from the Cotton Expert, Mr. Wm. B. Seabrook, Bulletin of Department of Agriculture, Vol. II. July, 1904, page 159.

III.

EXPENDITURE AND RECEIPTS.

The following figures of cost of cultivation and receipts *per acre* should encourage planters to try cotton wherever conditions are suitable. The figures are taken from actual accounts kindly supplied by the planter. No account is taken of value of land, stock, and other expenses.

Cultivation :—	£	s.	d.	£	s.	d.
Stumping land ...	0	2	8½			
Close and cross-ploughing ...	0	9	6¾			
Breaking clods ...	0	0	8			
Harrowing ...	0	0	11¼			
Opening rows ...	0	1	5¼			
Planting ...	0	9	6½			
Seeds* ...	0	6	8¾			
Trenching ...	0	4	11			
Cleaning and cultivating with ploughs * ...	1	6	5			
Irrigation ...	0	1	1			
Applying Paris Green ...	0	3	2½			
Purchase of Paris Green ...	0	9	6½			
" " Lime ...	0	0	8½	3	17	5½
Harvesting :—						
Picking, cleaning, drying and bagging cotton ...	1	11	6			
Cartage ...	0	4	6¼			
Bags and calico ...	0	2	3	1	18	3¼
				5	15	8¾
Receipts :—						
By cotton, 32,500 lbs., from 45 acres sold as seed-cotton ...	387	18	3½	8	12	4¾

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The monthly meeting of the Board of Agriculture was held at Head Quarter House on the 11th July at 11.15 a.m., the following members being present: the Hon. the Colonial Secretary, Chairman, the Director of Public Gardens and Plantations, the Agricultural Chemist, Messrs. C. A. T. Fursdon, Geo. D. Murray and W. Harris, acting Secretary.

Annual Reports—The Report on the work of the Board, and the Report of the Director of Public Gardens and Plantations for the year ended 31st March, 1905 were brought up for consideration, and it was agreed that the portions of the Director's Report dealing with educational and experimental work should be incorporated in the Report on the work of the Board,—taking the Director's Report of the Board for 1902-03 as a model.

Visit of Sir D. Morris—The Asst. Colonial Secretary wrote informing the Board that Sir D. Morris has intimated that it would be more convenient for him to arrive in Jamaica about the end of July, and that he hopes to spend the greater part of August in the

* Cost acknowledged by planter to be excessive.

island and meet the members of the Board at such time as may be convenient after his arrival.

Letters from Schools' Commission—The Secretary of the Schools Commission wrote (1) acknowledging receipt of a copy of Dr. Cousin's minute of the 2nd May, and asking for fuller information on the subject, and (2) acknowledging receipt of letter informing the Commission in regard to fees to be paid by boys from Secondary Schools attending lectures in Agricultural Science at the Government Laboratory.

Reports on Tobacco at Hope—The Reports of Mr. Fornaris, and Mr. F. V. Chalmers on tobacco grown at Hope were considered. The Board decided to ask the Government for a further grant of £25 to continue the experiment under shade.

It was also decided that the Board should render every assistance possible to any persons who intend to go in for the cultivation of wrapper-leaf tobacco.

Letter from Mr. Cradwick re his acting as Secretary at Shows—Mr. Cradwick wrote asking the Board to re-consider the question of his undertaking secretarial and other duties in connexion with local agricultural shows, and pointing out that all the help that can be given is needed to keep up an interest in these shows.

The Board decided to abide by its decision already communicated to Mr. Cradwick, viz. that "he may assist in his capacity as Travelling Instructor in persuading the people in the districts in which agricultural shows are to be held to take an interest in such shows, but it objects to his undertaking secretarial or other duties which were not within the scope of his work as a Travelling Agricultural Instructor."

Proposed Pamphlet on School Gardens, and Pamphlet on School Gardens from the U. S. Department of Agriculture—The draft of a pamphlet on School Gardens, prepared by Mr. W. M. Cunningham, and one from the U. S. Dept. of Agriculture were brought up, and it was decided to refer them, with the accompanying minutes, to the acting Superintending Inspector of Schools for his opinion.

Improvement of Jamaica Rums—A confidential report on the subject of the improvement of Jamaica Rums, drawn up by the Chemist and addressed to the Government, was referred to the Board for its opinion and advice. After some discussion further consideration of the matter was deferred to next meeting.

Reports, &c.—The following Reports, &c. were presented and ordered to be circulated.

From the Director of Public Gardens and Plantations:—

1. Mr. Cradwick's Reports (2)
2. Mr. Cradwick's proposed Itinerary to the 14th November next.
3. Mr. Thompson's Reports (4)
4. Mr. Thompson's Itinerary for July and August.
5. Report on Hope Experiment Station.

From the Agricultural Chemist :—

1. Report on Sugar Canes at the Experiment Station.
2. Report by the Supt. of Sugar Experiments.

Plan of Experiment Station.—The Director of Public Gardens and Plantations presented a plan showing the position of the various plots at the Hope Experiment Station, and asked for authority to have a block prepared so that the plan may be printed in the Bulletin.

This was approved, the cost of preparing the block to be charged against the vote for Petty Expenses of the Board.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 15th August, 1905. Present :—Hon. H. Clarence Bourne, Colonial Secretary, Chairman; Sir Daniel Morris, Imperial Commissioner of Agriculture for West Indies, the Director of Public Gardens and Plantations, the Agricultural Chemist, Hon. T. H. Sharp, Mr. G. D. Murray, and the Secretary, John Barclay.

Letters from the Colonial Secretary's Office were read as follows :—

(*a*) *Shade Tobacco*—Report from Mr. F. V. Chalmers on samples of Tobacco grown at Hope. (This Report is published in the Gazette, and the Bulletin.) Approving of the expenditure of £25 for providing new shade cloth required for continuing the experiments of growing tobacco under shade at Hope, provided the total vote for the year was not thereby exceeded by more than £10. The Board resolved to recommend that the expenditure be paid from re-imbursements from sales of tobacco, and the Director of Public Gardens was asked to communicate direct with the Colonial Secretary.

(*b*) *Sugar Experiment Committee*—Advising that Mr. W. A. S. Vickers had been asked to represent the Westmoreland Sugar Planters Association on the Sugar Experiment Committee and that Mr. G. D. Murray, Vere, had been appointed to be a member on the Committee.

(*c*) *Industrial School*—Advising that the proposal to transfer the inmates of Hope Industrial School to Stony Hill could not be made under present conditions.

(*d*) *Jamaica Scholarship and Agriculture*—Advising that the suggestion to utilise the Jamaica Scholarship for the encouragement of Agriculture would be considered by the Jamaica Schools Commission as soon as that body obtained certain details for which they had applied to the Board.

Mr. Nolan and Rum—A letter from Mr. J. C. Nolan, Special Commissioner re the Rum Industry in England, announcing that his first case was then under the consideration of the Board of Trade, was submitted.

Vegetable Growing—A letter was submitted from the Hon. H. Cork that instructions should be given to the Local Agricultural

Instructors to induce special efforts to be made in the neighbourhood of the largest towns for the growing of vegetables.

The matter was left to be dealt with by the Agricultural Society, as it was understood it was to be considered by that body.

Reports from the Director of Public Gardens—Reports from the Director of Public Gardens were submitted as follows :—

a. Experiment Station.

b. Statement of cost of Tobacco grown at Hope.

c. Instructors' Reports.—These were directed to be circulated.

d. Pamphlet on School Gardens with criticism by the Acting Inspector of Schools.

School Gardens—It was resolved that Mr. Williams' offer to help in the getting up of a general outline which could then be submitted for revision and the addition of local colour by Agricultural Experts, should be accepted.

Reports Chemist—The following Reports from the Chemist were submitted :—

a. Preliminary Report on Manurial Experiments and memo., asking for increase of travelling allowance for the Superintendent of Sugar Experiments owing to the extension of his work and suggesting that the saving of £50 made on the salary of Mr. Murray when he was appointed be transferred to increase his travelling allowance. This was agreed to.

b. Vacancy on Distillers' Course, asking that the vacancy caused by the inability of Mr. Stewart of Green Park to attend be given to Mr. Percy Sewell. This was agreed to.

c. Application of Mr. Geo. Taylor of Long Pond to shorten his course so that he could leave at the end of the week because of pressing estate business. This was allowed.

d. Re visit to Locked Still by Distillers, asking that the expenses of the 10 Distillers to visit the Locked Still at Denbigh be paid out of the travelling allowance of the Chemist and staff. This was approved if the vote was not exceeded.

e. Application for four Laboratory apprentices payable at the rate of 4/ per week and quarters at Hope to be paid from the vote of apprentices on the Director of Public Gardens' estimates.

The Board decided that this could not be sanctioned as the money saved from the reduction of the Hope apprentices had been settled by its appropriation for extra hired labour.

The Chemist then asked if the Board would approve on general principles of his having four apprentices to be renewed as they were absorbed in his Laboratory staff and that the Government be asked to make a special grant for the purpose of £26. This was agreed to.

f. Resignation of Assistant Chemist stating that a memo had been submitted to the Government with suggestions for filling the vacancy.

g. Stating that His Excellency had granted Mr. C. Allan, Fermentation Chemist, three months' leave on three-quarter pay from September to November inclusive.

h. Report on the work of the Students for summer term 1905.

i. Progress Report Sugar Experiment Station.

a. h. & i. were directed to be circulated.

The following papers which had been circulated were now submitted for final consideration :—

Resolution *re* Mr. Nolan.

Memo *re* analyses of samples of rum and papers *re* production of rum in the United Kingdom and the following resolution was proposed by Mr. Sharp seconded by Mr. Murray : "It is the opinion of this Board that it is undesirable that Mr. Nolan should continue prosecutions in the United Kingdom in the interests of the Rum Industry, pending further information from the investigations being made here."

This was agreed to.

Report on Canes at Hope and Report of the Superintendent's visit to St. James and Hanover.

Report on Rubber Trees—Mr. Sharp said that Mr. Thompson had also visited Rubber trees which he had grown at Angels and he wished to state that he would give every opportunity to the Director of Public Gardens and his officers to experiment with these trees, but he wished to be present when the visits were made.

Asst. Superintendent at Hope—Papers re vacancy at Hope.

After discussion it was resolved to recommend the appointment of Mr. N. A. Rudolf of Hampstead.

Insect Pests on Cotton—Mr. Sharp said he desired to bring up an important matter and that was the employment of an entomologist for investigation into the matter of insect pests on Cotton and Cassava.

It was resolved to form a Committee consisting of Messrs. Sharp, Fawcett and Cousins to investigate the matter of combating insect pests.

Agricultural Conference—Sir Daniel Morris said that he was arranging to hold the Agricultural Conference of the West Indies in Jamaica during January of next year and he asked that two members of the Board be chosen as representatives on an Agricultural Conference Committee which would also have representatives from the Agricultural Society.

It was agreed that the Chairman and Mr. Fawcett should act on the Committee on behalf of the Board.

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BULLETIN

OF THE

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Vol. III. OCTOBER, 1905. Part 10.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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KINGSTON, JAMAICA:
HOPE GARDENS.

1905.

JAMAICA.

BULLETIN

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JAMAICAN FODDERS.—II.

By H. H. COUSINS, Island Chemist.

In continuation of the first article on the fodders of Jamaica* a report is now presented of results since obtained at the Government Laboratory in the study of our local food products.

HAY GRASS. (*Sporobolus indicus.*)

Samples of this grass were obtained from the Hope Experiment Station after 2 and 4 weeks growth respectively and the following analytical results obtained :—

HAY GRASS FROM ST. ANDREW.

Constituents.	Air dry.		Dried @ 100°C.	
	2 weeks.	4 weeks.	2 weeks.	4 weeks.
Moisture ...	29·10	14·83	...	...
Fat and wax ...	1·10	0·58	1·55	0·68
Albuminoids ...	7·19	5·06	10·14	5·94
Amides ...	1·25	1·07	1·76	1·26
Total nitrogenous substance	8·44	6·13	11·90	7·20
Carbohydrates ...	31·85	41·15	44·93	48·29
Crude Fibre ...	21·62	27·62	30·49	32·43
Ash ...	7·89	9·72	11·13	11·41
Potash ...	...	...	2·06	1·02
Lime ...	...	...	0·83	0·81
Phosphoric acid ...	...	...	0·74	0·75

When quite young this grass presents a very favourable composition, particularly as regards albuminoids. The difference between 10 per cent of albuminoids in the dry matter at 2 weeks and 6 per cent at 4 weeks is very striking.

* Bulletin of the Department of Agriculture, Jamaica, Nov. 1903, p 241.

Experience fortifies the view that this grass when young and succulent is a first class fodder for all kinds of stock.

Horses fed upon hay made from young hay grass develop the condition associated with the feeding of good American Timothy hay. As soon as the grass gets old, hard and wiry its feeding value is very greatly reduced.

There are large areas of hay-grass lands which are largely wasted owing to the fact that the grass is only really nutritious when young and simple grazing is not adequate to make the best use of the grass. If these grass-lands were mown for hay at a favourable stage of growth an enormous amount of valuable fodder could be obtained from lands at present of very poor quality as regular grazing land. One of the light American horse mowers should save its cost very speedily upon many a dry-weather pen in such a district as St. Andrew if judiciously employed in the production of hay from young hay grass.

GUINEA GRASS—(*Panicum maximum.*)

The following results are recorded to emphasize two important points connected with the agricultural value of guinea grass, viz: the high feeding value of the coarse guinea grass found in many parts of the island when cut at the right time and secondly the great deterioration arising from the seeding of the grass. Sample No. 1 represents the wild growth of guinea grass that has sprung up spontaneously in the laboratory grounds as a result of cutting down the brushwood, this grass was cut when the flowering spikes were just being produced; sample No. 2 represents guinea grass as fed to a dairy herd in St. Andrew when the grass was actually seeding :—

GUINEA GRASS.

Constituents.	Air Dry.		Dried @ 100°C.	
	No. 1.	No. 2.	No. 1.	No. 2.
Moisture ...	13·87	18·26	...	...
Fat and wax ...	0·26	0·41	0·30	0·50
Albuminoids ...	5·13	2·00	5·96	2·45
Amides ..	2·87	0·28	3·33	0·34
Total nitrogenous matter ...	8·00	2·28	9·29	2·79
Carbohydrates ...	34·21	25·03	39·72	30·62
Crude fibre ...	34·11	43·43	39·60	53·13
Ash ...	9·55	10·59	11·09	12·96
Potash ...	...	...	3·57	0·80
Lime ...	...	...	0·79	0·79
Phosphoric acid ...	...	...	0·37	0·76

It has been commonly accepted as a fact that the coarse or "St. Mary's" variety of Guinea grass was greatly inferior to the fine grass as grown in St. Ann and other stock-raising parishes. These figures show that if the coarse grass be harvested just before flowering it is of very high feeding value. To illustrate this point a comparison of the nitrogenous constituents and fibre in the samples previously reported upon (loc. cit.) is here made.

Source of Grass.	Amides.	Albuminoids.	Total Nitrogenous substance.	Fibre.
St. Mary .	0·61	3·47	4·08	36·86
St. Ann .	2·50	5·44	7·94	40·28
Hanover .	1·95	4·93	6·88	39·87
Westmoreland .	0·54	5·08	5·62	42·17
Manchester .	1·22	3·81	5·03	40·70
Government Laboratory St. Andrew .	3·33	5·96	9·29	39·60

It is indeed surprising that the coarse grass of St. Andrew as growing wild in the Laboratory grounds should prove itself superior on analysis to the other samples of guinea grass grown in the island.

Hay made from grass of this quality compares quite favourably with Timothy hay and is a valuable fodder.

If, however, the grass be not cut at the right stage but is allowed to flower and form seeds, a remarkable deterioration sets in and the value of the fodder is reduced to about one third.

It is obvious that in dry districts like St. Andrew where guinea grass will not stand close grazing by stock that it is of the highest importance to make the surplus crop of guinea grass into hay before it seeds. The writer has had most encouraging results from this practice and the analytical figures given above throw light upon the matter.

BREADNUT FODDER (*Brosimum Alicastrum.*)

An analysis of this valuable fodder from St. Ann was published in the previous article (loc. cit.) Mr. W. Cradwick of the Agricultural Department kindly supplied a sample from an upland pen in Westmoreland. The composition of this sample corresponds fairly closely with the previous one and confirms the valuable character of this fodder.

BREADNUT FODDER, *Westmoreland.*

Fat and wax	...	3·64
Albuminoids	...	10·50
Amides	...	3·01
Total Nitrogenous substance	...	13·51
Carbohydrates	...	47.33
Crude Fibre	...	27.46
Ash	.	8·06
Potash	...	3·74
Lime	...	4·02
Phosphoric Acid	...	0·30

BAMBOO FODDER. (*Bambusa vulgaris.*)

A sample of this fodder was sent by a planter in St. James with a statement that he had found it very valuable in times of scarcity.

The analysis is as follows:—

Constituents	Air Dry.	Dried at 100° C.
Moisture	13·26	—
Fat and wax	0·41	0·47
Albuminoids	13·31	15·34
Amides	3·13	3·61
Total Nitrogenous Substance	16·44	18·95
Carbohydrates	30·21	34·84
Crude Fibre	25·00	28·82
Ash	14·68	16·92
Potash	—	1·39
Lime	—	0·84
Phosphoric Acid	—	0·17

These figures indicate that Bamboo fodder is a highly nitrogenous material. The amount of mineral matter is rather excessive, but in other respects the composition is that of a valuable fodder.

Note by Mr. J. Barclay on bamboo fodder.

"The leaves of bamboo are eaten with relish by horses and cows and they thrive well on them as a portion of their diet.

"I have no specific experience as to the results on cows, that is to what extent, as compared with other fodders, bamboo leaves make flesh or produce milk. I only know that where through several months of dry weather they formed the larger part of the food of cows, there was no apparent difference as when the animals had abundance of grass to feed on. Clumps of bamboo had been cut down and had sprung up again, providing dense masses of foliage for feeding stock. As regards horses, bamboo is spoken of locally as a 'hard' food, that is, a food that make horses hard, able to stand hard work better than the more succulent grasses. My experience would tend to confirm this.

"Of course bamboos are generally grown along riversides or grown to shade ponds, and are not often found growing through pastures. They are, however, a good stand-by in drought when stock-owners are short of grass."

These analyses are the work of Mr. H. S. Hammond, F.C.S., assistant Chemist, and although the study of Jamaican fodders is by no means complete, owing to Mr. Hammond's resignation of his appointment, it was considered desirable to publish the work so far as he had been able to carry it. We wish Mr. Hammond every success in his new sphere and regret that the laboratory has lost his valuable services.

CORNS.

Maize. (*Zea Mays.*)

A special study of the composition of country corn as compared with the imported American corn has been made by Mr. E. J. Wortley of this department and the results of his analyses are here given. The outstanding features of this investigation are (1) the great superiority of country corn over the imported corn as a source of albuminoids and (2) the excessive amount of moisture in the country corn. Calculated on a uniform basis of 12 per cent. moisture, country corn shows a content of over 10 per cent. of albuminoids as against a little over 7 per cent. in the imported article.

The prejudice against country corn among horsekeepers has arisen simply from the excessive moisture and the liability of such corn to ferment and give horses colic. If properly dried our native product is decidedly superior to the imported corn. To secure immunity from fermentation corn should be dried to a content of 12–13 per cent. of moisture. This was attained with the corn at the Experiment Station at Hope by drying for 12 days.

Guinea corn. (Sorghum vulgare.)

The analysis of this corn shows that it contains 12 per cent. of albuminoids and is decidedly superior to any sample of maize in the list.

In olden days guinea corn was an important staple and formed one of the chief foods of both man and beast in Jamaica. It is of interest to record so favourable a composition for a crop grown with such simple culture and capable of such good returns in dry districts.

Corns

No.	Variety.	Where grown.	Details.	Moisture.	Ash.	Total Nitrogen.	Albuminoids. N x 6·25.	Fat o/o.	Fibre o/o.	Albuminoids on basis 12 o/o water.
1	Guinea corn ...	St. Andrew	—	10 99	1·64	1·93	11·96	4·56	1·36	—
2	Country corn ...	Bought	Kingston	12·46	1·38	1·68	10·50	4·52	0·93	10·6
3	Imported corn ...	"	"	11·97	1·23	1·15	7·11	4·24	1·21	7·2
4	Country corn ...	St. Ann	Uncured	20·08	1·24	1·50	9·37	3·34	1·21	10·3
5	Ditto ...	do.	Average sample	12·79	1·25	1·60	10·00	3·81	0·93	10·1
6	Ditto ...	do.	Light coloured—selected grains	12·81	1·26	1·67	10·44	4·54	1·36	10·5
7	Ditto ...	do.	Dark coloured—selected grains	13·31	1·18	1·64	10·25	3·66	1·31	10·4
8	Ditto ...	d0.	Not properly cured or dried—small grains	14·95	13.2	1·58	9·87	4 00	1·17	10·2
9	Ditto ...	Manchester	Sold in Kingston not properly cured	16·70	1·28	1·55	9·69	4 53	1·21	10·2
10	Ditto ...	Hope Gardens	Dried 6 days on cob	15·26	1·39	1·54	9·62	4.79	1·33	10·0
11	Ditto ...	do.	Dried 12 days on cob	12·71	1·21	1·57	9·82	4·83	1·86	9.9

THE COFFEE MARKET.

The attention of coffee planters is directed to the fact that the rate of exchange with Brazil has gone up in 9 months from July, 1904, to April, 1905, from 12d. to 17d per milreis.

The result must be to increase the cost, reckoned in sterling money, of growing coffee in Brazil. This would naturally make it less easy to sell at low prices and tend to reduce production, which again should enhance prices of coffee the world over.

Planters in Jamaica should therefore extend the area of coffee cultivation. Coffee planted now cannot come in for four or five years, and by that time the increased consumption which has been promoted by the long prevalence of low prices, added to the possible, if not probable, diminution of supplies from South America, may combine to make the crop once more a very profitable one. At any rate it is not likely to be under any greater disadvantage than at present, and it is not subject to great loss by hurricanes.

The following information on the subject will be read with interest:—

Mr. R. S. Gamble, to Director of Public Gardens and Plantations.

Kingston Jamaica, 11th August, 1905.

SIR,

Referring to our recent conversation, I have now the pleasure to enclose a statement prepared by Messrs. Gillespie, Bros. & Co., New York, showing the statistical movement of coffee during the last eleven years, including prices of "Rio No. 7" which is a representative standard, and the Brazilian exchange.

You will particularly observe that the world's consumption has been steadily growing all the time, and is now 50 o/o more than it was in 1894-5.

It will also be observed that the Brazilian exchange, which went as low as 5-11/16 in 1898 is now somewhere about 17-3/18, and that a high exchange has generally involved higher prices for coffee, though this effect is not always immediate as it naturally comes about by a decreased output from Brazil, which for a time may depend on other considerations than mere cost of production. The latter, however, is bound to tell eventually, and it is only natural to suppose that the reduction in the Brazilian exports, which has been continuous since 1901-2, will be forced further by the advance in exchange. In 1904-5 it was about 33 per cent. less than in 1901-2.

This points to a more encouraging outlook for coffee, but it remains to be seen if the advance will be gradual and safe or unnaturally forced and but short-lived. As these are the months when large deliveries are usual, let us hope that it may be moderate and so fail to stimulate excessive further planting in Brazil.

I also submit a copy of the latest market report from my New York principals, which contains some interesting matter in this connection.

I am, etc.,

R. S. GAMBLE.

COFFEE STATISTICS.

July 1st to June 30th.	Coffee: Rio and Santos.	Coffee: other sources.	Coffee: total.	Total deliveries.	Prices of Rio "No. 7."	Brazilian Exchange.
1894–5 ...	6,695,000	5,164,376	11,859,376	11,212,851	High $16\frac{3}{4}$ c. Mch. '95 ... Low 15c. Oct. '94 ..	September, '94, $12\frac{1}{2}$d. May, '95, 9 1/16d.
1895–6 ...	5,476,000	5,390,442	10,866,442	11,142,813	High $16\frac{1}{4}$c Aug. '95 ... Low 13c. July '95 ...	July, '95, $11\frac{1}{4}$d. March, '96, $8\frac{1}{4}$d.
1896–7 ...	8,680,000	4,628,891	13,308,891	12,244,204	High 13c. July '96 ... Low $7\frac{1}{4}$c. April, '96 ...	July, '96, $9\frac{3}{8}$d. March, '97, 7 9/16d.
1897–8 ..	10,462,000	5,523,996	15,985,996	14,571,902	High $7\frac{3}{8}$c. July, '97 ... Low $5\frac{1}{2}$c. March, '98 ...	August, '97, 8 3/16d. May, '98, 5 11/16d.
1898–9 ...	8,771,000	5,385,943	14,156,943	13,480,904	High 7c. Dec., '98 ... Low $5\frac{3}{4}$c. Oct., '98 ...	November, '98, 8 29/32d. March, '99, $6\frac{3}{4}$d.
1899–0 ...	8,959,000	5,795,747	14,754,747	14,972,699	High 8 15/16c. Feb. 1900 ... Low 5 7/16c. Sep. '99 ...	September, '99, 7 29/32d. June, 1900, 10 31/32d.
1900–1 ...	10,927,000	3,662,491	14,699,491	14,329,925	High 8 15/16c. July, 1900 ... Low 6c. April, '01 ...	July, 1900, $14\frac{1}{2}$d. September, '01, $9\frac{3}{4}$d.
1901–2 ...	15,439,000	3,574,267	19,013,367	15,516,663	High $7\frac{1}{2}$c. Nov., '01 ... Low $5\frac{1}{4}$c. Jan., '02 ...	July, '01, 9 23/32d. December, '01, 12 23/32d.
1902–3 ...	12,324,000	4,555,840	16,887,840	15,966,498	High 6c. Aug., '02 ... Low 5 1/16c. June, '03 ...	February, 02, 11 21/32d. May, '03, 13 23/32d.
1903–4 ...	10,408,000	6,644,828	17,052,828	16,133,707	High $9\frac{1}{8}$c. Feb. '04 ... Low $5\frac{1}{8}$c. July, '03 ...	November, '03, 11 27/32d. February, '04, 12 17/32d.
1904–5 ...	9,968,000	5,476,265	15,444,265	16,163,353	High 8 15/16c. Jan., '05 . Low $7\frac{1}{8}$c. July, '04 ...	July, '04, 12d. April, '05, 17d.

The most salient point about the above statistics is, in the main, that a high rate of exchange has meant a high price for coffee. The apparent exception in 1900-1 when the coffee quotations did not rise in proportion to the rise in exchange was due to the fact that the latter was caused by speculation, not in coffee, but in exchange itself. The present rise in exchange is attributed to the confidence inspired by the improved state of the country, and consequent investment of foreign capital. The government has also for the past few years been withdrawing the paper currency from circulation. The principal result of a high exchange is that the "Milreis" price received by the planters is reduced and that with his cost of production remaining constant, he must reduce his output of coffee. A particularly fine crop of coffee however would depress prices, even though the rate of exchange were on a higher level than at present.

It is also noticeable, however, that while consumption has been satisfactorily increasing, production has been falling away from the high point of 1901-2, and this, quite apart from the exchange question, is encouraging to the producers of coffee.

The following is from Messrs. Gillespie's fortnightly market report of same date :—

Coffee.—The activity of the coffee market is still pronounced, though a large part of the sales reported are in reality only speculative transfers from, say, September options to December, or later. The receipts reported from the interior of Brazil are, however, on a smaller scale than is usual at this season of the year, and the "bulls" are busy with reports of a large decrease in the total crop. They are helped in their arguments by the present high rate of Brazilian exchange, which is now in the neighbourhood of $17\frac{3}{8}$d. This is always expected to send up the price of coffee, as with a high exchange the expenses of cultivation become heavier and the tendency is to curtail production. The quotation for No. 7 Rio to-day is $8\frac{1}{2}$c. per lb., and the tendency is toward higher prices, though traders would in most cases prefer to see the new crop open at a lower figure. Mild coffees are firmly held, and a considerable business has been done lately. Good average Bogota has been sold at from $11\frac{1}{4}$c. to $11\frac{1}{2}$c. per lb., and good Cucutas are quoted at from $9\frac{3}{8}$c. to $9\frac{1}{2}$c. per lb. The supplies of Jamaica coffee are practically unimportant, and, in the absence of sales, quotations are nominal. Good ordinary Jamaica coffee is probably worth from $8\frac{1}{2}$c. to 9c. per lb., better grades up to 11c. per lb., according to quality.

Our London house cables us to-day the spot quotations : For fair ordinary Jamaica coffee 41/ per cwt., market firm ; for good ordinary greenish Jamaica coffee 44/ per cwt., market firm and the c. i. f. Havre quotation for fair ordinary Jamaica coffee 42/ per cwt., market firm.

CASSAVA TRIALS IN 1905, II.

By H. H. COUSINS, Island Chemist.

In continuation of the report published in this Bulletin* the results of the Varietal test of the 22 Cassavas at Hope after fifteen months' growth are now presented. Besides the tonnage of tubers per acre, the composition and the indicated starch per acre, a statement is given of the increase (or decrease) in tubers and of starch per acre resulting from the 3 months' growth since the first results were obtained. The results are very encouraging for the Cassava industry and indicate that the gross yield of starch per acre obtainable in Jamaica is far beyond the estimate previously accepted by the writer as a basis for considering the commercial possibilities of the starch industry.

In these trials the variety that was second in the order of starch yield at 12 months now leads by a large margin and "Long Leaf Blue Bud" heads the list both in tonnage and in starch content. This cassava has given 15½ tons of tubers per acre containing 37½ per cent. of starch equal to 12,857 lbs. starch per acre (6 tons.) The 3 months' extra growth has enabled the plant to make nearly 5,000 lbs. more starch per acre. On the other hand "White Top" the variety from St. Elizabeth that led at 12 months, has only added half a ton per acre and a slight *loss* of starch is indicated as a result of leaving the plant for another 3 months Clearly this is a variety that should be harvested at 12 months and will not give profitable returns for a longer season of growth.

"Blue Top" has proved itself a good variety and comes second with an indicated starch yield of 9,733 lbs. per acre.

The Manchester Cassavas "Mass Jack," "New Green," and "Yellow Belly" have proved themselves quite worthless as starch producers at Hope. "Brown Stick" made the greatest gain of any variety in the 3 months (over 8 tons per acre) and it is possible that in the final reaping of the plots at 18 months' growth that this well-known variety will hold a higher position.

These results indicate that Cassava varieties differ very greatly in their productive power and period of maturation and, considering the extreme variety of our local conditions, it is very desirable to carry out careful trials in all the Cassava districts.

We can recommend "Long Leaf Blue Bud" and "Blue Top" as two of the most promising varieties tested at Hope. The analyses of these tubers were made by Mr. F. A. Thompson of the Laboratory staff, while the tonnage was determined by the staff of the Hope Experiment Station. A third report of the results of 18 months' growth of the 22 varieties will be presented in due course.

* Bulletin of the Department of Agriculture, Vol. III., July, 1905, pp. 152-155.

Cassava Trials II.

(Twenty-two varieties harvested after 15 months' growth.)

Order of Starch Yield.	Variety.	Tubers: Tons per acre.	Moisture	Total Solids.	Sugars.	Starch.	Starch per acre, lbs.	Gain per acre from 12–15 months: Tubers (tons.)	Gain per acre from 12–15 months: Starch, lbs.
1	Long leaf blue bud ...	15·4	57·7	42·3	1·0	37·4	12,857	6·4	4,955
2	Blue top ...	14·2	64·4	35·6	2·0	30·6	9,733	6·0	4,097
3	Smalling ..	11·1	60·0	40·0	1·0	34·4	8,553	3·6	3,059
4	Mullings ...	11·1	60·5	39·5	1·7	32·9	8,180	5·3	4,020
5	Luana (bitter) ...	9·4	55·8	44·2	1.1	36·7	7,686	5·1	4,611
6	White top ...	11·0	61·9	38·1	1·5	31·0	7,638	0·5	·264 *loss*
7	Duff House ...	10·6	60·9	39·1	2·0	32·0	7,598	5·1	3,491
8	White smooth bitter ...	9·4	58·2	41·8	1·1	35·5	7,435	6·1	4,975
9	Brown stick ...	11·6	64·7	35·3	1·1	28·5	7,405	8·3	5,021
10	Rodney ...	9·7	63·8	36·2	1·1	31·9	6,931	2·2	1,594
11	Luana (sweet) ...	8·1	55·3	44·7	1·3	36·5	6,540	0·3	1,218
12	Bobby Hanson ...	8·4	62·0	38·0	0·8	32·6	6,134	2·1	1,357
13	Black stick ...	6·5	55·0	45·0	1·5	35·7	5,197	Nil	319
14	Black bitter long leaf blue bud ...	6·9	58·1	41·9	0·8	33·6	5,193	0·9	731
15	White bunch of keys ...	6·5	59·2	40·8	1·8	33·7	4,906	1·2	·837
16	Silver stick ..	6·5	63·8	36·2	1·9	31·6	4,600	3·0	1,856
17	Black bunch of keys ...	6·5	62·0	38·0	1·5	31·5	4,586	3·2	2,198
18	Prize or silver stick ...	5·1	61·6	38·4	1·3	35·4	4,044	1·6	1,410
19	Mass Jack ...	5·1	66·5	33·5	1·6	28·4	3,243	0·8	152
20	White stick ..	3·9	56·6	43·4	1·4	35·8	3,127	0·6	605
21	New green ...	6·5	64·8	35·2	1·5	21·2	3,086	1·2	106 *loss*
22	Yellow belly ...	3·2	68·0	32·0	1·8	26·8	1,921	0·3 loss	·400 *loss*

CASSAVA: COST OF CULTIVATION.

The following statement of the cost per acre of cultivating and harvesting Cassava on old ruinate land has been sent by a cultivator in the Magotty district, St. Elizabeth.

Job Work.

	£	s.	d.
Cutting ...		10	0
Burning and clearing up ...		4	0
Digging 4,840 holes (3 feet distances) at 3d. per 100		12	6
Sticks at 3/ per cart load—2 loads*		6	0
Cart hire—2 days at 5/*		10	0
Planting suckers—8/		8	0
2 weedings at 8/ ...		16	0
Harvesting—6/ ...		6	0
Supervision—10/ ...		10	0
	£4	2	6

Cartage, where the fields are within measurable distance of the mills, say ten tons to the acre, ought not to exceed 10/.

REPORT ON COCOA IN ST. MARY.

Mr. W. Cradwick, Travelling Instructor, to the Director of Public Gardens.

Ramble P.O., 25th Feb., 1905.

SIR,

I have sent to Dr. Cousins, the Agricultural Chemist, samples of soils as follows:—

E. Hope Dyer, Highgate P.O., Orange River property ...	3	lots surface soil
A. M. Edwards, Riversdale, Mission property, Mt. Hermon ...	4	" "
do do do ...	2	" subsoil
Jno. Lockett, Troja P.O., Kendal ...	3	" surface soil
do do do ...	3	" subsoil
H. J. Rudolf, Hampstead P.O., Belleville ...	6	" surface soil
do do do ...	3	" subsoil
Richard Sutherland, Oracabessa, Home Cottage ...	2	" surface soil
do do do ...	2	" subsoil
Josiah Campbell ...	1	" surface soil
do do do ...	1	" subsoil
Isaac Milbourne, Port Maria, Preston ...	1	" surface soil
do do do ...	1	" subsoil

* Omit these items for fields once established.

Henry Livingston, Port Maria, Islington		1	lots	surface soil
do do do	...	1	"	subsoil
H. Q. Levy, Brown's Town, Sheerness	...	2	"	surface soil
W. H. W. Westmoreland, Highgate, Charlottenburg	...	3	"	surface soil
do do do	...	3	"	subsoil
H. J. Rudolf, Hampstead, Rio Magno		3	"	surface soil
do do do	...	3	"	subsoil

The properties Rio Magno and Mt. Hermon Mission are in St. Catherine. I visited in addition to these properties, Halcot Farm, the property of H. D. Graham; Llanrumney, the property of Mr. Ernest Kerr, and many small settlers.

I investigated complaints of cocoa trees dying from disease, fiddler and other bugs. I think instead of individualizing properties it will be better to treat them generally, except as far as remarks are necessary for the sake of information on the soils sent up to be analysed.

On Mr. X's estate the cocoa never had permanent shade, but, before the hurricane, was well shaded with bananas; of course the hurricane destroyed the shade and exposed the trees to full sun and wind in a few minutes.

I think the best course would have been to have replanted the whole field with bananas immediately after the storm. The drainage at present is by no means systematic, although Mr. X has paid a good deal of attention to it of late years; but the trenching having been done subsequent to the planting of the cocoa, it was not done on any definite plan. As it is well nigh, if not quite, impossible to drain the field systematically, without replanting the bananas, and as the bananas are obviously in want of replanting, I would advise the replanting of the bananas, doing nothing to the cocoa except removing dead wood from the weak, and suckers from the strong trees. By September of this year it will be easy to see which of the trees will be worth saving, and which are not. Then the trees which still look unthrifty should be dug out and burnt, and young healthy plants substituted; if the replanting of the bananas were done by the end of April, they will have grown enough to furnish shade for the young cocoa in September,

I would advise the planting of permanent shelter trees on the ridges; these I would recommend to be mixed fruit, timber and rubber trees,—breadfruit, mangoes, cedar, star apple, kola, and castilloa. I would advise regular contour drains of 2 feet in depth and 24 feet apart. In steep places these drains should have stones on piles driven in at intervals to retard the flow of the water and thus prevent wash.

The ridges of the land require regular additions of vegetable matter,—banana trash, stable manure, grass and weeds are the easiest to procure; the wash is very great in these parts and unless it is compensated for in some way, the cocoa trees will always look poorer there than in the bottoms, where all the humus, &c., is washed from the ridges. I do not think permanent shade is required as shade, but shelter from the wind is urgently required; a tree also which will deposit a large quantity of leaves on the land would be a great help to the land.

If an artificial manure can be applied about June which would help to hurry up the bananas, and the same for the cocoa on the poor spots about September, I think there is no question that the majority of the trees would soon be in good condition. Pruning will have to be looked after constantly—"little and often" is a good maxim for the pruner at all times, and especially so after such a calamity as these trees have passed through. Healthy trees which are leaning badly, or which have been damaged by wind or bananas, &c., falling on them, beyond the chance of their again being made into good shaped trees, should each be allowed to send up one good sucker, selecting the strongest one as near the ground as possible, removing all the others and preventing fresh suckers from growing by constant pruning. Cocoa plants which have not fully recovered from the effects of the hurricane should on no account be allowed to bear fruit; the bearing of four or five pods this year on an enfeebled tree will probably mean a loss of five times that amount during the next two or three years.

One or two general points which may look small, but are of vast importance, were noticed by me.

When roads or drains are made, the soil is often heaped round the stems of the trees causing them to become soft and pappy, and rendering them liable to attacks by the grubs of the Fiddler and other bugs. In any case if soil is heaped up round the stems of the cocoa trees for any length of time, the bark rots and the trees get feeble, drop their leaves, cease to bear, and often die outright. Even in weeding, labourers often heap up the soil round the stems of the trees to their great detriment: the best plan to remedy this would be to select a careful old woman with a piece of stick to go round after weeding, and clear the stems of all the trees of soil. A cutlass should not be used, although if the stems are exposed to air and light, they soon recover from wounds inflicted by cutlass or hoe; if the wounds are covered up they are great sources of danger, from grubs, fungoid pests, &c.

Another point I observed was that young plants had often been kept too long in the bamboo joints, the roots being twisted round and round the bamboo joints. Plants such as these are not likely to thrive. Another point people are not careful with, and that is to see that the roots of the young plants when taken out of the bamboo joints are properly wet. Before removing them for planting, the precaution should always be taken of soaking the bamboos with the plant in, in a bucket or pan of water, for at least half an hour, especially the plants procured from Hope Gardens, which often get very dry on the journey from the gardens to the plantations.

With reference to the damage done by grubs at Halcot Farm, the trees have not been troubled underground, but the limbs of some trees have been almost stripped of their bark, and from the appearance of the limbs now, it looks almost as though it were the work of slugs. Mr. Graham, however, is strongly of opinion that a caterpillar was the cause of the trouble. I recommend the trees being dusted with Paris Green, should the trees be again attacked.

With regard to the harm done by Fiddler bugs, I am still somewhat sceptical of the harm done by these to really healthy trees. I have not yet been able to find a tree believed to be killed by these; which was free in my opinion from contributory causes. If Fiddler bugs can attack the roots of healthy orange and cocoa trees, then these industries are not worth ten minutes' purchase. I found trees which were in very bad health and on which the Fiddler grubs had been feeding; now if these trees are examined casually, it is a nice easy way out of the difficulty, immediately a grub is discovered, or traces of its presence in the past, to lay all the blame on the Fiddler bug, when as a matter of fact, I found that in nearly every case it was almost certain that the tree had been suffering from two or three other causes, each sufficient to nearly kill the tree independent of the Fiddler bug.

Perhaps the largest number of the Cocoa trees attacked by Fiddler bugs are those growing in the upper parts of steep fields, where the fertile soil has been washed away to the lower parts of the field, the increased fertility of the lower parts of the field and the consequent luxuriant growth of the trees there are followed by the starvation of the trees on the upper parts. These trees always had their roots "eaten by Fiddler grubs." *The luxuriant ones never.* In many places the trees were found to be buried very, very deep. The digging of trenches, the making of roads, are often responsible for the heaping up of the soil as much as eighteen inches round the stems, this with or without the help of Fiddler bugs spells only one thing, and that is *death.*

Trees too are often buried too deep by labourers weeding, being often first chopped by the hoe and then they are covered up with a large quantity of soil. I think these may be safely looked upon as first causes, while I admit that the Fiddler bug in these cases certainly does help to aggravate the evil by eating off the bark of the unhealthy trees, but I much doubt if trees suffering from the causes I have mentioned, would ever be useful trees, even without the harm done by the Fiddler bug.

Why I say that if the grub of Fiddler beetles attacks the roots of healthy trees, the cocoa industry is doomed, is that at Mr. Lockett's at Kendal for instance, on one small pimento tree were enough Fiddler beetles to furnish 6 for each cocoa tree on the property, and if the whole of the damage done to the dying trees can be attributed to the one grub usually found at its roots then a very small percentage of the beetles will be enough to furnish grubs enough to kill all the orange and cocoa trees in the island. I may add that Mr. H. Q. Levy, and Mr. R. L. Young have for a long time had the matter under careful observation for me, and quite agree with my view.

At the same time the mature Fiddler beetles do considerable harm to the foliage of the trees which they happen to infest, and the Paris Green remedy should always be used.

Throughout the parish of St. Mary I saw nothing which can be termed a disease of cocoa trees; those which it was stated were suffering from disease were growing under the same circumstances as those which were said to have been attacked by Fiddler beetles, viz., on the poorer parts of the land, ridges or places suffering from bad drainage; exposure to wind on poor soil is more than cocoa trees can be expected to flourish under; I saw many trees under such conditions, the owners of which were fearing disease in consequence of the thriftless look of the trees.

I must say, I came away from St. Mary with a much higher opinion of cocoa as a permanent crop than I went with to that parish, after hearing the reports of the bad state of the trees from the effects of the hurricane of 1903, diseases, &c. It is little short of wonderful to see the way in which some of the trees after being badly battered in the hurricane have recovered their former vigour and are bearing fine crops; this of course has taken place only on good land and where attention was promptly paid to the trees and the land after the hurricane.

Mr. Rudolf at Belleville and Messrs. Kerr & Co., of Llanrumney showed me trees which it seems hard to believe were so battered as recently as August, 1903; the only indication in some of the fields of anything unusual having happened, consisted of a tree here and there still being out of the perpendicular; in cases where trees were broken badly, gormandizers have sprung up and are now bearing; on the other hand I found fields which have had no attention, still looking very bad; this was notably the case at a small settler's field at Islington (Mr. Livingston's). The drainage had never been particularly good, and in consequence of the heavy rains during the past two years it had steadily got worse; here the trees have not yet attempted to recover.

Some of the planters in St. Mary are pruning too severely, growing long weakly primary branches which bend down, leaving the centre of the tree too open, which results in the crown of the tree and the bark of the pruning branches getting sunburnt—I was careful to point out the evil effects of this. I would suggest that trees which are recovering slowly from the effects of the hurricane should be left unpruned; with the exception of the removal of the gormandizers, too much repression of foliage must not be practised till the trees have recovered their usual vigour; I would also suggest the removal of the pods if such trees attempt to bear. Where they have recovered, and are strong and healthy, they should be pruned in the usual way, and may be left to bear, but the production of half a dozen pods on a weakly tree will probably mean a loss of 13 months' growth and probably many times 6 pods next year.

Shading.

With regard to permanent shade, I am inclined to agree in toto with Mr. Lockett whose system is to pick out the richest land which is most protected from wind, cultivate this highly, protect it from wind by planting strong growing trees to windward, but practically plant nothing as a permanent *shade;* this I believe to be sound cultivation, and Mr. Lockett's results demonstrate it.

The necessity for good drainage cannot be too strongly impressed on the cocoa planters of St. Mary. The heavy, retentive nature of the soil points to this as a primary necessity of cultivation. Many valuable years will be saved in the life of the cocoa tree if this is accepted as a fact, and the drainage properly planned and executed before the planting of the tree instead of after as has been often done in many cases.

The necessity of shading for young plants need not be emphasised, on the other hand, the evil of too much shade should be carefully avoided as it results in lanky feeble plants. When establishing young fields of cocoa, I think more use might be made of the ground cocoe—(Colocasia esculenta); this plant seems admirably adapted for the conservation of moisture and the keeping down of noxious weeds, some planters allow their labourers free use of the land between young bananas and cocoa for the purpose of planting this vegetable and judging from appearances it seems to do admirably what I have just claimed for it without in any way reducing the fertility of the soil, and the extra cultivation which is willingly given by the people growing the cocoes must be of the highest benefit to the close, heavy soils in St. Mary.

I noticed that usually the varieties of cocoa with red colouring matter on the pods seem to have recovered their vigour more quickly than the yellow varieties. In many places, particularly with the small settlers, I noticed that the cocoa cultivation is very crowded with bananas and other economic plants, this *may* be the most profitable way of utilizing an acre of land, if so, there can be no objection to it; but it would be as well if planters and peasantry were to decide which kind of cultivation they think best bananas, chocolate, or chocolate with just as many bananas as are useful for shading purposes and not to try to get £20 worth of cocoa and £20 worth of bananas per acre per annum, and succeed in getting £10 worth of neither.

In many cases good cocoa trees are prevented from bearing to anything like their full capacity by bananas, which are managed in such a way (or perhaps it would be more correct to say— not managed at all) as to give only such poor bananas, and so late in the year, that I am sure the return per acre would be better if the bananas were retained only just in such numbers as would be useful for helping to shade the thinner parts of the cocoa field. It is exceedingly hard to estimate the yield per acre of cocoa fields in Jamaica, and that yield does not compare even on the estimate favourably with that of other colonies simply because in nearly every case the cocoa has to play second fiddle to the banana.

Of course if bananas pay better than cocoa, there is nothing to be said against this, but planters had better make up their minds which does pay best in their own particular circumstances and develop the most profitable industry.

With reference to what are termed "Gall Spots" on ridgy land which as a rule, simply means spots where the surface soil is very thin and the subsoil very poor, I would strongly advise the cessation of attempts to cultivate such land in bananas or cocoa, and the planting of it with grass and trees, the trees would serve to protect the plants growing in the better parts of the land, and the grass might be cut to manure the same (it is appalling to stand at Highgate and look towards Annotto Bay, for there is absolutely nothing to modify wind storms between there and the open sea.) I may say that this method of dealing with "galls" is being carried out by Mr. Melville of Llanrumney.

I forwarded some cocoa pods, which were affected with what appears to be a rot; the pods presenting a nasty brown appearance; the disease attacks pods of varying ages; I would suggest spraying these trees with bordeaux mixture.

Thrips were found in places and I would advise spraying these with a kerosene emulsion. I do not think they appear to be any worse than during the last few years.

My attention was drawn to the spotted appearance of the bananas from parts of St. Mary. Mr. E. H. Kerr told me that he thought they got a much larger proportion of fruit with these spots on, during wet weather, but he has promised to observe more closely and report to the Department. Mr. Melville, the attorney of Llanrumney, is of opinion that the spotted fruit comes from land which is poor from any cause; Mr. Rudolf is of the same opinion, but adds that he thinks it is worse in ratoon bananas than plants.

A planter at Highgate, assured me that before he had drained a field which he showed me, that all the fruit from this was badly spotted, even as plants, but since draining, the spots have almost entirely disappeared; there was very little spotted fruit when I saw the field except in some patches which appeared to be in want of still more drainage, and were otherwise naturally poorer.

These spots on bananas would appear to be a fungoid pest—similar to that attacking the bananas at Hazelymph.

In conclusion, I would wish to again point out the necessity for the care in laying out drains; these should always be as free from rapid falling as possible, but where it is impossible to avoid digging the drains straight down steep land, the drain should be either piled at short intervals, or large stones should be laid into them to prevent the rapid rush of the water.

I have the honour to be,

Sir,

Your obedient Servant,

W. CRADWICK.

NOTE BY DR. COUSINS.

Re Cocoa Trees dying.

There is no doubt whatever that "Fiddler" larvae can and do attack the roots of healthy orange and cocoa trees.

I consider that in view of the recorded fact that the original cocoa cultivation in Jamaica was destroyed by a similar, if not identical pest, mentioned by Dalby Thomas * in extract below, that Mr. Cradwick fails to appreciate the serious nature of this pest.

The reason why trees growing on thin and denuded soil are specially attacked is not, as Mr. Cradwick concludes, that weak trees are specially liable to attack but because the roots are accessible to the larval attack under such conditions. The wholesale death of budded oranges in the Manchester orchards had been attributed to defective drainage, deep planting, poverty of soil, etc., until I went there and had a number of trees dug up when the cause was found to be solely the girdling of the roots by Prepodes larvae. Cultivated soils encourage the attack of these pests because of their friability. This is why wild oranges in the pastures in Manchester are free from damage while budded fruit, if neglected, rapidly succumb to this pest. I think it is desirable to warn planters of the serious possibilities of Prepodes if neglected and that a regular crusade of hand-picking of adults and spraying with Paris Green and treatment of infested trees with Carbon Bisulphide to destroy larvae in the soil are desirable.

EXTRACT FROM "AN ACCOUNT OF THE RISE AND GROWTH OF THE WEST INDIA COLONIES," BY DALBY THOMAS, LONDON, 1690.

"Cocoa is now no longer a commodity to be regarded in our colonies, though at first it was the principal invitation to the peopling Jamaica; for those walks the Spaniards left behind them there, when we conquered it, produced such prodigious profit, with little trouble that Sir Thomas Moddiford and several others set up their rests to grow wealthy therein, and fell to planting much of it, which the Spanish slaves who remained in the island always foretold would never thrive, and so it happened; for though it promised fair and throve finely for five or six years, yet still at that age, when so long hopes and care had been wasted about it, withered and died away, by some unaccountable cause, though they impute it to a black worm or grub which they find clinging to its roots—the manner of planting it is in order like our cherry gardens, which tree, when grown up it much resembles. It delights in shade, so that by every tree they plant one of plantain, which produces a fruit nourishing and wholesome for the negroes. They by hoeing and weeding keep their cocoa walks free from grass continually, and it begins to bear at three, four or five years

* See extract, for which I am indebted to C. E. DeMercado, Esq.

old, and did it not almost constantly die before, would come to perfection in fifteen years' growth and last till thirty, thereby becoming the most profitable tree in the world, there having been above £200 sterling made in one year of an acre of it. But the old trees planted by the Spaniards being gone by age, and few new thriving, as the Spanish negroes foretold, little or none now is produced worthy the care and pains in planting and expecting it. The slaves gave a superstitious reason for its not thriving, many religious rites being performed at its planting by the Spaniards, which their slaves were not permitted to see. But it is probable, that wary nation, as they removed the art of making cochineal and curing venelloes into their inland province, which were the commodities of those islands in the Indians' time, and forbad the opening of any mines in them, for fear some maritime nation may thereby invited to the conquering them, so they might likewise, in their transplanting cocoa from the Caracas and Guatemala, conceal wilfully some secret in its planting from their slaves lest it might teach them to set up for themselves, by being able to produce a commodity of such excellent use for the support of man's life, with which alone and water some persons have been necessitated to live ten weeks together, without the least diminution of either health and strength."

NOTE BY DIRECTOR OF PUBLIC GARDENS AND PLANTATIONS.

There is no proof that the original cocoa cultivation in Jamaica was destroyed by "Fiddler" larvae, in fact the destruction is attributed by the historian Long to a "blast" which probably was a hurricane.

Several orange plantations in Manchester and other parishes have been examined by myself and others. In some cases we found evidences of "Fiddler," but elsewhere there was no trace of any injury by larvae at the roots, and the causes of ill health and death were want of aëration and drainage of soil, deep planting, poverty of soil in lime or some other ingredient, shading by bananas or stiff clayey soil. Where there was evidence of the larvae at work on the roots, it could not be said that this was the sole cause, for one at least of what seemed to be the true causes of ill health, was also acting.

Of the thousands, one might say millions, of orange seeds that are scattered by natural causes in pastures, a very small number meet with favourable conditions and are strong enough constitutionally to fight successfully against all enemies. Budded fruit planted alongside succumb, because they do not meet with favourable conditions unless elementary principles of agricultural hygiene are attended to, and also, because possibly the stock plants are wanting in vigour.

The Fiddler should of course be destroyed, but it would be a fatal mistake to devote sole attention to it, and leave unsolved the other recommendations made by Mr. Cradwick.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, XIII.*

(Continued from Bulletin for August.)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

OTHER METHODS OF COAGULATION.

The traditional method of treating Para rubber in Brazil is to spread it in thin layers on wooden paddles, which are held over burning palm nuts. The highest grades of commercial rubber have been produced in this way, but the process is too slow, laborious, and disagreable. There seems, however, to be ground for a suspicion that some constituent of the smoke, which is incorporated into the rubber, may have a beneficial effect upon its mechanical properties and the previously cited adverse opinion upon the pure but unsmoked Hevea rubber from the East Indies seems to give further warrant for such a notion. The experiment of smoking Castilloa rubber has been tried at La Zacualpa, but the result was a hopelessly sticky mass. The difference of behaviour is, however, more likely to be due to differences in the latex rather than to differences in the rubber itself.

It is not to be overlooked that, while the high percentage of albuminous impurities in Castilloa rubber has rendered the price lower and the removal of them should increase the price, yet it will reduce the quantity of the marketable product and will thus not be an unmixed advantage. All the methods of coagulation now in use bring about the incorporation with the rubber of a large amount of the albuminous substances of the latex. Dr. Weber claims that if none of the albumens are left out they will constitute over 25 per cent. of the solid product and adds:

> The native rubber collectors prepare the rubber from the latex in such a way that at least part of the aqueous vehicle of the latex is drained away before coagulation takes place, and consequently we never find a Central American rubber (crude) which contains as much as the above-stated quantity (25 per cent. of albuminous matter), but lots containing from 9 to 13 per cent are quite common.

The meaning of this sentence is not obvious, and it becomes still less so if we read it in connection with one which follows a little later.

> Therefore, whenever we coagulate the rubber, we can only do so by coagulating it in conjunction with the albumen present, and we have at once a product possessing all the irremediable drawbacks which above we discussed at some length.

None of the native methods of coagulation enumerated by Dr. Weber shows any provision for eliminating any part of the albumen. There is certainly nothing of this kind in connection with scrap rubber, into which all the solid constituents of the milk are simply dried down and little escapes except by evaporation, and yet scrap rubber is commonly deemed of good quality. In coagulation by the acid or alkaline juices of plants or by soap, salt, or alum, or by the boiling of the juice, the only materials which escape are those

* Extract from the U. S. Department of Agriculture, Bull. No. 49. Bureau of Plant Industry.

which do not coagulate, so that it is difficult to avoid the inference that the percentage of albuminous matter is not constant or that it has been incorrectly determined.

At La Zacualpa was witnessed still another method of coagulation by which all the non-volatile constituents of the latex are retained. The latex is spread in a thin coating upon the large banana-like leaves of a species of Calathæa, laid out on the hot bare ground in the open sun. This exposure to heat, light, and air turns the milk dark with great rapidity, and in a few minutes it has become firm enough to permit a second layer to be spread on. Subsequently two of the leaves have their rubber-covered faces pressed together by being trodden upon, and the rubber adheres to form a single leaf-like sheet from which the leaves themselves are easily stripped away.

COAGULATION OF SCRAP RUBBER.

Whether due to a varietal difference in the trees or to climatic or other differences of the external conditions, it seems to be a general fact that on the more continuously humid eastern slope of Central America the milk of Castilloa does not run from the trees in quantities which can be collected and treated by improved methods of coagulation, but hardens in the cuts made by the rubber gatherer, who does not carry home the milk but returns in a day or two to pull out the dried "scraps," as rubber obtained in this way is called in the trade. As both the quality and the price of scrap rubber are satisfactory, the chief objection to this method of harvesting is the greater number of cuts in the tree and the greater amount of labour necessary to collect it, though the latter objection is somewhat counterbalanced by avoiding the work of coagulation. The principal point is the amount obtainable, and this depends upon the question of climates and varieties rather than upon that of coagulation. According to Professor H. Pittier, 6 pounds of scrap rubber are sometimes taken from a single wild tree in Costa Rica; but while this amount is considerable it is much less than that claimed by Koschny for the same country.

YIELD OF CULTIVATED TREES.

It may be said that at the present stage of this inquiry 2 pounds per tree is looked upon as the reasonable maximum yield to be expected from adult trees of twelve years and upward, growing under favourable natural conditions. This is the highest estimate which is known to the writer as having been made by reliable planters of intelligence and experience; and some such hold that the probabilities lie nearer to half a pound than to 2 pounds. It is appreciated that this estimate is much smaller than many claims based on wild trees and that it is much larger than the results reached on some of the earlier plantations would seem to promise. The estimate is not, however, made as an average of all published figures, but is reached rather by the elimination of unwarranted expectations from one end of the series, and from the other of disappointments due to adverse local conditions.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on 12th September, present: the Colonial Secretary, the Commissioner for the Imperial Department of Agriculture for the West Indies, the Director of Public Gardens, the Government Chemist, Hon. T. Capper, Messrs. C. A. T. Fursdon, C. E. deMercado. J. W. Middleton, G. D. Murray and John Barclay, Secretary.

The Secretary read letters from the Colonial Secretary as follows:—

a. Intimating that Mr. N. A. Rudolf had been appointed Assistant Superintendent of Hope Gardens and the Experiment Station, with a salary at the rate of £100 a year and quarters, his duties to include, if required, the instruction of the boys at the Industrial School.

b. That the grant of £26 asked for by the Chemist for Government Laboratory apprentices could not be acceded to in the present financial position. The Chemist, however, submitted a later letter to him sanctioning the employment of four apprentices at 4/ a week each, the payment being made from general savings on the Laboratory estimates for the current year.

c. Transmitting copy of letter from the agent of Messrs. Elder, Dempster & Co. in regard to the appointment of fruit experts.

After discussion, on the suggestion of Sir Daniel Morris, it was agreed to recommend to the Government, that as Mr. Robert Thomson had been put at the disposal of the Board, they should ask if Messrs. Elder, Dempster & Co. could see their way to appoint two or three Instructors leaving it to the Board to nominate such as were satisfactory to them, who could assign them to different districts.

d. Intimating that the Government had appointed in addition to Mr. G. D. Murray, Lt. Col. C. J. Ward, C.M.G., the Hon. W. A. S. Vickers, and Mr. Jos. Shore, to be associated with the Government Chemist in the management of the sugar experiments.

e. Advising that in accordance with a resolution of the Board Mr. Nolan had been informed that the Governor considered it desirable that prosecutions in which the sole evidence that the rum sold is not Jamaica rum, is the fact that it does not contain a certain percentage of ethers, should be discontinued.

The Secretary submitted report on the cotton gins in charge of the Board. He was instructed to insert a notice in the Agricultural Journal asking for applications for the steam gin and baling press and 2 hand gins.

Chemist's papers :—

a. Application for a grant of £200 for experimental distillery installation from the estimates (alteration and new plant for estate distilleries) of the sugar industry fund.

It was agreed to recommend the appropriation of £200 for the experiment, subject to approval by the Board, of agreement with the estate proprietor, and plans and estimates to be prepared by the estate engineer, to be first submitted to the Board.

b. Statement by the Chemist on the proposed enquiry into the insect pests attacking cotton and cassava.

c. Report on the special course for distilleries.

d. Report on the Locked Still installation at Denbigh estate.

The last two reports were directed to be circulated.

Reports by the Director of Public Gardens and Plantations.

a. Report Mr. W. J. Thompson's work.

b. Report Mr. Cradwick's work.

c. Report Experiment Station.

These were directed to be circulated.

The Director of Public Gardens submitted a statement of the sale of Havana tobacco at Hope. As regards shade cloth for the Sumatra tobacco experiment, he was instructed to get the same cloth as was used two years before, from the United States.

The Director also reported that, subject to the confirmation by the Board, he had arranged for an experimental acre of cocoa and rubber at "Shettlewood," all expenses being paid by the Hon. Evelyn Ellis, the cultivation to be directed by Mr. Cradwick.

This was approved.

A letter from Mr. W. Kirkland submitted, was directed to be circulated.

Mr. Murray submitted letter from agents in England together with account sales for shipment of oranges made to London by Dr. Tillman showing very satisfactory prices and reported on as being the best packed oranges the agents had ever received from Jamaica.

[Issued 5th October, 1905.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. NOVEMBER, 1905. Part 11.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1905.

JAMAICA.

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RUBBER AT THE AGRICULTURAL CONFERENCE 1905, AT TRINIDAD.*

RUBBER CULTIVATION IN THE WEST INDIES.

The PRESIDENT, Sir D. Morris, said: The cultivation of rubber trees in different parts of the tropics has been taken up with great energy, and considerable success has been attained in Ceylon and the Straits Settlements especially with Para rubber. The commercial value of rubber is steadily increasing, and in view of the numberless uses to which rubber is put, there is no doubt that if plantations of rubber trees could be successfully carried on, either alone or in connexion with other industries, they might prove profitable in some parts of the West Indies. In British Guiana rubber trees of several kinds already exist, and one would naturally suppose that in that colony a rubber industry might be established under more favourable conditions than anywhere else. The more recent idea is to establish regular plantations, and these, as far as I am aware, have only been started at Tobago and Trinidad. In the former island rubber plantations have been started now for over twelve years, and they are beginning to yield commercial rubber. I have asked Captain Short, of Richmond, to prepare a paper showing the results of rubber cultivation in Tobago. He has sent a most interesting paper with results compiled by himself and Mr. T. L. M. Orde, the manager of Louis d'Or, a plantation belonging to the West India Rubber Syndicate.

CASTILLOA RUBBER IN TOBAGO.

By Captain M. SHORT, of Richmond, Tobago.

The Castilloa is practically the only rubber tree grown in this island. There are a few acres of Ceara (*Manihot Glaziovii*), and a small quantity of Para (*Hevea brasiliensis*) and African (*Funtumia elastica*), but although the growth of these two latter species seems fairly satisfactory, it is too early yet to judge if they will eventually flourish and yield well here.

There is no doubt, however, that in the chief cacao-growing districts the Castilloa thrives remarkably well, and the tree appears to grow equally well at an elevation of 900 feet as at sea-level. Some few trees, up to three and four years of age, have at times

* Reprinted from the *W. Ind. Bulletin*, Vol. VI., No. 2, 1905, page 139.

been attacked by blight, but in the larger number of cases where this has occurred, the young trees have succeeded in throwing it off, without spraying being resorted to, or, where the tops have died back, have sent out flourishing suckers.

SHADE FOR CASTILLOA.

In good soil and in moist situations, no shade at all is required for the young tree, but otherwise it does want a certain amount of shade for the first two or three years after planting. Too dense a shade, however, is not beneficial to it, and plants set out in the forest make very slow progress, and develop into spindly trees.

Where three to six-years-old trees are shaded by Bois Immortel or other large trees, as might be expected, they increase rapidly in height, but where they are planted fairly close, or where the stem only is shaded by bananas, etc., the tree thickens out as it grows.

SIZE OF TREES

There are about 90,000 Castilloa trees in the island. The oldest are those on the Richmond estate, where 100 to 150 were planted thirteen to fourteen years ago. The largest of these now measures 6 feet in circumference at 3 feet from the ground. Some measurements were taken in December, 1898, when the trees were eight years old, the largest being 5 feet in girth at 3 feet from the ground. Others measured 3 feet 9 inches, 3 feet 5 inches, 3 feet 1 inch.

YOUNG CASTILLOAS.

Mr. Orde, who is managing the West India Rubber Syndicate, has kindly furnished the following information on young Castilloa :—

The Castilloas on Louis d'Or estate are still young. Planting was begun in the autumn of 1898, and the oldest trees are six years or thereabouts.

The larger number of the trees have been planted to stand finally at a distance of 17 feet. Some fields are planted at 8½ feet by 8½ feet, others at 8½ feet by 17 feet, in the hope that a yield might be obtained from the cultivation while young, by tapping the intermediate trees before they grew large enough to necessitate being cut out.

It has been found that a well-grown field, planted at 8½ feet by 8½ feet, cannot stand longer than about five years without being thinned out, as at that age the branches begin to interfere with each other, and the tree tends to become thin and spindly.

Experiments were made in tapping some of these young trees, averaging five to six years old, in 1904. Large numbers of them were tapped as severely as possible with chisel and mallet. The latex was in some cases taken wet and washed before coagulation, and in others it was allowed to dry on the tree, and picked off afterwards as scrap.

The yield obtained was very small, averaging ¼ oz. per tree, though individual trees gave more. In one case, 160 of the best grown trees were tapped, the rubber being taken wet, and the yield from these was rather over 5 lb. of dry rubber, or an average of $\frac{1}{2}$ oz. per tree.

Small lots of this rubber have been sent to London for valuation, and good prices have been quoted, 2s. to 2s. 6d. being quoted for the scrap, and 4s. 2d. to 4s. 8d. for the washed rubber. No large quantity has yet been put on the market.

It is not yet known how frequently trees of this age can be tapped and made to yield an amount worth the cost of collecting. It is possible that they might stand three tappings in the year, which would bring the yield up to about 1 oz. per tree. The cost of collecting the rubber as scrap is from 6d. to 7d. per lb., while if the latex is taken wet and washed, the operation is more laborious and the cost per pound increases. There are some twenty to thirty trees on the estate, aged seven years from seed, and experiments have also been made on these, from which it appears that the yield increases fairly quickly as the tree gets older.

Six of these trees were tapped, not severely, in March, 1904, and gave $12\frac{1}{4}$ oz. dry rubber. The same trees were tapped again in September and gave 10 oz.. or nearly $\frac{1}{4}$ lb. per tree in the two tappings. These trees, however, were rather above the average in growth for their age.

Trees planted at $8\frac{1}{2}$ feet by $8\frac{1}{2}$ feet could not be left growing to this size without injury to each other; and if a field is planted with the idea of getting rubber from the intermediate trees, as soon as they get old enough to yield, and before it is necessary to cut them out, it would seem that $8\frac{1}{2}$ feet is too close a distance, and that 12 feet would be about the most suitable distance.

In a field planted at 12 feet by 12 feet, and intended to stand permanently at 24 feet by 24 feet, the intermediate trees could probably be allowed to attain an age of eight or nine years before being cut down. In such a field there would be about 225 intermediate trees per acre on which to work. Basing a calculation on a yield of 4 oz. per tree in the seventh year, the yield works out at 56 lb. of rubber, which, at 2s. 6d. per lb., and deducting 6d. per lb. for the cost of collection, shows a profit of £5 12s. per acre.

These tappings might be continued in the eighth and ninth years, with a probable increase in yield each year, at the end of which time the intermediate trees would be cut down, and the tapping of the permanent trees begun.

DISTANCE OF PLANTING.

The conclusion to be arrived at from these facts seems to point to close planting being advisable in order to ensure a comparatively quicker return, but it is doubtful if it would be worth while to plant closer than 10 feet, and I am inclined to agree with Mr. Orde that 12 feet is the best distance to adopt.

YIELD OF LATEX.

Tapping was first started on Richmond estate in November 1899, the trees being then about nine years old. One hundred and twenty-two trees were tapped, the average yield being 2 oz.

to 2½ oz. dry rubber at one tapping. One tree was tapped four times at a week's interval and gave in all 9¼ oz. dry rubber :—

No. 1 tapping gave	3	oz. dry rubber	
" 2 " "	2½	" "	"
" 3 " "	2	" "	"
" 4 " "	1¾	" "	"

In May 1903, thirty trees, then twelve to thirteen years old, were tapped every second day for twelve days. A row of cups was placed round each tree, commencing 6 feet up on the first day, and oblique cuts were made with the chisel as high as could be reached from the ground. At the second tapping the cups were placed 5 feet up and so on, a foot lower each time, The total amount of rubber obtained in the six tappings was 16 ℔. 10 oz., an average of nearly 9 oz. per tree :—

No. 1 tapping averaged per tree	2¼	oz. dry rubber
" 2 " " " "	2	" " "
" 3 " " " "	1⅞	" " "
" 4 " " " "	1⅞	" " "
" 5 " " " "	1⅛	" " "
" 6 " " " "	1	" " "

This method of tapping has been discontinued, as it was found that the process of putting on the cups at various heights the same day was both quicker and less expensive in the end, while the total yield was equally good.

These thirty trees were tapped again twice in February according to the latter method, the average yield being then 5 oz. making the total yield per tree in the eight to nine months 14 oz.

Tapping was carried on in February 1904 with the following results :—

	Total yield	Average per tree.
Feb. 4, 19 trees gave ...	4 ℔. 6 oz.	3¾ oz. dry rubber
March 19, do " ...	3 " 10 "	3 " " "
Feb. 8, 16 do " ...	4 " 1 "	4 " " "
March 15, do " ...	2 " 11 "	2¾ " " "
Feb. 17, 15 do " ...	5 " 11 "	6¾ " " "
April 27, do " ...	3 " 0 "	3 " " "

These fifty trees gave an average yield of just under ½ ℔. of dry rubber in the two tappings.

The yield of latex varies greatly in trees of the same size and age. Two trees out of these fifty gave 7½ to 8½ cups of latex at each tapping, the one tree yielding 1 ℔. 10 oz. of dry rubber in the two tappings, the other 1 ℔. 9 oz. Other trees tapped in the same month gave 1 ℔. in the two tappings and another gave ¾ ℔. in one tapping. Trees of the same age and size gave less than half these amounts. Why this should be I cannot say, and I believe no explanation has yet been given to account for the difference in the yield of latex. As far as my own observation goes, trees in the open, or only partially shaded, appear to be better yielders, as a rule, than those in denser shade.

In comparing this tapping with that of 1899, it appears that, at nine years old, a tree on an average yields about one-half of what a tree thirteen to fourteen years old does.

The results of the different tappings have led me to conclude that from ¾ lb. to 1 lb. of rubber per annum may be safely reckoned on, as the average yield of a tree thirteen to fourteen years old.

It is intended at the next tapping to use a ladder, and to tap as far as possible up the stem. No doubt the total yield of rubber would then be greater. It is also intended to tap a few trees continuously for twelve to fourteen days, or every second day for a month although it is very doubtful if the yield of latex would be much increased by so doing, or that the extra yield so obtained would compensate for the greater damage to the tree. In this respect the Castilloa appears to differ from the Para, and the experiments to be tried in 1905 will probably do something towards settling the point.

The cost of collecting was 8d. to 9d. per lb., but this cost would be reduced when tapping is carried on regularly and on a larger scale. The rubber extracted from the nine-year old trees in 1899 to 1900 was valued at 3s. 9d. per lb., a good price at the time.

MODE OF CLEANING.

The rubber extracted in 1899-1900 was mixed with water and put through a cream separator. The result was good, clean, pale rubber, but the difficulty in extracting the rubber from the bowl rendered this process impracticable on a large scale with the machine in use. Later on, the latex was mixed with five times its volume of water, strained and skimmed after settling. This is a long process, as, after the first washing or two, the rubber takes two or three days to coagulate. The rubber, when dry, is very dark. The colour of the dry rubber, however, according to the most recent information, does not affect the price.

CASTILLOA AS SHADE FOR CACAO.

There is little doubt that the return per acre would be greater from a plantation of cacao and Castilloa than from cacao shaded by Bois Immortel. On Richmond estate there is an acre of cacao twelve and a half years old, planted at 12 feet by 12 feet, shaded by Castilloa and Bois Immortel. The rubbers are at 24 feet by 24 feet. The Immortel are being gradually killed, many of them being already dead. The cacao crop for 1903-4 from this field was 3 bags. This would give a return per acre of from £22 10s. to £25 3s., thus:—

3 bags cacao at £4 ...	£12
75 rubber trees ¾lbs. each at 3s. 6d. per lb	10
	£22

If the average yield were 1lb. per tree, this would give a return of £25 3s. per acre.

The return from other cacao fields of the same age, planted on similar soil and shaded by Bois Immortel, was from 3½ to 4½ bags per acre. Taking the average of 4 bags, this gives £16 per acre, so that, deducting the cost of the rubber extraction, the return from the cacao and rubber would be from £4 to £6 more.

By applying some nitrogenous manure to supply the deficiency in the soil arising from the absence of the Bois Immortel tree, this figure would doubtless be increased. It is also probable that the rubber could be planted closer than 24 feet.

INFORMATION REQUIRED.

There are several points on which rubber growers are anxious to obtain information, among these being:—

1. A method of tapping the tree that would dispense with the claying of the cups, and also any improvement on the method of tapping with the chisel and mallet.

2. The reason of the difference in yield of latex in trees of the same age and size.

3. Whether the yield of latex could be increased by the application of manure, and if so, what particular manure.

4. The constituents in the soil specially required by Castilloa.

5. In making oblique cuts in the tree, it is believed that a cut given upwards is preferable to a downward cut. Why is this?

6. With Para rubber the yield increases after the first few tappings, when carried out on consecutive days, but this does not appear to be the case with Castilloa. It would be interesting to find out the reason of this.

A cut on the Castilloa, of course, drains a greater extent of the tree at the first tapping, but why does the yield of the Para, which is small comparatively on the first days of tapping, increase?

It is hoped that some members attending the Conference may be able to give some information on these points.

THE PRESIDENT: Mr. Hart has closely associated himself with the question of rubber planting in these colonies, and I would ask him to review Captain Short's paper adding any further information he may have on the subject.

MR. J. H. HART (Trinidad): Captain Short states that it appears that Castilloa rubber will grow well at 900 feet above sea-level. I think he is quite correct in that statement as I have seen Castilloa growing in its native country, Central America, at that elevation. I cannot, however, follow him in the statement made in one part of his paper, taking it with that made in another part in connexion with shade. He is of opinion that no shade is required for Castilloa in good soil, but that it requires a certain amount of shade for the first two or three years. This would seem to show that Castilloa does require shade in some places. Experiments carried out in Trinidad prove most decidedly that Castilloa does require shade It does not grow with the same vigour when exposed to sun as when partially shaded. I do not mean by shade, such shade as is given to cacao, but a growth of trees of similar size by the side of Castilloa, as it would grow in its natural forest. Dr. Weber, in late writings in the *India Rubber Journal*, expresses the same opinion and comes to the conclusion that Castilloa requires protection of the stem by the growth of trees around it both in the young and mature stage. He came to that conclusion after a short visit to Central America. I am of opinion that trees will grow at 50 per cent. greater rate if shaded than if not shaded, and if left unshaded they will die: while those planted in the wood, as I can show you on the lands of the Botanical Department, continue to grow vigorously and scatter their seeds widely around.

THE PRESIDENT: Would you now discuss the question whether Castilloa trees should be used as shade for cacao?

Mr. HART: Captain Short seems to be in favour of it, but it seems to me that a a tree which itself requires to be shaded with a tree equally its own height, would scarcely be of value as a shade for such a low-growing tree as cacao, found indigenous in Trinidad as a tree of the undergrowth of the forest.

The PRESIDENT: Would not that vary with the climate as in the case of cacao itself?

Mr. HART: Probably; but I am speaking entirely on Trinidad and Central American experience. In Grenada, where shade is not required, it is possible that Castilloa will grow equally as well without shade as cacao now appears to do.

With regard to tapping, the cultivation of rubber is yet in its infancy, and the methods of extracting rubber are, up to the present time, merely matters of experiment. We have tried experiments with tapping rubber generally, and tapping at different ages. These experiments have shown that the latex from young trees contains a very much larger amount of resin, and that the older the trees get, the larger the amount of rubber. In some instances the rubber flows slowly and coagulates before it can run down to the cup. In such cases it was probably tapped in dry weather. After heavy showers the latex runs more freely and contains much more water. I do not think that need interfere with the operator because it is necessary to add a certain proportion of water to the latex before you can clean it and prepare it for perfect coagulation. The amount of rubber contained in the ducts of different rubbers—*Funtumia elastica*, *Funtumia africana*, *Castilloa elastica*, and others—has been well worked out by the Chemists of the Imperial Institute, and the results are published in *Bulletin* No. 41, of the Botanical Department of Trinidad. A recent issue of the *Bulletin*, for January 1905, contains a short article on the preparation of Castilloa rubber. It is stated by other authorities that the coagulation of rubber depends on the coagulation of the albuminoids contained in the latex. Two or three years ago I criticized that statement, and that criticism was adopted by the late Dr. Weber, then scientific adviser of the India Rubber Association, and it has now been proved that we can remove a large amount, if not all, of the albuminoids without injury to the rubber. With regard to tapping, that, as I have said before, may be regarded as being still in an experimental stage. It is believed that more latex may be obtained from a horizontal than a vertical cut. There is also the view held by Captain Short that an oblique cut also induces a greater flow than a vertical cut. I do not see how an oblique cut made upwards instead of downwards can help the flow of rubber; but I have never tried it as yet, and it might be quite feasible.

The PRESIDENT: The point with regard to that is this: you want to have a rough cut in order to wound the edges of the ducts. I have heard that with an upward cut you go against the grain more than with a downward cut. I do not know if that is true.

Mr. HART: Nor am I aware of that. I have here an instrument for tapping which I have had made here in Trinidad: it works very satisfactorily and with greater rapidity than the mallet and chisel. I have also here machines for cleaning and repairing the rubber, the working of which I shall be glad to explain to members of the Conference.

With regard to manure: I believe that anything that will tend to improve the growth of the trees can be usefully applied. Castilloa appears to grow almost anywhere and to thrive in different classes of soils. I am not prepared to state what are the constituents which suit it best, but it is found that almost any fairly good soil for cacao will also grow Castilloa. I am unable to give any reason for the increase in the flow of rubber from Hevea after frequent tappings, but I believe the fact to have been fairly established. As to the greater flow of latex from trees of the same size, I think that is accounted for chiefly by the position of the trees in the ground, and the amount of moisture in the particular tree. The difference, however, is in the flow of latex and not the yield of rubber; that is to say, there is a larger amount of water in the tree; but in our case the yield of rubber is found to be the same.

The Hon. WM. FAWCETT (Jamaica): Our experience in Jamaica differs from the experience in Trinidad in regard to shade. At Hope Gardens, which are in a dry district, and at Montego Bay, which is also a dry district, and in another district which has an average rainfall of 70 inches, we find that Castilloa does better without shade. Attempts have been made to grow it with shade, but they failed. Mr. Hart says that Castilloa will not grow in Trinidad without shade, but is it not strange that in Tobago, which is not very far from Trinidad, and where one would expect similar climatic conditions to prevail, there is a large number of Castilloa trees growing as shade for cacao and not requiring shade themselves, except for a short time in the early stage of their growth? Professor Cook, in a Bulletin* lately published by the Department of Agriculture at Washington, has given his experience in Central America, and it is that Castilloa grows better without shade than with. My experience is that after germination, Castilloa trees do not require any shade beyond that provided by themselves.

The Hon. B. HOWELL JONES (British Guiana): The experience in British Guiana is exactly as in Jamaica. Castilloa grows without shade. I have recently planted 200 young trees and have not planted any shade trees with them.

* The Culture of the Central American Rubber Tree.

Dr. H. A. A. NICHOLLS (Dominica): With regard to one question brought up in the course of this discussion, I should like to sound a note of warning more particularly to the cacao planters of Trinidad. It is urged that Castilloa should be used as a shade for cacao. Assuming, for the sake of argument, that shade is necessary for cacao, the planters here possess in *Erythrina* a shade tree which is not cropped and which, therefore, takes nothing from the soil, on the contrary it improves the soil by adding nitrogenous matter, and so will assist the cacao trees in producing crops. If, on the other hand, the planters follow the advice given them to-day and plant *Castilloa elastica* amongst their cacao trees, they will, later on, be getting two crops from the same soil. The yield here of dried cacao is said to be about 1½ lbs. per tree; in the Northern Islands this wonld be considered a very small return. If rubber trees be planted amongst cacao in Trinidad it may be expected that the cacao return will be less, for the rubber will take away soil constituents of the cacao therefrom. It will be a case of robbing Peter to pay Paul.

MR. W. R. BUTTENSHAW (Scientific Assistant on the staff of the Imperial Department of Agriculture): With a view to showing that considerable attention is being paid to the planting of rubber-yielding trees in the West Indies, if on a small scale, I have obtained from the various annual reports the following figures as to the distribution of rubber plants from some of the Botanic Stations and Botanical Gardens. I must mention that rubber trees have, no doubt, also been distributed from some of the other stations, but in those cases these trees are not specified :—

Dominica ...	1902–3	1,215	Funtumia plants, quantities of Funtumia seed, and 32 lb of Castilloa seed.
"	1903–4	4,316	Funtumia plants, 2,480 Castilloa plants, 38 lb. of Castilloa seed, and quantities of Funtumia seed.
St. Lucia ...	1902–3	171	Castilloa plants.
Monserrat ...	1902–3	388	Funtumia plants and 181 of Castilloa.
"	1903–4	316	Funtumia plants and 11 of Castilloa.
Tobago ...	1903–4	644	rubber plants (kind not specified).
Jamaica ...	1903–4	2,640	miscellaneous rubber plants were distributed from Hope Gardens.
British Guiana...	1903–4	1,500	Funtumia plants, 60 Castilloa, and a quantity of Castilloa seed.

THE PRESIDENT: When I visited British Honduras in 1882 Mr. Reginald Ross was then establishing a cacao plantation, and I suggested whether he could not try Castilloa as a shade tree.

The Castilloa is related to the bread-fruit tree, which is well known as a good shade tree for coffee. Mr. Ross followed my advice, and after a lapse of more than twenty years, Mr. Campbell, Superintendent of Agriculture in British Honduras, informs me that the cacao has done exceedingly well, and likewise the rubber trees. I believe that, where the soil is sufficiently rich, Castilloa trees might advantageously be grown among cacao trees. We cannot lay down any general rule with regard to this matter; we can only assert that in some instances Castilloa trees have been used as shade for cacao without any injurious results. In Trinidad Mr. Hart is of opinion that these trees require shade, and we have the theoretical opinion of Dr. Nicholls that it is undesirable to plant rubber trees for shade for cacao because he thinks that possibly we may injure the cacao trees. We may leave the matter open for the present and continue our experiments, in the hope that a few years later we shall know more about it.

APPENDIX.

CASTILLOA AS A SHADE TREE FOR CACAO.

In the foregoing discussion the possibility of using *Castilloa elastica* as a shade tree in cacao plantations is brought forward. As bearing on this phase of the subject the following extracts from an article by Mons. P. Cibot, reproduced in the *Tropical Agriculturist* (February, 1905), descriptive of cacao cultivation in Venezuela, are likely to be of interest:—

'I have recently had the opportunity in Venezuela of visiting one of the principal plantations which produce that cacao, so justly reputed, known as Caracas. I found opportunity there to study also a plantation of *Castilloa elastica* used as a shade tree.

'General Fonseca, installed in the fertile valley for some twenty years, has gradually acquired the greater part of the plantations laid out in it. He owns to day thirteen plantations, producing a total of 480,000 ℔. cacao in 1903-4.

'Going over General Fonseca's plantations, I could not but admire their beautiful appearance and the care taken with the irrigation of the whole property; but my attention was specially drawn to the plantation of *Castilloa elastica* mentioned above. In 1890, when they were only beginning to think of plantations of rubber trees in South America, General Fonseca was among the first to realize the value of giving as shade to cacao, in place of the trees formerly used and which served no purpose beyond that of screens, such a tree as Castilloa, able to furnish a valuable product. He imported 5,000 Castilloa seeds from Costa Rica; but these seeds, badly packed, lost their germinating powers, and only seventy seedlings could be raised. The young plants, after some months, were planted out in different parts of Las Monjas estate, amongst the cacao trees, which gave them favourable shade. These Castilloas developed admirably.

'In 1895 these first trees fruited; the seeds were carefully collected and planted in nurseries, and in 1895-6 about 8,000 plants were put out in places where shade was wanted for the cacao trees. These trees, aged eight to nine years now, are a beautiful sight; they have attained a height of 36 to 45 feet, and have an average circumference of 33 inches.

'At about four or five years the Castilloas easily outgrow the cacao trees and commence to give them a little shade. As they plant up Castilloas on the property, they kill out the "Bucares," or other shade trees, ring-barking them with the axe at about a yard above the ground.

'The yield of Castilloa plantations is no longer to be doubted; the result obtained at Ocumare is a new proof, but the experiment made by General Fonseca is specially remarkable as it shows that the Castilloa can be grown among cacao trees without in any way harming their production. Indeed, at Ocumare they have noticed no diminution in the number of pods carried by the trees shaded by Castilloa, nor any change in the quality of the bean.'

In the same number of the *Tropical Agriculturist* (p. 529) the following extract is published from a letter from 'a well-known planter at Matale,' Ceylon, in which he sums up his experience in regard to Castilloa and cacao as follows:—

'I have very large Castilloas growing both along roads and also scattered through cacao, the latter of about fourteen years' growth showing no evidence of prejudicial influence from the Castilloas. My clearing of some 30 acres of Castilloa and cacao planted together six years ago so far supports the contention that these two products may be grown together.'

RECENT DEVELOPMENTS IN AGRICULTURAL SCIENCE

From a Paper by MR. A. D. HALL, *Director of the Rothamsted Experimental Station (Lawes Agricultural Trust Committee). Harpenden, England, read at the Meeting of the British Association at Johannesburg, Aug. 30, 1905.*

NITROGEN FIXING BACTERIA.

One of these, *Bacterium radicicola*, although widely distributed as it is in the soil, yet is not universally present; heaths and peaty soils, for example, that have never been under cultivation frequently lack it entirely; consequently, it is impossible to obtain a satisfactory growth of leguminous crops until this class of land has been inoculated with the appropriate organism. Again, although but one species of bacterium seems to exist, yet several investigators have found that by its continued existence in symbiosis with particular host plants it has acquired a certain amount of racial adaptation, so that, for example, clover will flourish best and assimilate the most nitrogen if it be inoculated with the organism from a previous growth of clover, and not from a pea or a bean plant. *B. radicicola* does not develop very freely on the ordinary media used for the cultivation of bacteria, nor can it be made to fix much free nitrogen when removed from the host plant. In particular it is maintained that the medium used, gelatine with an infusion of some leguminous plant, causes the organism to lose, to a very large extent, its power of fixing nitrogen, because it contains so much combined nitrogen. G. T. Moore, for instance, says:— "As a result of numerous trials, however, it has been found that although the bacteria increase most rapidly upon a medium rich in nitrogen, the resulting growth is usually of very much reduced virulence; and when put into the soil these organisms have lost the ability to break up into the minute forms necessary to penetrate the root-hairs. They likewise lose the power of fixing atmospheric nitrogen, which is a property of the nodule-forming bacteria under certain conditions." Latterly the sub-cultures have been made on media practically free from nitrogen, on agar agar, for example or on purely inorganic media, supplied of course with the carbohydrate, by the combustion of which is to be derived the energy necessary to bring the nitrogen into combination. In example of the two preparations now being distributed on a commercial scale, the one sent out by Professor Hiltner, of the Bavarian Agricultur-botanische Anstalt, consists of tubes of agar which have to be rubbed up in a nutrient solution containing glucose, a little peptone and various salts, and this after growth has begun is distributed over the soil or the seeds just before sowing. Moore of the U.S.A. Department of Agriculture, dips strands of cotton wool into an active culture medium and then dries them. The cotton-wool for use is introduced into a nutritive solution which in a day or two is distributed over soil or seed. Of late attention has been chiefly directed to a conspicuous organism known as *Azotobacter chroococcum* which may be readily identified in most cultivated soils, but is not symbiotic in leguminous plants. The impure cultures (which may be quickly obtained by introducing a trace of soil into medium containing no nitrogen, but a little phosphate and other nutrient salts, together with 1 or 2 per cent. of mannite or other carbohydrate) fix nitrogen with considerable activity; in one case, for example, when working with a Rothamsted soil, as much as 19mg. of nitrogen were fixed for each gram of mannite employed and partially oxidized. But Beyerinck, the discoverer of the organism, now attributes the nitrogen fixation to certain other organisms which live practically in symbiosis with the *Azotobacter*, and which are present in the impure cultures just referred to. The exact source of the nitrogen fixation may be left a little doubtful; still the main fact remains that from the bacteria present in many soils one or a group may be found capable of effecting rapid and considerable nitrogen fixation if the necessary conditions, chiefly those of carbohydrate supply, are satisfied.

ACTIVITY ON OLD AND NEW LAND.

It is too early yet to determine what measure of success has been attained by inoculations with pure cultures; but, in considering the results, a sharp distinction must be drawn between their use on old cultivated land, such as we are dealing with in the United Kingdom, and under the conditions which prevail in new countries where the land is often being brought under leguminous crop for the first time. Few of our English fields have not carried a long succession of crops of clover, beans, vetches, and kindred plants; the *Bacterium radicicola* is abundant in the soil; and, however new the leguminous plant that is introduced, infection takes place unfailingly, and nodules appear. It is true that the organism causing nodulation may not belong to the particular racial adaptation most suited to the host plant, and that, in consequence, an inoculation from a suitable pure culture might prove more effective. Again, it is possible that even a plant like clover, which would be infected at once through the previous growth of the crop, might be made a greater collector of nitrogen through the introduction of a race of bacteria which had acquired an increased virulence; but in either of these cases the most that could be expected from the inoculation would be a gain of 10 per cent. or so in the crop. This great though limited measure of success depends upon two things—on obtaining races of, *B. radicicola* possessing greater virulence and greater nitrogen-fixing power than the normal race present in the soil, and again on the possibility of establishing this race upon the leguminous crop under ordinary field conditions, when the introduced organisms are subject to the competition both of kindred bacteria and of the enormous bacterial flora of any soil. Up to the present all evidence of greater nodule-forming power and increased virulence of the artificial cultures has been derived from experiments made under laboratory conditions without the concurrence of the mass of soil organisms. In the other case, however, where new land is being brought under cultivation and leguminous crops are being grown for the first time, there can be no doubt of the great value of inoculation with these pure cultures of the nitrogen-fixing organism. An example is afforded in Egypt, where land that is "salted," alkali or "brak" soil, is being reclaimed by washing out the salt; inoculation may be necessary before a leguminous crop can be started on such new land, though in many cases the Nile water used for irrigation is quite capable of effecting inoculation. The body of evidence brought together by the United States Department of Agriculture is very convincing, and shows in repeated examples that the use of Moore's cultures has enabled farmers to obtain a growth of lucerne and kindred plants, which before had been impossible. In view of the economic importance the lucerne or alfalfa crop is assuming in all semi-arid climates, the financial benefit to the farming community is likely to be great and immediate. And since in the development of South African farming the lucerne crop is likely to become very prominent, both as the most trustworthy of all the fodder crops and as the one which brings about the *maximum* enrichment of the soil by its growth, the behaviour of the lucerne plant as regards bacterial infection in South African soils is worthy of most careful investigation. It is necessary to know to what extent nodules are formed when lucerne is planted on new soils in South Africa, as, for example, on freshly broken-up veld; the condition of the organisms within the nodule should be investigated, so as to ascertain if improvement be possible by inoculation from pure cultures, either imported or prepared *de novo* from lucerne within the country. These and kindred questions connected with the symbiosis of the nitrogen-fixing organism and the leguminous plants must to a large extent be worked out afresh in each country, and South Africa, with its special conditions of soil and climate, cannot take on trust the results arrived at in Europe or America.

SOIL ENRICHMENT BY CROP RESIDUES.

The enrichment of the soil due to growing lucerne, caused by the decay of the great root residues containing nitrogen derived from the atmosphere, is quite independent of the amount of similarly combined nitrogen taken away in the successive crops of leafy growth. Some of the Rothamsted experiments show very clearly how great the gain may be. In one particular case, when an extra large crop of clover was grown, notwithstanding the fact that the clover plots yielded between three or four tons per acre of clover hay, yet the wheat crop which followed this growth of clover was 15 per cent. better than the wheat crop following the bare fallow. The swede turnip crop, which followed the wheat, although similarly and heavily manured on both plots, continued to be better where the clover had been grown two years previously; and even the barley, which came next three years after the clover, showed a decided superiority on the clover land. Thus a clover crop, itself wholly removed from the land, exercised a marked influence for good on at least the three succeeding crops grown under the ordinary conditions of farming. In fact, the crop residue supplies as well as nitrogen, also carbohydrates, which are required for the development of the bacterial energy, and where this supply of carbohydrates is deficient or not maintained on arable land falling off of the crops ensues. In the case of grass land the conditions are entirely different, especially when dealing with wild prairie or forest where the annual growth of carbohydrates falls back to the soil and is available for such organisms as the *Azotobacter*. The fixation of nitrogen is in fact an oxidizing process, and hence in two experimental fields at Rothamsted it is observed that the one with the smaller accumulation of nitrogen has the larger quantity of carbohydrates in the soil and in bacteriological tests shows a much greater development of *Azotobacter* than the soil from the other field. Henry has also shown that the shed leaves of many forest trees during their decay may bring about the fixation of nitrogen; and this fact, which again depends on the oxidation of the carbohydrates of the leaf to supply the necessary energy, has been confirmed in the Rothamsted laboratory, as well as the presence of *Azotobacter* on the decaying leaf. It is obvious that one of the most interesting fields for the study of these organisms must lie in the virgin lands of a country like South Africa. We all know that virgin soil may, on the one hand, represent land of almost perpetual fertility; on the other, it may constitute wastes of any degree of sterility.

LIME ESSENTIAL.

It is possible also that on some of the newer lands this and kindred bacteria are absent because the conditions are not entirely suitable to their development. A. Koch has shown that the presence of calcium carbonate is necessary to the action of *Azotobacter*, and determinations of the power of soils from the various Rothamsted fields to induce fixation confirm his results, the development of the organism in question being feeble when the soil was derived from some of the fields that had escaped the "chalking" process to which the calcium carbonate of the Rothamsted soils is due. The value of calcium carbonate in this connexion only adds to the many actions which are brought about by the presence of lime in the soil—lime, that is, in the form of calcium carbonate, which will behave as a base towards the acids produced by bacterial activity. The experimental fields at Rothamsted afford a singular opportunity of studying the action of lime, since the soil, a stiff, flinty loam, almost a clay, is naturally devoid of calcium carbonate, though most of the cultivated fields contain now from 2 to 5 per cent. in the surface soil, due to the repeated applications of chalk, which used to be so integral a part of farming practice up to the middle of the 19th century. Where this chalking process has been omitted, as is the case in one or two fields, the whole agricultural character of the field is changed; the soil works so heavily that it is difficult to keep the land under the plough, and as grass land it carries a very different and altogether inferior class of vegetation. On the experimental fields it has been possible to measure the rate at which natural agencies, chiefly the carbonic acid and water in the soil, are removing the calcium carbonate that has been introduced into the surface soil, and it is found to be disappearing from the unmanured plots under arable cultivation at an approximate rate of 1,000lbs. per acre per annum —a rate which is increased by the use of manures like sulphate of ammonia, but diminished by the use of nitrate of soda and of dung. Failing the renewal of the custom of chalking or liming—and its disuse is now very general—the continuous removal of calcium carbonate thus indicated must eventually result in the deterioration of the land to the level of that which has never been chalked at all, and even a state of sterility will ensue if much use is made of acid artificial manures. That many soils containing naturally only a trace of calcium carbonate remain fairly fertile under ordinary farming conditions is due on the one hand to an action of the plant itself, which restores to the soil a large proportion of the bases of the neutral salts upon which it feeds, and partly to the action of certain bacteria in the soil, which ferment organic salts like calcium oxalate existing in plant residues down to the state of carbonate. Were it not for these two agencies restoring bases the soil must naturally lose its neutral reaction, since the process of nitrification is continuously withdrawing some base to combine with the nitric and nitrous acids it sets free.

This varying distribution of calcium carbonate in soils suggests the undertaking of a systematic series of soil analyses in any district, with a view to making soil maps that shall be of service to the agriculturist. Various foreign Governments have long been executing such a soil survey, but in the United Kingdom the matter has only excited one or two local attempts. While the basis of such work must always be the geological survey of the district, a geological survey in which, however, the thin "drift" formations are of greater importance than the solid geology, there are certain other items of information required by the farmer which would have to be supplied by the agricultural specialist. In the first place, the farmer wants to be told the thickness of the superficial deposits; he requires frequent "ground profiles," so that he can construct an imaginary section through the upper 10 feet or so of his ground. The proximity, and, if near the surface, the direction of flow of the ground water are also matters on which there could be given to the farmer information of great importance when questions of drainage or water supply have to be considered. For the examination of the soil the field surveyor will procure typical samples of which the texture and physical structure can afterwards be worked out in the laboratory. But analytical figures are liable to be deceptive. This is because the productivity of a given piece of land depends upon a large number of agencies, any one of which may be the limiting factor in the crop yield. We may enumerate, for example, temperature and water supply, both determined by the climate, by the natural physical structure of the soil, and by the modifications in its texture induced by cultivation; there are further, the aeration and the actual texture of the soil, the initial supply of plant-food of various kinds, and, again, the rate at which this last item is rendered available to the plant by bacterial action or by purely physical agencies. All these factors interact upon one another, to all of them, and not merely to the nutrient constituents, does Liebig's law of the *minimum* apply; so that any one may become the limiting factor and alone determine the yield. It is of no use, for example, to increase the phosphoric acid content of a soil, however deficient it may be, if the *maximum* crop is being grown that is consistent with the water supply, or if the growth of the plant is being limited by insufficient root range caused by bad texture and the lack of aeration in the soil. However much we may refine our methods of analysis, we may take it as certain that we shall never be able to deduce *a priori* the productivity of the soil from a consideration of the *data* supplied by the analysis. The function, then, of soil analysis is not to make absolute deductions from the results, but by a comparison of the unknown soil under examination with other soils already known, to interpret the divergencies and similarities in the light of previous experience. What, then, the soil analyst can do is to characterize the type, ascertain its normal structure and composition, and correlate its behaviour under cultivation, its suitability for particular crops, and its response to manuring in various directions. Thus an unknown soil may by analysis be allotted to its known type, deviations from the type can be recognized and conclusions may be drawn as to the connexion of these defects. One of the services, then, which the farmers in every country may very properly expect from the scientific man, is such a survey of the principal soil types, affording the necessary *datum* lines by which the comparative richness and poverty of any particular soil may be gauged. In an old settled country like the United Kingdom such a survey would guide the farmer in his selection of manures; in a new country the advantages would be even more apparent, as the areas appropriate to particular crops would be indicated, and settlers would be saved from many expensive attempts to introduce things for which their land was unsuited. It would also be possible to indicate the measures which should be taken to ameliorate the nature of the poorer soils. The main facts of the nutrition of the plant have been so long established that it is not always realized how much still remains unknown. It has become a commonplace of the text-books that the plant needs nitrogen, phosphoric acid, potash, often in excess of the quantities present in a normal soil; so that these substances alone are considered of manurial value, other necessary materials like lime, magnesia, iron, sulphuric acid, and chlorine being practically never lacking under natural conditions. But the function of these substances in the development of particular plants, the manner in which the character of the crop is affected by an excess or a deficit, is still imperfectly apprehended. Examine the effects of silica, for example. A plant that is being starved of phosphoric acid can economize and make more use of its restricted portion if a quantity of soluble silica be available. There is no possibility of replacing phosphoric acid by silica in the general nutrition of the plant but the abundance of silica at the disposal of the cereals certainly enables them to diminish their call for phosphoric acid from the soil. Much in the same direction lie the researches which are being pursued with so much vigour by Loew and his pupils in Japan on the stimulus to assimilation and plant development which is brought about by infinitesimal traces of many metallic salts not usually recognized as being present in plants at all. It has been often recognized that substances which are toxic to the cell in ordinary dilutions, may, when the dilution is pushed to an extreme reach a point at which their action is reversed and begins to stimulate. Probably some of the materials used as fungicides and inhibitors of disease act in this fashion by strengthening the whole constitution of the plant rather than by directly destroying or checking the growth of the fungus mycelium. The subject is certainly one which promises to yield results of value in practice, and calls for more extended and exact observation. The importance of research on the particular function of the various constituents of the crop lies in the fact that it is only by the possession of such knowledge we may possibly influence in desired directions the quality of our crops. The "strength" of wheat, however, is more decidedly influenced by climatic conditions than manuring. But while the climatic factor proves to be large it is less than was anticipated; an English soft wheat, for example, grown on the Hungarian plain for two seasons has not altered greatly in character nor taken on the characteristic appearances of the wheat of the district. A specially strong wheat from the Canadian north-west, after some considerable fall of strength in the first English crop, has fallen no further after three successive crops, and still retains all the characters of an exceptionally strong wheat, although the yield remains poor from an English standpoint. Other varieties have rapidly and entirely lost their strength when changed to English conditions from America, or Hungary, or Russia; many, however, while showing the effect of climate, yet stand apart from the typical English wheats and show no tendency to "acclimatize" in the sense of acquiring the character of the local varieties.

IMPORTANCE OF "VARIETY."

In the whole work the thing which stands up most prominently is the fundamental importance of the "variety"; each race, each botanical unit as it were, possesses an individuality and yields grain of a characteristic composition; and though climate, soil, season, manuring are factors producing variation in the composition they are all small compared with the intrinsic nature of the variety itself. Similar conclusions follow from the work of Wood and his colleagues upon the composition of mangels, and of Collins on the composition of swedes. The proportion of dry matter and sugar in the root, while varying markedly in the individual roots, possesses a typical value for each race; and though season, locality, and to some extent manuring affect the composition, the changes thus induced are not great. Starting, then, from this point—that variety or race is the chief factor in the composition of a given plant, and that, once the variety is fixed, the other factors, which are more or less under control, such as manuring, soil and climate, have but minor effects upon the quality—the road to the improvement of the quality of our farm crops lies in the creation of new varieties by breeding. An improved variety is all clear gain to the farmer; climate, season, and to a large extent soil are outside his control: while better manuring and cultivation, however much their cost may be lessened by increased skill, yet involve expenditure and become unremunerative above a certain point. But an improved variety, without costing any more to grow, may increase the returns by 10 or 20 per cent., in some cases may nearly double them. As regards the value of selection, Wood shows that the composition of the mangel, which has been selected solely for such external qualities as shape and habit, has remained stationary during the 50 years or so for which we possess any information; while between 1860 and 1890 the sugar beet has had its sugar content raised from an average of 10.9 to 15 per cent. by the steady selection of seed-mothers for their richness. The prospects of breeding new varieties of wheat, and particularly of securing improvements in such qualities as "strength," have been enormously improved within the last year or two through the investigations which have followed on the rediscovery of Mendel's law of inheritance. Wheat as a normally self-fertilized plant is particularly suited to the investigation of Mendel's law and the work of Biffen shows that, with a few possible exceptions, the characters of the parent varieties are inherited strictly in accordance with the expectations derived from a consideration of that law. Extreme strength shown in any particular wheat can then be picked out and combined with any other essential qualities, such as the yield and the character of the straw, which distinguish our present varieties of wheat. Biffen's work among the wheat hybrids touches also upon another point of special importance to South African farming, where the incidence of "rust" forms the greatest obstacles to extensive and successful wheat-growing. It is generally recognized that relative immunity or susceptibility to an attack of yellow rust is characteristic of particular varieties, and Biffen finds that such "immunity" is a true Mendelian character, recessive and therefore only appearing in the second generation of hybrids between a rusting and a rust-proof parent. It is not correlated with shape or character of the leaf, but is transmitted from one generation to another quite independently, and can therefore be picked out of a desirable parent and combined with other qualities of value in different parents. Here, again, we are dealing with a character that is only relative, for no wheat can be called either absolutely rust-proof or entirely susceptible; the offspring that have inherited immunity will still vary a trifle among themselves in the degree of their resistance to attack, and in this possibility of variation lies the chance of the plant-breeder to improve upon the rust-resisting powers of the varieties we now possess. The whole work of the plant-breeder is of singular importance in a country like South Africa, whose agricnltural history is so recent. Our European crops represent the culminating points of a tradition, and are the fruit of the observation and judgment of many generations of practical men working, as a rule, with chance material. The products are eminently suited to European conditions, but, as has been seen so often, they fail comparatively when brought into other climates and soils. It follows then, that, in a new country, the work of the acclimatizer is one of the necessary foundations for agriculture, and this involves a careful study of climatology, and of the influence that the distribution of rainfall and temperature in various parts of the country has on the character of the crop. Then the cross-breeder's work begins; acclimatization alone is hardly likely to yield the ideal plant, but by it are found plants possessing the features, one here and one there, that are desiderated; and starting with this ground material, the hybridizer can eventually turn out an improved plant.

PALM OIL AND SHEA-BUTTER.

By J. W. SHERRIFF.*

I. PALM OIL.†

The following is the method of preparation of palm oil from the fruit :—

Commercial palm oil manufacture : The nut bunches are cut down from the trees and put in a heap outside in the air, where they are allowed to remain for four or five days, which causes the joints of the nuts attaching them to the bunches to be weakened by the process of decomposition, and allows them to be detached by simply beating them against any substance; the nuts are then gathered up and the husks (decayed sepals) that adhere to their base removed, either by the hand or by rubbing them together, and separated by throwing them in the air and allowing a strong breeze to blow them away. The nuts are now put into iron or earthenware pots and boiled until they become a pulpy mass ; when this has been accomplished, the mass is allowed to cool by being emptied out into a canoe or hollowed-out tree trunk, which is always kept alongside the place of manufacture ; it is now covered over and allowed to remain all night thus. At daylight next morning women pour water into the canoe over the pulpy mass, a man or men get into the canoe with a stick in each hand to balance and steady them while they walk up and down the canoe, thus pounding the oil out of the pulpy mass under their feet. The oil rises to the surface of the water and is skimmed off by the women who pass it through a sieve to remove the remaining chaff into a pot placed on the fire and heated to boiling point, and allowed to continue in that state whilst the oil floats up as a bright red substance; the water at this stage is being continually stirred and the oil removed as it floats up until the whole is removed. The oil is now put into a pot and heated to drive out any water it may contain. In the Calabar district and in fact throughout the Protectorate there are only two classes of oil manufacture i.e. the one known to commerce as "hard" and the other "soft," the only difference in the manufacture being that in the case of the "hard" oil the nuts are put straight away into the canoe in the first instance without any preliminary boiling. The difference in the price of the two oils is a pound sterling a ton, the "soft" oil of course realizing the higher price.

The extraction of the kernel from the nut.

All the oil having been extracted from the fleshy and pulpy mass around the nut by the above process, the nuts are then laid out in the sun for days to dry after which they are stored away in heaps in the native houses for weeks, in some cases months, then when thoroughly dry in the rainy or off season when the manufacture of oil has ceased, native women can be seen sitting around in their huts cracking these nuts one by one by the use of a rough

* Communicated by His Excellency Sir J. A. Swettenham, K.C.M.G., Governor, &c.
† Elæis guineensis.

stone which in some cases has a small groove into which the nut fits, the kernel of commerce is thus obtained.

II. SHEA BUTTER.*

Tree reaching to a height of thirty or forty feet, with a trunk five to six feet in diameter. The wood is red like cedar, very hard and close grained. Shea butter is a solid fat obtained from the kernels, which are first dried in the sun, then bruised, and finally boiled, when the fat flows on the surface and is skimmed off for use: it constitutes a main article of inland commerce, and is used by the natives for anointing their bodies, also, after indigo has been mixed with it, as a pomatum for colouring grey hair, for lighting and for food. This fat is exported from Sierra Leone and all down the West Coast as far as Lagos to the extent of 700 to 1,000 tons annually for use in the manufacture of hard soaps, chiefly in combination with other oils.

A substance somewhat resembling gutta-percha to the extent of 3·6 per cent is found in Shea Butter, and is called Gutta-Shea; no application, however, has been found for it. The fleshy portion of the fruit is very sweet and is eaten by the natives. It is one of the commonest trees of the hinterland of Lagos and Northern Nigeria.

Early in 1902 the Governor of Lagos submitted dried leaves and twigs of this tree for examination by the Scientific and Technical department of the Imperial Institute.

An analysis made by Professor W. Ramsay of University College, London, reads:—

"Shea-Butter (Butyrospermum Parkii) gives a yield of some 3·6 per cent. of extract. This also consists largely of chlorophyll—the green colouring matter of leaves, but it also consists mostly of fatty matter, apparently similar in character to Shea-butter.

"A test for gums of the gutta kind led to negative results. I do not consider it is worth while to investigate this matter further. The small percentage of extract, even if it were worth anything, would preclude a profitable extraction. Indeed, I doubt if it would pay under 8 or 10 per cent."

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on 10th October, present: the Colonial Secretary, Chairman, the Director of Public Gardens, the Island Chemist, Hon. T. H. Sharp, Messrs. C. E. deMercado, J. W. Middleton, and John Barclay, Secretary.

Papers *re* Mr. Nolan and Jamaica rum in the United Kingdom were submitted and directed to be circulated.

* Butyrospermum Parkii.

The following letters from the Colonial Secretary's Office were submitted :—

(a) Informing the Board that the Governor approved of the expenditure of £200 from the sugar industry fund for Experimental Distillery Installation, together with the sanction of the Privy Council for same.

(b) That the Governor approved of the expenditure of £25 from the vote of the Island Chemist to aid in the endeavour to be made to exterminate insect pests on cotton and cassava, on the undertanding that a similar sum would be saved from the travelling allowances of Chemist and his staff.

(c) That the Governor was desirous of conferring the Agricultural Scholarship on the best agricultural student in any year in which the Rhodes Scholarship, as by the rules, is to be awarded to a candidate educated entirely in Jamaica, provided a satisfactory syllabus could be arranged.

This letter was instructed to be sent to the Chemist for him to report on, and the Secretary was directed to circulate this report before the next meeting of the Board.

(d) Enclosing copy of letters from Mexico re Virus for rats.

On the suggestion of the Chemist, the Secretary was instructed to reply to the Colonial Secretary that the Chemist would be glad to receive a supply of the Virus offered.

(e) That the Governor sanctioned the expenditure for the removal of the hand cotton gins being paid from the vote for petty expenses of the Board, provided the cost of removal does not exceed £4.

The Secretary reported that the cotton gins from Dr. Pringle had been sent on carriage paid, but the Board would have to pay the carriage of the gin from Mr. Levy at Brown's Town, which the latter had never been able to use. There were no applications for the use of these hand gins or the steam gins so far.

Mr. Sharp offered to take the steam gin and baling press to Eltham and make a thorough inspection of it, put it in order if possible, and if the machinery was all right, he would probably make an offer for it, and he might also find a purchaser for a hand gin.

It was resolved to accept Mr. Sharp's offer and the Secretary was instructed to have the hand gins overhauled and put in order at the Railway Work shops.

(f) Transmitting a copy of a statement prepared by the Board of Trade shewing the import duties levied on Fresh Tropical Fruits in Russia, Norway, Sweden, Denmark, Germany, Holland, Belgium and France, a list of which has been published in the "Gazette."

(g) Transmitting a copy of a letter from Sir Daniel Morris regarding arrangements he was endeavouring to make for the transport of the members attending the proposed Agricultural Conference.

Letters from the Secretary of the Northside Sugar Planters Association were submitted as follows :—

(a) Asking that deliveries of cane tops should be made on a large scale to one or two centres and suggesting Cinnamon Hill and Long Pond as two estates which could contract to hand over to the other estates in the neighbourhood, desiring of them at least as many tops as were received, after the canes were cut.

(b) Asking if planters will be allowed to inspect the operations in the distilleries on which the apparatus to be installed at the expense of the sugar industry fund is erected and if they will be allowed to witness any experiments conducted by the Chemist or his Assistants there.

The Secretary was instructed to acknowledge these letters and refer them to the Chemist for his suggestions.

The Chemist submitted the following reports :—

(a) Notifying that the Governor had granted three months leave of absence to Mr. Teversham upon half pay on a medical certificate and the interim appointment of Mr. W. E. Mace to carry on his work on half pay and reporting that the latter was working efficiently.

(b) Arrangements made for the study of insect pests by Mr. Panton, notifying that Mr. Sharp instead of a former arrangement, would subscribe £20 and Messrs. Farquharson & Milholland £5 so that with the £25 from the Laboratory vote they had £50 available to go on with the work.

Mr. deMercado reported the entire loss of the cotton plants at Hillside left for the second crop, the trees being covered by aphides, but it was not certain whether these were the cause of the trouble.

Mr. Middleton said he had used on his orange trees a concoction of bitterwood and bluestone in certain proportions and by spraying with this he kept his orange trees entirely clear of insect pests.

(c) Notifying that the Governor had approved of the appointment of Mr. E. J. Wortley as Assistant Chemist and of Mr. G. D. Goode as Second Assistant, and that by the arrangement of the salaries there would be a saving of £140 and recommending that these savings should be made available for the training of a new officer as a Fermentation Chemist on half pay.

(d) Minutes of the first meeting of the Advisory Committee of the sugar experiments.

(e) Arrangements made with Hampden estate for rum experiment, which after discussion were approved.

(f) Recommendation of the advisory Committee for supply of chemical apparatus to estates, recommending that a grant of £100 be made from the estimate for " new plant for estates" to the Amity Hall Laboratory for apparatus and asking authority to spend £50 on this estimate. This was approved.

(g) Appointment of four Laboratory apprentices and two volunteers.

(h) Proposed Amendment Jamaica Rum Protection Law of 1904.

(i) Report Superintendent of field experimants.

These papers were directed to be circulated.

The reports of the Director of Public Gardens were submitted as follows:—

(a) Experiment Station.

(b) Instructors.

(c) Mr. Cradwick on School Gardens.

These were directed to be circulated.

The meeting then adjourned until Tuesday 14th November.

[Issued 3rd November, 1905.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. DECEMBER, 1905. Part 12.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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PRICE Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1905.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. III. DECEMBER, 1905. Part 12.

RUBBER.

His Excellency the Governor at a meeting of the Jamaica Agricultural Society a short time ago, introduced the subject of rubber, and commended it to the attention of planters. Members present declared themselves willing to undertake the cultivation, and the Director of Public Gardens and Plantations was instructed to procure seed. About 6,500 Para rubber plants (out of 10,000 seeds of Para from Singapore) and 4,500 Castilloa plants have now been raised. They have all been bespoken, but applications will be booked by the Director, and a further supply of seed, both of Para and Castilloa, will be obtained next year. Applications should be sent in at once, as the demand for seed is very great, and soon there will be none available, even at a year's notice.

The *Tropical Agriculturist** is now the *Magazine of the Ceylon Agricultural Society.* It is edited by members of the staff of the Royal Botanic Gardens, and the first two numbers (July and August) contain a great deal of information about rubber, some of which is given below.

THE RUBBER INDUSTRY IN CEYLON.

By RICHARD HOFFMAN.†

Since the discovery of the vulcanisation of rubber the demand has gone up by leaps and bounds. Before that date rubber could only be used for very few purposes; in fact, only where the finished article was subjected to an even temperature, could rubber be employed, as for instance, for elastic-side boots, where the warmth of the foot kept the rubber in good condition. Rubber tyres would have been impossible without vulcanisation, as they would have cracked in frosty weather. Rubber hot-water bottles were impossible, as they would have melted. Vulcanised rubber, however, which is rubber chemically combined with sulphur, has made the article available for the thousand and one uses to which it is put to-day.

* The Tropical Agriculturist and Magazine of the Ceylon Agricultural Society. New Series commenced in July. Published once a month. Rate of subscription, including postage, in advance, to any part of the world, yearly £1, half-yearly, 12/. Apply to A. M. and J. Ferguson, 19 Baillie St., Colombo, Ceylon.

† Extracts from *Financial News* in *Tropical Agriculturist*, July, 1905.

KINDS OF RUBBER.

Rubber is the latex of a plant or tree. There are 40 or 50 known varieties of rubber-giving plants; but only five or six of these are exploited commercially, the chief being *Hevea brasiliensis* (the true Para rubber tree), *Castilloa elastica* (the Central American, or Mexican tree), *Ficus elastica* or Rambong (an Indian tree; this is the plant often grown for ornamental purposes in rooms), *Landolphia* (a vine, or creeping plant, found in tropical Africa), and a few others of less importance. Half the supply of the world comes from Brazil, and is the product of *Hevea brasiliensis.* It grows along the Amazon, and being shipped from Para, is called Para rubber. The rest of the world's supply is derived from Africa (East and West Coast), Central America, Madagascar, India, and the other-side South American States. The world's demand apparently doubles every twelve or fourteen years, and the export from Para, which is the chief source of supply, was 13,000 tons in 1886, 22,000 tons in 1896, and 30,000 tons in 1904. At present the world's consumption is about 60,000 tons, which, reckoned at 5s. a pound, is worth over £33,000,000.

Plantation rubber has been tried for a great number of years; but it is curious that the present boom in rubber-planting, which is just breaking out in our Eastern tropical possessions (chiefly Ceylon and the Malay States), should for the first time be tackling the true Para tree, viz., *Hevea brasiliensis.* This, however, is easily explained. The seed has only recently been obtainable in these countries, as it was impossible, on account of its quick germination, to bring it from Brazil to the East whilst steamers and communications were slow. The Government, however, managed, some years back, to get a few hundred plants to grow out of 70,000 seeds brought over by Mr. Wickham, and these were at first nursed in Kew Gardens and subsequently shipped in glass cases to Ceylon where there is probably the best botanical garden in the world. No notice was taken of these trees until quite lately, however, as the first experiments of trying to turn the milk into rubber were failures. On the Amazon this is done by dipping a sort of paddle into the milk, and toasting the same over a smoky fire in which a certain nut is burnt, which gives off an acrid smoke, that evaporates the moisture and sterilises and congeals the milk. Successive layers are thus put on, and the resultant ball cut off. In Ceylon they did not possess this nut, and it was at first thought, after every nut in the island had been tried, that the nut tree would also have to be imported and grown. However, a few years ago Mr. Parkin discovered that if the milk was put into a basin and a few drops of acid added, the rubber congealed, and to-day an article is produced, called a Ceylon biscuit, which is fetching 8d. or 10d. per pound more than Fine Para. Latterly, even the acid has been dispensed with. The higher price obtained is not because the rubber itself is any better. The trees being identical, it follows that the rubber is the same; but the Ceylon article is free from moisture, and contains no particle of other substances, such as stones, sand, dirt, twigs, &c., the milk being carefully filtered before coagulation, and, as the "biscuits" are thin and transparent, any adulterations, foreign matter or accidental additions are thus easily detected. By analysis, a Ceylon biscuit contains 95½ per cent. of pure rubber, whereas, Para is considered "fine" if the sample contains 75 per cent. of rubber. This means that the real value of Ceylon biscuit rubber should be at least 25 per cent. more than Fine Para, whereas it is only fetching about 15 per cent. more. This, however, is accounted for by the small quantity so far coming forward and the manufacturers having their plant and methods installed for treating ordinary Para rubber.

Planting began slowly, and there are probably not over 70,000 trees over eight years old in Ceylon; but from these 75,000 lb. of rubber were exported from Ceylon in 1904, and this quantity may be largely increased this year The industry was retarded for several years by planters trying to imitate the conditions under which it was thought the tree best grew on the Amazon, viz., by planting in swampy ground. This was occassioned by most travellers stating that they had seen the tree growing on the banks of the Amazon, which frequently overflowed. The explanation is evident. They did see the trees under these conditions, because they were travelling on the river; but those that are thus growing are the result of probably tons of millions of seeds which have been washed down by the river from the primeval forests, and of these countless numbers a few seeds have managed to survive. These were the trees seen by travellers, as they were easily visible from the river. It has since been found that whereas 2 or 3 per cent. of seeds grow in a swamp, 98 or 99 per cent. survive and thrive on well-drained and good soil. This, and the discovery how to make the rubber out of the milk, have given an enormous impetus to planting; so that during the last few years quite 3,000,000 trees have been planted in Ceylon, and probably as many more in the Straits. This sounds a large number; but as the yield from 6,000,000 trees is not likely to increase the world's output by more than about 5 per cent., when they come into bearing viz., in six or seven years, it will be realised that there is room for a great many more, if the demand, which increases year by year, is to be satisfied.

Measurements of the largest rubber trees on the Amazon, considered to be 50 or 60 years old, are 6 ft. to 7 ft. in circumference. In Ceylon, trees 17 years old have attained a girth of 80 in. A tree can be tapped when it is 2 ft. in girth 3 ft. from the ground, and this size is attained in Ceylon about the sixth year. Such trees would be passed by on the Amazon, as it would not pay collectors to stop for the small amount of rubber obtainable at each tapping from so small a tree, with probably, at most, two or three to the acre. This, then, is the great difference in the two industries—the one means collecting from large, old, giant trees, which yield 5 lb., or even more, per tree, but which are found at great distances apart, and therefore involves an enormous amount of labour in collection, whereas on a plantation, with trees 15 ft. apart, the quantity from each tree is small, but a number of trees are tapped with a minimum of labour.

THE COLLECTION OF RUBBER

is mainly a question of labour. There are vast forests of untapped trees in the basin of the Amazon, where no human being has ever penetrated, and in order to exploit these distant primeval forests immense barren regions, mountain ranges, and passes have to be traversed, whereas in plantations now being opened in Ceylon and the Malay States, a few hours' journey along a good cart road brings the produce to the railway. Whenever cheap labour can be found, as in China, India, Japan, Ceylon, and elsewhere in the East where coolie labour has penetrated, the only problem for solution to enable European capital to find profitable employment is to hit on an article or occupation within the capacity of that labour. A coolie cannot make your clothes, your boots or your watch; but he has been imported into South Africa for gold-mining purposes, and in his own country he can be used for plucking tea or cocoa, planting rice, or doing any other outside work appertaining to tropical agriculture. For such purposes he is employed "for all he is worth," and in consequence the world is supplied with tropical produce at a price which would be impossible if it were grown in countries where labour is more highly paid. If Kent or Surrey could grow tea, coffee, cocoa, rice, pepper, or spices, they would cost the consumer almost as much more as the difference in wage; *i.e.*, from eight to ten times as much. In Ceylon a coolie's wage is 6d. a day, out of which he feeds himself, and is happy and contented. It is he who has brought the price of tea from 2/6 a pound to 7d., which is the average wholesale price for Ceylon tea.

NO PROSPECT OF OVER-PLANTING FOR 30 YEARS.

It is probable that rubber, which is the article under consideration, will also be brought down in price in years to come; but as tea has taken twenty-five years to reach the point of over-production, with a three or four years' wait for the first crop, it is fair to assume that rubber, which is a six to seven years' wait will take a longer time, if ever it is over-done. Added to this, there is a good deal less land available for rubber planting that there was for tea; and inasmuch as the cheapening of tea has led to a greater consumption, it is a fair supposition that any cheapening of rubber is likely to stimulate consumption to a much greater extent; indeed it is more than probable that all the planting that can take place in the world during the next thirty years will barely keep pace with the very much increased demand. There is a great shortage to make up before the normal price of a year or two ago will again be established, and a number of industries which are now languishing will be revived when rubber is cheaper. The normal figure for fine Para should be about 4/3 per pound; it is now 5/7 and the comparative price for Ceylon biscuit rubber should thus be 5/, whereas it fetched 6/7 at the last sale in Mincing lane.

THE LABOUR SUPPLY.

At the price of 5/ or even at 4/, there are few industries which promise a more brilliant return on capital than the planting of Hevea brasiliensis, the Para rubber tree, in Ceylon, provided the soil is judiciously selected and the enterprise honestly, carefully, and competently managed. The question of obtaining labour is not a difficult one; there is an inexhaustible supply of coolies in India, and the journey to Ceylon is not much more than crossing the English Channel. As the climate suits the coolie, there is every chance of labour being forthcoming when wanted, and wanted it will be during the next few years, and more still when the trees now being planted are ready for tapping. The importation of coolie labour from India to Ceylon was 4,568 in January, 1905, as against 1,175 in 1904. What a source of human energy, ready to work at the locally current and acceptable 6d. per day, for those who are willing to sit at home and do the organizing and financing of the industry employing them. The question whether the supply of wild rubber is likely to increase is not an easy one to answer. Those best able to judge, viz.: the editors of the "Indiarubber Journal," the American "Rubber World," and most English and continental rubber merchants, are afraid of the price going still higher on account of the shortness of the supply. That well-informed and careful journal, the American "Rubber World" of January 1, 1905, says, in a leading article on "The Natural supply of Rubber":—

"The fact that rubber has so long been obtainable is due to the enormous original supply. But this supply has not been increased or even kept up to the original limits, by any process of nature, and the rubber situation to-day is comparable to a private fortune of fixed limits, which is diminished in proportion as its owner draws upon it. He may spend twice as much this year as last, but this does not make him twice as rich; it only hastens the time when he will become bankrupt. It is quite possible that, somewhere or other, more rubber may be produced next year than this. It is out of the question to say in what year the highest output of rubber will be reached. Possibly higher prices for rubber than have been known hitherto are yet to be experienced. But there is no room for uncertainty on two points: (1) a continued increase in the industrial demands for rubber; and (2) the hastening of the extinction of the natural supply by every addition to the yearly production."

THE BAR TO EXCESSIVE PLANTING.

How much is likely to be planted? The great bar to excessive planting is the long period of waiting before the first in-gathering (six to seven years). Good land, also, is not plentiful. Soil must be very carefully selected. If not, there will be failure. There is the further fact that until the pioneers have made fortunes, others will be slow to follow (and the wiseacres' fortunes will not be made for quite eight or ten years from now), and, moreover, however great a boom in rubber planting is attacking Ceylon, planting can only be done as seed is obtainable. For the moment the whole of the seed until the autumn of 1906 is booked. Lucky are those who have plantations giving seed. They are, of course, careful to supply their own needs first. Only planters of experience can look at a jungle forest and decide whether the land is suitable. There judgment is based on the variety of trees growing, and the size and condition of those trees enable them to decide whether the soil is suitable. Tests must be made of the soil, the rainfall, and the wind, all which points are of importance. Most people would say, why select jungle? The answer is, because in a tropical country, if no jungle is growing, you may be sure the soil is bad, for the birds and the wind, in the space of years, have sown so many seeds of all sorts that if it has not formed jungle something must be wrong. When clearing, the large trees are felled, and, after being allowed to dry, the whole is burnt off, and for this, of course, a dry season is requisite. Rainfall should be from 75 in. to 120 in., and as soon as rain sets in, planting starts from a nursery-bed, sown a few weeks or months previously.

RUBBER AND COCOA.

The trees are usually planted 15 ft. apart. Between the rubber trees are frequently planted smaller growing trees or shrubs, such as cocoa, tea, and coffee, and latterly even cotton has been tried. These are all dwarf plants, compared to the rubber trees, which attain a height of 60 ft. to 80 ft. Cocoa has been found to be the best and most profitable crop to grow under the rubber trees; for the reason that the trees help each other. The cocoa has a heavy fall of leaf, and thus manures and benefits the rubber, and the rubber acts as a shade to the cocoa, which, indeed, cannot be successfully grown without a shade tree. Whether or not the rubber would eventually "snuff out" or stifle the cocoa nobody can say, as there are no plantations old enough for one to be able to judge. It looks, however, as if the cocoa would survive for about twenty years and as it yields crops from the fifth year (a year or so before the rubber is fit to tap), there is every prospect of the crop of both products lasting for quite fifteen years, and either the one or the other could be given the preference thereafter, either by cutting back the shade or allowing the cocoa to be stifled.

At present it looks as if nobody would worry about the cocoa; for the production of cocoa, being about 1½ lb. a tree (200 trees per acre), is worth only 6d. a pound, or, say, £7 10s. per acre whereas the 1½ lb. of rubber obtainable from trees only eight years old is worth at the present moment about £100 per acre. The cocoa cost 3d. per pound to pick and prepare, that is, about 50 per cent of its value; whereas the rubber only costs about 6d. per pound to collect and prepare or about 10 per cent. of its value.

Although at the present moment the oldest estates (10 years of age) are giving 2 lb. of rubber per tree per annum, it is hardly fair to take this yield as the basis of calculation; but even with Ceylon biscuit rubber at 5/ and only 1 lb. per tree yield, from the sixth or seventh year onward a profit of over £40 per acre can be made without counting anything for the cocoa. These are not fictitious figures, as a considerably larger profit is being made per acre at the present time; but it is only fair to reduce the estimate of both price and yield for future and distant calculation. However, although the price may go down, the yield per tree, as the trees grow older and larger, is certain to go up. Therefore, after making due allowance for every contingency that prudence can foresee, it would appear that the industry must be highly remunerative.

To obtain land at the right elevation, with the requisite rainfall and proper soil, is the first consideration in connection with the successful culture of the Para rubber tree, *Hevea brasiliensis.* The elevation most suitable is from sea level up to 1,200 feet or 1,300 feet. It will grow at a higher elevation; indeed there are reports of it growing at over 2,000 feet; but it would probably take several years longer to come to maturity than if it were planted at a lower elevation. A rainfall of 80 in. to 100 in. per annum is usually considered more suitable than an excessive rainfall of 150 in. to 200 in., or more as is frequently found in some districts of Ceylon.

As the tree is deciduous, it periodically requires a good rest, and a farther objection to too heavy a rainfall is that tapping is rendered inconvenient and the milk rather weak during the rains; so that a better quality of milk and more tapping days are the result of rather drier conditions. Land in Ceylon is worth anything from £3 per acre upwards. Five pounds would not be too much to pay for well-situated, good jungle land, and even higher prices have been and are being paid. The cost of felling, planting, weeding, and general upkeep for five years including superintendence, may be placed at from £12 to £15 per acre; so that the cost of an acre of clearing, five years old, planted with rubber with a catch crop of cocoa, may be taken to vary from £15 to £30, according to the price of the land and the ability of the superintendent to work economically. After the fourth year, and during the fifth, no further expense need be looked forward to, as then the cocoa would start bearing and give a crop of from 1½ to 2 cwt., or a yield of, say, £5 per acre. The sixth year the rubber is fit to tap, and should yield 1 lb. of dry rubber per tree. This, with 200 trees per acre, would, with the selling price at only 5s. per lb. (it is now 6s. 9d.), be worth £50. The cocoa should subsequently give a yield of £7 10s. per acre, viz., 3 cwt. at 50s. per cwt. The cost to be deducted from the £57 10s. thus derived from both products is 50 per cent. for the cocoa, or £3 15s. per acre, and 6d. per pound for collecting and curing the rubber, say, £5. Shipping and selling charges, which amount to about 5 per cent. of the total value of the produce equals £3 per acre, or, to make a liberal total, £12 10s. in all, leaving a net profit the sixth year of £45 per acre.

In future years the profit could be still larger, not for the cocoa, but the rubber trees will go on growing in size for twenty years, yielding yearly larger and larger crops, until they have no more room for expansion, and they would then probably stifle the cocoa, or any other catch crop growing underneath. I do not purpose to venture upon any calculation beyond the sixth year, as the figures would appear too outrageously large. Those already given are beyond all dreams of avarice; but they are nothing like as large as the profit which is actually being obtained from those estates (of which there are only a few) where the rubber is already fit to tap. Mr. Hugh Bagot, of Arapolakande, writes to the American *Rubber World* that he is getting £80 per annum per acre profit—a nice income of what only cost, in the most, £20 to plant and upkeep to the producing stage. Isolated trees have given 14 lb. or 15 lb. of rubber per tree; but it is not fair to assume anything like so large a yield on an estate with trees planted 15 ft. apart; but such yields show what the tree is capable of doing in Ceylon when growing under such conditions as would allow it room to expand to the height and size reached on the Amazon.

The greatest boon of all is the wonderful way in which the tree stands tapping without exhausting or imparing its productiveness. Mr. P. J. Burgess, the great authority on rubber-planting in the Malay States, who is now in the country, states that he has repeatedly experimented to see what a tree would stand, and that he has never been able to kill a tree by excessive tapping. Photographs are before me now of some giant trees in Brazil, which must have been tapped for fifty years, judging by the appearance of the bark, which is scarred and gnarled for 30 ft. upwards. We really do not yet know the quantity of rubber a tree will give, and what it will stand; so our present yields are probably smaller than those to be obtained with mature experience. No rubber tree, except *Hevea brasiliensis* stands this usage. It would appear, indeed, that it is the only rubber tree that can be relied on not to succumb to tapping; and Hevea not only thrives in spite of tapping, but gets used to it, and it has been found that an eight-year-old tree that has been tapped for two or three years yields a great deal more rubber than a tree of similar age which has not previously been tapped. Hence the present adage is: Tap early to accustom your tree to yield its valuable milk, and it will respond to your demands in ever-increasing quantities.

THE REVERSE OF THE MEDAL.

What, then, is the reverse side of the medal, and wherein lie the risks?

These are—

(1) Possible disease.
(2) A possible efficient substitute for rubber.
(3) Over production.

The first point is always possible, but very improbable, for the tree, being deciduous (viz.. shedding its leaves annually), is not likely to contract a permanent leaf disease. Against ants and other boring animals and insects it has the great protection of exuding its sticky juice as soon as an incision is made. In its native habitat it is a forest tree, and so is unlikely to suffer from close planting. Disease is no more likely than in an English apple-orchard. The discovery of a substitute for rubber is as improbable as the making of artificial diamonds, which remote contingency does not seem to detrimentally affect the value of the DeBeers Mines. The only substitutes so far discovered have added to the uses of rubber, by requiring a certain percentage of pure rubber as an indispensible ingredient. Rubber mixtures thus produced result in substances which can be used for certain purposes where no elasticity is required. Whether this will always be so it is impossible to say; but it is a fair commercial risk to take. Overproduction is impossible for at least a generation, as the supply is stationary and the demand for ever increasing. These latter questions, however, every business man is able to argue for himself. Opposite views may be taken; but, for the moment, at any rate, few industries appear to offer greater and better prospects.

MIXED PLANTING OF RUBBER.

Mr. Herbert Wright, of the R. Botanic Gardens, Ceylon, in the *Ceylon Observer,* says:—

"Personally I cannot say that I like rubber in any form under coconuts. Rubber cnnnot be grown successfully with coconuts except they are planted at the same time. In the case of Para and coconuts, both plants are superficial feeders and have very strong root systems, and six years after both are planted together a tremendous struggle will take place, and in the long run neither product will give satisfactory results."

"Then what about interplanting tea with Para?"

"From what I've seen in the Ceylon low country I expect that on those tea estates where the rubber has been interplanted 10 by 15 feet, the tea will not pay for plucking in 5 to 8 years from now."

"Have you seen any instance of this?"

"Yes. I know of one place where the rubber over six years old is planted 10 by 10 feet through tea nearly 14 years old. The tea has dwindled down considerably, and the bushes which remain appear to be only equal to what we can get from a seedling plant only two or three years old. I was so misled by appearances that I said to the planter—'Why, you don't mean to say you're planting tea in this old rubber'—and the planter smiled; and then so did I. Tea alone of the same age as that under the rubber, exists alongside and is quite normal."

"What about Para through cocoa?"

"I think these two products can be grown together for many years to come, providing diseases are properly attended to."

"But won't it also choke out cocoa?"

"Not to the same degree, for the simple reason that the cocoa plant is one which in its native home lives under forest shade, and when under cultivation is only planted 10 x 15 feet, or even at greater distances apart. There is much more available soil between the roots of the cocoa plants on the average estate than there is between the roots of the tea plant or those of the coconut palm; and for the same reason castilloa and ceara could be interplanted with cocoa."

THE QUESTION OF HOLING FOR RUBBER

was another point brought up.

"I know from experience that rubber will respond to generous treatment and I would recommend that holes be made as large as possible in area in young clearings; they need not necessarily be more than two feet deep. The difference in growth of stumps put in holes two feet wide against those planted in ordinary alavanga-made tea holes is surprising; and when rubber is planted in tea, I question whether it would not really pay to uproot a tea bush where the rubber stump is being planted. On a large area, that, of course, means a great deal in loss of tea plants, and it's really a point more for the practical planter to settle."

RUBBER IN S. INDIA.

The *Madras Mail* says,—

To sum up the advantages which S. India has as a rubber-producing country, we may claim that it has an abundance of good suitable soil and a climate which enables rubber to grow well at what would elsewhere be considered extraordinary altitudes; this being greatly to the advantage of the European planter in health and convenience. Our labour, averaging four annas (four pence) a day for men, defies competition, our competitors and neighbours who drew upon our inexhaustible supply having to pay practically double rates or more, taking into consideration the cost of exportation and the extra rate of pay it is necessary to agree upon before the Indian labourer will leave his country. Land can be obtained at a moderate cost, under safe titles, and the cost of transport is very moderate. Then—a very important point—it seems probable that the coffee industry can be directly utilised in extending rubber cultivation, and indirectly on account of the comparative ease and cheapness of opening clearings from an existing estate. Of course, the question arises in connection with the planting of rubber amongst coffee—is the former a useful and safe shade for the latter?

In the case of Ceara we have generally decided in the negative, but with Para and Castilloa the verdict seems likely to be the other way. Certainly we have not a long experience to guide us as yet, and personally, I can only speak (as far as any real acreage is concerned and not judging by a tree here and there) of coffee under six years old rubber, and under that age the result of which I mentioned in my first article as being thoroughly favourable to Para, and, in a slightly modified degree, to Castilloa. It is only fair to say, however, that Mr. Nicholson, the owner of the property I alluded to, considers that the Castilloa has had no bad effect on the coffee, and I have certainly not noticed any such thing elsewhere, even where both were interplanted simultaneously, though I have carefully looked for it. Moreover, as far as my observation, in various districts extends, if coffee does well under young shade of any species, the older that shade becomes the better will the coffee look, provided, of course, the height and density of the former be properly regulated. It is quite true that the same shade does not suit all districts or even all parts of a district, and there are few things more remarkable in planting than the opposite effects produced by the same tree under different conditions, so that it is possible that here and there planters may find the one or the other of these rubbers unsuitable for shade purposes. I can only say, so far, that after seeing a large quantity of coffee interplanted with them in three different districts, I do not hesitate to continue doing so myself.

A well-known Ceylon planter tells me that tea certainly will not grow under rubber (in Ceylon); but it has always seemed to me that any shade checks the growth of leaf either in tea or coffee, and, as tea is grown for its leaf production, no shade is really suitable to it. Nor does it seem likely that Mysore, Coorg, and Wynaad, where shade has to be fairly dense to keep down borer, could easily replace their present trees with rubber, however desirable this may be. The young rubbers would grow up very whippy under such conditions, and naturally take a long time to be of value, whilst the original shade would require much careful and constant regulation lest the coffee should suffer. Still in these districts, abandoned fields of coffee and new clearings could be planted with rubber, which would probably become the leading product after some years, whilst on the Nilgiris, Shevaroys, Pulneys, Anamalais and Travancore hills, whole estates could be under rubber shade. As to whether such shade may prove injurious by introducing any enemies of the coffee trees so far the answer must be in the negative. Where rubber is planted in new clearings the example of some parts of Ceylon might be followed and catch-crops be utilised such as cotton, ground-nuts, cassava, chillies, lemon-grass, etc., all of which are reported to do well and keep down weeds. It is true that Mr. F. Lewis, Assistant Conservator of Forests, Ceylon, states his opinion very clearly that Ceylon soil cannot stand interplanting, at any rate so as to give a good yield from each product, and it will certainly be well to try such an experiment with great care; but I may mention that I have seen coffee in Southern India interplanted with tobacco—a very exhausting crop—yet neither seemed to suffer.

AVAILABLE RUBBER LAND.

Having seen that growth is good, the yield promising, and that South India has great advantages in its rich soil, suitable climate, and cheap labour, we next ask what land is available. The Para has been proved to be a hardy plant, and the Castilloa was considered to have a yet larger range, but there are some limitations which must be observed. For practical purposes it seems as if, for the present, we should confine ourselves to a zone between 500 and 4,000 feet, with a rainfall averaging not under 45 inches, and up to possibly 150 or more. The soil should not be a stiff clay, and must be of good depth, preferably a free loam. Situations exposed to a continuous strong wind should be avoided. The above limits would cover the great bulk of the coffee districts beside much of their western slopes between 500 and, say, 2,500 feet the latter elevation being taken roughly as the lower limit of the coffee belt. The eastern slopes, at a similar height, would be generally too dry. Large portions of Cochin and Travancore, and possibly part of the eastern Ghauts would also be included, probably not less than 300 square miles in all, say 200,000 acres. The total apparent area is far more than this, but it seems only reasonable to make large deductions, as any planter will understand, soil and exposure accounting for much. Mr. F. Lewis is very clear that the growth of rubber in poor land and good forest is enormously in favour of the latter, and presumably yield will follow growth.

Cinchona, it is true, died out all over Ceylon and in certain parts of South India. Is there any chance of rubber doing the same? We need not, I think, be alarmed at, however much we may sympathise over, what happens to Ceylon. Coffee had previously gone the same road, and it is recognised that the chief asset of a plant in Ceylon is the climate, whicn is but poorly backed up by the soil, except in some favourable instances. There is also the drawback, from a plant's sanitary point of view, of very large contiguous areas of the same cultivation, so that if disease once establishes itself the conditions are all in its favour. Speaking generally, the soil of the former coffee districts strikes one as lacking in depth and freedom, and this was probably the fundamental reason why coffee, and after it, cinchona died out there.

Tea is one of the hardiest plants in existence, and will, we trust, go on indefinitely; but there is no doubt that rubber requires depth of soil if it is to be a permanent and paying staple. The bulk of our Indian soil, however, is competent to stand any test of this kind. I have seen a field in Coorg which had been under coffee for over 100 years,—not the identical trees, probably, that were first planted, as the ravages of borer make such a thing unlikely—but the land was standing its crops as well as ever; in Mysore I have seen still older coffee, and on the Nilgiris there are flourishing fields, planted in the early forties, cropping with vigour; whilst the Government Cinchona plantations, the oldest in India, are in splendid health.

But a few cases are of little value, the best test is the continued existence of the South Indian coffee districts, except, possibly Ceylon's neighbour, Travancore, which has turned to tea. Cinchona also grows as well as ever with us, though now that the market is ruled by high-class Java bark, it has ceased to pay us to have any but the best kind, and consequently the great bulk has been uprooted and harvested. There were, however, cases where cinchona was planted, in suitable situations and died out as the Ceylon plantations did, and this generally was due to hard subsoil and want of depth or drainage. In such places it would, I imagine, be unwise to plant rubber, which demands as much freedom as cinchona did; neither with our choice of soil is there any reason for doing so.

CEARA RUBBER.

The cultivation of Ceara or Maniçoba* rubber (*Manihot Glaziovii*) was begun in Nicaragua about four years ago. The splendid condition of the plantings and the large yield and excellent quality of the product taken in trial tappings, give promise of the success of the enterprise, The Ceara rubber tree is a dry land plant, and will not prosper in a wet soil. It is being planted in the districts of La Pas and Momotombo (300 ft. above sea level), where the Momotombo mountain, by driving the clouds to one side, protects this section from the force of the tropical rains so that it is comparatively dry, receiving just about enough water to grow corn, which is abundant for Ceara rubber. The soil is sandy, with an admixture of a little clay, and very deep and level or slightly rolling. The Nicaragua Rubber Co.'s plantation is the "San Nicholas," on which are the oldest and largest trees in this section. Three-year-old trees on this plantation measures 26 in. in girth 3 ft. above the soil, and are more than 30 ft. high. Ceara rubber trees yielded latex at two years of age. Twenty-one trees from fourteen to twenty-one months old, with an average age of fourteen months, were tapped, and together gave 7½ lb. of dry rubber. A tree fifteen months old gave 3 oz. of rubber. However, it is not intended to tap until the trees are four years old, in order not to retard the best development. It is expected that four-year-old trees will produce 1 lb. of rubber each, and from that time the product will augment rapidly. There are now in the district outside of native plantings, four American plantations of *Manihot Glaziovii*, on which are planted some 200,000 trees, while as many more will be planted in another year.—*Work.*

Present experiments with the Para and Castilloa varieties on the Periyar River (elevation 2,300 ft.) in Madras Presidency tend to prove that the cold nights are against a rapid growth of these varieties, the thermometer falling to below 40 degrees at night in January and February, though in the day time it is as hot as in the plains. But for Ceara, I can say with confidence that the climate suits it, and there are thousands of acres of magnificient land only awaiting development with this species to make many fortunes.—*Madras Mail.*

A large Ceara rubber tree is growing on abandoned coffee land on Franklands in the Kadugannawa district in Ceylon. The tree is 5 feet 9 inches in girth at the bottom and 6 feet from the ground it is 4 feet 6 inches. It is supposed to be about 20 years old. A considerable area of land at a medium elevation, which has lain fallow since the failure of coffee, is considered suitable for rubber of this variety; and we understand many acres are being prepared for the purpose of planting Ceara.—*Ceylon Observer.*

* [See *Bulletin of the Department of Agriculture*, April, 1905, page 72.]

COCOA DISEASES.

The attention of the cocoa planters is invited locally to a disease of the pod which has lately been noticed.

It may be more prevalent than planters are themselves aware of, and there is the certainty of its spreading unless measures are taken to prevent it.

The disease is due to a fungus,* which was described and figured by Mr. George Massee of the Kew Herbarium in the Kew Bulletin,† and later in his "Text-book of Plant Diseases," from specimens sent from Trinidad by Mr. Hart.‡

The disease is recognized by a darkening of the pod which spreads from one end, and by a delicate white mould which appears on the outside. The mould produces immense numbers of very minute particles, lighter than dust, which are blown off by every breath of air and scattered on the pods all round, even at great distances if the wind is high. These particles infect the pods they fall upon; the disease grows all through the shell, killing young pods, and even in almost mature pods affecting the cocoa beans, causing inferior grade and light weight. These particles falling on a dry pod will do no harm, and therefore wet weather, moist situations, and overhead shade encourage infection. The spread of the disease is due also to other particles, which lie dormant for some time in the substance of the shells of the pods. Like seeds, under favourable conditions and after a resting stage, when the shell decays, they germinate, producing more particles that are carried about by the wind.

To prevent the spread of the disease, all diseased pods should be picked and either burnt, or buried so deep that they will not be brought to the surface again. All shells from which the beans have been removed should always be buried to ensure that the disease is not propagated by the germination on them of the wind-borne particles, or in them of any of the resting particles.

If these measures are rigidly carried out, the disease will probably not give any trouble, but if on any estate the disease is found to be wide-spread, all the pods which are not picked off, should be sprayed with Bordeaux mixture,§ and a constant watch kept against the breaking out of the disease.

THE VALUE OF MULCHING WITH LEAVES GRASS, &c.

It has frequently been pointed out of late years in the Bulletin,‖ and by the Agricultural Instructors that mulching the ground with vegetable refuse is of the greatest value to the crops grown on it. The practice has been carried out on coffee plantations, and also

* Phytophora omnivora
† Jan. & Feb. 1899.
‡ See also W. Indian Bulletin, VI. 1 page 86.
§ For method of preparing Bordeaux mixture see Bulletin for last February page 32.
‖ For instance, in "The question of Shade for Coffee and Cocoa," Bulletin, Vol. I, June & July, 1903, page 124.

on banana estates where the trash is saved for that purpose, and on one estate blankets are imported and used for wrapping in order to save the trash for mulching. The idea has also been drilled into the minds of small settlers, and in Manchester, for instance, the people cut grass and bush along the road-sides, or ask leave to go on a property to cut fox-tail grass.

It is very interesting to find now that Dr. Watts has made careful experiments to test the value of a mulch of this kind as compared with various manures in Dominica, and the results, given in the Agricultural Report of that island for 1904-5, confirm our opinion of the value of the practice. The special part of the report dealing with this subject is given below :—

CACAO MANURIAL PLOTS.

"Dr. Watts, C.M.G., Analytical and Agricultural Chemist for the Leeward Islands, has summed up the results of the Cacao Manurial Plots at the station for the past three years as follows :

"In 1900, a plot of cacao, about $1\frac{3}{4}$ acres in extent, was divided into five plots for manurial experiments as follows :—

No.	Letter on Station plan.	No. of trees per plot.	Manure.
1	C.	34	No manure.
2	A.	37	Basic phosphate 4 cwt. per acre. Sulphate of potash $1\frac{1}{2}$ cwt. per acre.
3	B.	40	Dried blood 4 cwt. per acre.
4	E.	34	Basic phosphate 4 cwt. per acre. Sulphate of potash $1\frac{1}{2}$ cwt. per acre. Dried blood 4 cwt.
5	D.	39	Mulched with grass and leaves.

"The cacao trees were about ten years old and planted about 18 feet apart. The chemical manures were applied once in each year, from 1900.

"The weight of *wet* cacao has been recorded for each of the years ending June 30, 1903, 1904, and 1905. The results are as follows :—

* Reports on the Botanic Station, Agricultural School, and Experiment Plots, Dominica, 1904-5. Imp. Dept. of Agriculture for the W. Indies.

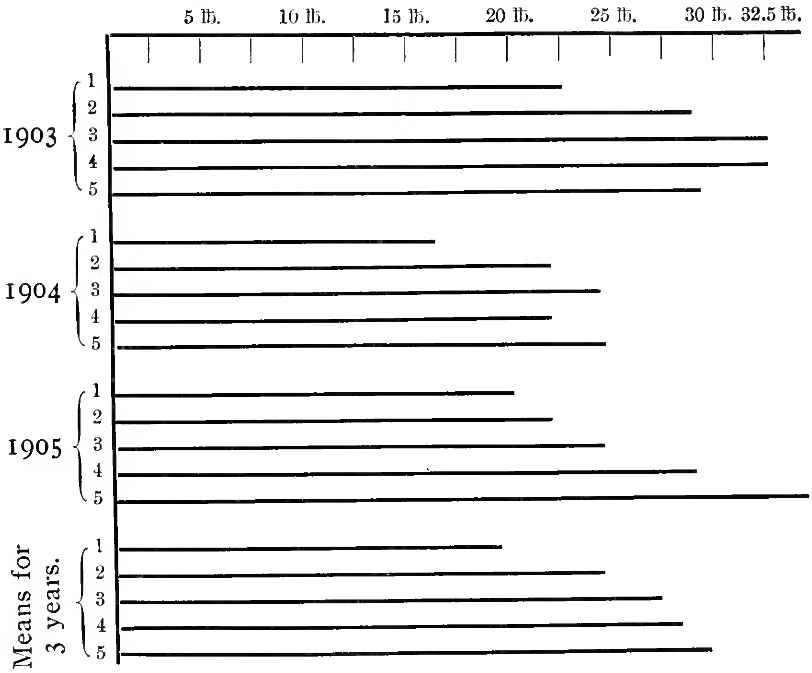
YIED OF WET CACAO IN POUNDS.

No.		Manure.	1903.		1904.		1905.		Mean of three years.		Difference on no manure.	
			per plot.	per tree.	per plot.	per tree.	per plot	per tree.	per plot	per tree.	per plot.	per tree.
1.	C.	No manure ...	759	22·3	548	16·11	673	19·76	660·0	19·41	-	—
2.	A.	Phosphate and potash ...	1,063	28·7	808	21·83	814	22·00	895·0	24·19	+235·0	+4·78
3.	B.	Dried blood ...	1,281	32·2	970	24·25	970	24·25	1,073·7	26·85	+413·7	+7·44
4.	E.	Dried blood, phosphate, and potash ...	1,104	32·4	738	21·70	979	28·79	940·3	27·65	+280·3	+8·24
5.	D.	Mulched with grass ...	1,145	29·3	962	24·60	1,279	32·79	1,128·7	28·95	+468·7	+9·54

"The results based on the yield per tree, are also given in diagrammatic form for convenient comparison :—

CACAO MANURIAL EXPERIMENTS, 1903–5.

Yield of wet cacao in pounds per tree.



"These experiments differ from those conducted with annual or short-period crops in that the effects are cumulative, the experiments are repeated on the same plot of ground and on the same individual trees year after year, and the results of several years have to be taken into account in estimating the effect.

"The first point which strikes one is that all the manures used have proved beneficial. In the first two periods (1903 and 1904) while the mixture of phosphate and potash, and the dried blood both gave substantial increases in the crop, the combination of all three in 1903 only gave about the same return as dried blood alone while in 1904 the return was even less where all three were given than where dried blood alone was used. This is anomalous and points to some disturbing influence.

The position of affairs in the third season is interesting and important. Here we find the smallest yield given by the plot receiving no manure, namely, 19¾ lb. of wet cacao per tree, the addition of phosphate and potash increased the yield to 22 lb., a gain of $2\frac{1}{4}$ lb. per tree. Dried blood gave a yield of $24\frac{1}{4}$ lb. a gain of $4\frac{1}{2}$ pounds over no manure, or $2\frac{1}{4}$ lb. more than phosphate and potash. The combination of dried blood with phosphate and potash increased the yield to $28\frac{3}{4}$ lb. per tree a gain of 9 lb. per tree over no manure, or $6\frac{3}{4}$ lb. over phosphate and potash, and of $4\frac{1}{2}$ lb. over dried blood. The combination of the two sets of manures has given greater increments than the sums of the increments from either singly, thus pointing the necessity for general manuring, i.e., for manure which will supply potash, phosphate, and nitrogen. The changes which have taken place in the soil during the previous three or four years probably account for the relative effects of the manures in this third period.

The plot mulched with grass and leaves, the sweepings of the lawns at the Botanic Station, is a very interesting one. In the first period this plot, though giving a greater yield than the no-manure plot, fell far behind the plot receiving dried blood; in the second period it again exceeded the no-manure plot and its yield was practically equal to, or a little better than, the yield of the dried blood plot; while in the third period (1905) it has far surpassed all the other plots and has given a yield 66 per cent. greater than that obtained from the no-manure plot. The soil of this plot is in better condition than the others, the surface soil is moister and darker in colour, while the trees have a better surface root development.

"This method of manuring by means of mulches of grass and bush is evidently the proper course to adopt in Dominica, where, owing to the large supplies of the required material which are available, the work of manuring can be carried out efficiently.

"These experiments again emphasize the desirability in the tropics of following agricultural methods which lead to the conservation of humus or vegetable matter in the soil. In most cases, if these methods are conscientiously adopted, sufficient supplies of plant food will be conveyed to the soil to obviate the necessity of buying artificial manures.

"These experiments should be carried on for a number of years, when further interesting results may be expected. It is probable that the plot mulched with grass and leaves will retain its vigour and productiveness for a much longer period than the others.

"As 100 lb. of wet cacao are found to yield 42 lb. of dry cacao, and as the trees are planted about 18 feet apart, or at the rate of 134 trees per acre, approximate calculations may be made as follows* :—

* Some vacancies occur in the plot so that the calculations have preferably been made on the yield per tree rather than per acre. The calculations per acre based on these are necessarily only approximations, but they are made for the sake of more ready appreciation of the commercial bearing of the experiments.

YIELD PER ACRE IN 1905.

	Dry cacao Pounds per acre.	Gain over no manure in pounds.	Value of increase over no manure at 6d. per lb. of dried cacao.		Cost of manure.*		Gain by manuring.	
			s.	d.	s.	d.	s.	d.
1	1,112	..	..		..		..	
2	1,238	126	63	0	45	3	17	9
3	1,365	253	126	6	36	0	90	6
4	1,620	408	204	0	81	3	122	9
5	1,845	733	366	6	60	0	306	6

"The general yield of the cacao plot in the Botanic Station has been very satisfactory, even on the portion receiving no manure: from the work now carried on it is evident that proper care and manuring can be relied upon to give substantial increases in yield. These experiments therefore appear to possess a considerable amount of interest and value for Dominica cacao planters as indicating the lines upon which they should carry on their work from the earliest stages.

THE TOBACCOS OF JAMAICA, V.†

Report on a sample of Tobacco from Jamaica, by Professor WYNDHAM R. DUNSTAN, M.A., F.R.S., Director.

Imperial Institute,

South Kensington, London, S.W.

This sample of tobacco was sent to the Imperial Institute by the Director of the Department of Public Gardens and Plantations of Jamaica and was referred to in a letter (No. 8083) dated the 9th June, 1905, which gave the following information regarding the sample.

"I send by this mail sample of tobacco, grown under shade-"cloth, from Sumatra seed, during the past season. Only one

* Taking manures at the following prices locally; basic phosphate, 5/6 per cwt.: sulphate of potash, 15/6 per cwt.; and dried blood, 9/ per cwt. and assuming that so large a sum as £3 a year be spent on mulching, an estimate which appears very liberal.

† For previous papers on Tobaccos see *Bulletin* for April, May and October, 1902, September and December, 1904, and June, July and August, 1905.

"quarter of an acre was grown as an experiment and there is "therefore none for sale. I shall be very glad to have a report "on its quality and value."

DESCRIPTION OF SAMPLE.

The sample consisted of six leaves of the "wrapper" type of cigar tobacco showing a dull, olive brown tint. The leaves were of fair length, uniform in colour, thin and free from 'stains' and 'burns.' They were somewhat brittle when handled, but this was probably due to their having been packed between sheets of cardboard which had absorbed the moisture, rendering the leaves abnormally dry.

When ignited the tobacco burned evenly and steadily, evolving a fairly fragrant aroma and leaving a greyish white ash.

As the sample was very small it was impossible to submit it to chemical examination. It was therefore sent to a firm of tobacco experts to be tried for "wrapping" cigars and for the determination of its commercial value. The experts' report on the tobacco was as follows :—

"The tobacco is a very handsome appearance, thin in texture "and therefore highly productive as a 'wrapper' for tobacco, in "use it is somewhat 'tender' and does not appear to have quite as "much elasticity as Sumatra tobacco of similar texture ? (see note "under "Description of sample" as to probable reason of this "tenderness') the burning is very fair and the flavour not unsatisfac-"tory. Similar tobacco well put up would fetch on the English "market up to about 3s. per lb. for first lengths, say 2s. 3d. per lb. "for the second lengths and from 1s. 3d. to 1s. 6d. per lb. for "the third lengths.

"We feel sure that the soil, and climate which have produced "this tobacco are suitable for growing 'wrapper' tobacco equal to "most in the world and if labour is plentiful and cheap and the "area of suitable ground large enough there is a chance in time "of this district of Jamaica becoming a serious competitor of "Borneo, Sumatra and Java.

"It will, however, be advantageous to prepare tobacco of this "class in a similar manner to that in which East Indian tobaccos "are got up for the European markets. If it were put up on the "market in the same form as the Mexican, Havana and other West "Indian tobaccos this would probably detract considerably from "its value."

The experts go on to suggest that it might be worth while to carry out a similar cultivation experiment in Jamaica with Java tobacco as this would probably yield a 'wrapper' leaf, which would be stronger in texture and of even better flavour than the present sample.

The results of the experts' trial of this tobacco show that it is of good quality and that if a similar quality can be placed on the English market in quantity it will probably realise remunerative prices.

If it is decided to carry out the cultivation experiment with Java seed as suggested in the above report the Imperial Institute will be glad to undertake the examination and valuation of the product. For this purpose a sample of about two pounds of the leaves should be sent so that an exhaustive investigation of the material may be made. In order that the differences between Java 'wrapper' tobacco and the Sumatra 'wrapper' tobacco, as grown in Jamaica, may be appreciated, two sets of samples of cigars wrapped with these two tobaccos are sent with this report.

Set No. 1 consists of cigars wrapped with the Sumatra tobacco grown in Jamaica.

Set No. 2 consists of cigars wrapped with the Java tobacco.

It will be seen that although the Jamaican Sumatra 'wrapper' is thinner and yields a cigar of good general appearance the Java wrapper is stronger in texture and when burned produces a better aroma and flavour than the former.

(Sgd.) WYNDHAM R. DUNSTAN.

3rd October, 1905.

BOARD OF AGRICULTURE.

EXTRACTS FROM MINUTES.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday 14th November, present: the Hon. H. Clarence Bourne, Colonial Secretary, Chairman, the Director of Public Gardens, the Island Chemist, the Superintending Inspector of Schools, His Grace the Archbishop, Messrs. C. A. T. Fursdon, C. E. deMercado, J. W. Middleton, Geo. D. Murray and the Secretary, John Barclay.

Mr. Murray asked, as a matter arising out of the minutes, if sugar planters would be permitted to see the operations in connection with the manufacture of High Ether Rum at Hampden Estate.

The Chemist said no one could do so without the permission of the proprietor, but he had no doubt the proprietor would give this permission, if he were asked.

Mr. Murray said he would like, however, to have it arranged so that there would be no mistake about this permission being granted.

The Secretary was instructed to write Mr. D. O'Kelly Lawson to say that the Board assumed there would be no objections to any sugar planters seeing the new system at work if they came with a letter from the Chairman of the Board.

The Secretary read the following letters from the Colonial Secretary.

1. Enclosing copy of minute received through the Secretary of State for the Colonies from Mr. Sydney Olivier relative to the action taken by the latter with reference to the Locked Still Experiment.

After discussion the Board unanimously resolved "That the minute of Mr. Olivier be entered in full in the minutes and that the Board records its conviction that in the action which Mr. Olivier took as Chairman of this Board he believed that he was carrying out the wishes and intentions of the Board and that the Board is satisfied that there was no discourtesy in the matter on the part of Mr. Olivier.

2. Resolved that a copy of Mr. Olivier's letter and of the minute of the Board thereon be sent to those gentlemen who resigned their position as members of that Board in consequence of the action taken by the Government in the Locked Still Experiment at Denbigh."

The following is Mr. Olivier's minute referred to:—

"I have had an opportunity of perusing some extracts from the minutes of the meeting of the Jamaica Board of Agriculture, held on the 11th of October, 1904, and copies of official minutes and correspondence connected with the expenditure for installing a locked still at Denbigh. I observe that the Board have recorded that this matter had been dealt with by the late Acting Governor in the exercise of his own power and that the Board did not desire to carry through the matter. I have learnt that on the 1st November a vote for an expenditure of £250 for this purpose was proposed to the Board, and that, on its being carried, three members resigned. There has been some misunderstanding with regard to my action in this matter the nature of which it is not difficult to explain, and I am desirous that the Board should be assured that I had no intention of ignoring in any way their authority.

"The expenditure which I authorised in this connection was for the purchase of a Spirit Safe for a locked still which was ordered through the Crown Agents for the Colonies by letter dated 18th August, 1904, and which cost altogether £30 15s. 4d. I regarded this order as being within the authority given by the Board in the approved vote of £1,000 for appliances on estates, &c., which I had always understood, and, rightly or wrongly, believed that the Board understood, as contemplating provision for locked-still experiments.

"On the 26th August I authorised a proposal submitted by the Island Chemist that the Public Words Department should be requested to prepare the plans and estimates for alteration at Denbigh Estate for a special lock-still at a cost of £220 to £250, and directed that Mr. Cousins' minute should be circulated to the Board of Agriculture. I did not authorise any works, or intend to authorise any until the plans and estimates had been received, but it appears that the minutes were understood in the Colonial Secretary's Office as approving of the commencement of work at Denbigh, and that, after I left the Island, work was done under this presumed authority.

"I understood from what passed at the meeting of the Board of the 13th of September, after I had myself left the chair, that they desired to see the plans and estimates before anything should be done there, and it was my intention that this course should be followed.

"On the 15th of September I left Jamaica.

"I have recently learnt that on the 1st September an order for fittings for Denbigh Estate was sent to the Crown Agents. I did not either see or know of this order at the time; but I have learnt that it was considered to be in accordance with my intentions as indicated by the instructions above mentioned. The cost was conjecturally estimated at £100.

"On the 4th of October the Crown Agents informed the Colonial Government by telegraph that the tendered price for these fittings was £190, and enquired whether they should order.

"On the 11th October they were authorised by telegraph to accept the tender.

"It is very uncongenial to me that it should be imputed in the proceedings of a Board with whom I always worked in harmony and good understanding, that my last act in relation to them was a discourteous overstepping of my authority. I feel confident that the Board will believe that in ordering the Spirit Safe above mentioned I considered that I was taking means to give effect to the deliberate intentions of the Board and will recognise that the responsibility for any further expenditure at Denbigh stands attributed to me, in their records, through mistake.

"SYDNEY OLIVIER.

12.9.'05."

2. Intimating the appointment of Mr. Luther Zinzendorf Brandford provisionally as from the 20th October to be master of the Hope Industrial School in succession to Mr. Hopwood at the salary of £70 a year with quarters, medical attendance, fuel and lighting.
3. Transmitting copies of further letter from Sir Daniel Morris relative to his endeavours to arrange for the conveyance of members of the West India Agricultural Conference to and from Jamaica, which stated that the Royal Mail Co. informed him that they were unable to do anything to assist him in the matter and that he had heard nothing from Messrs. Elder, Dempster & Co. so that the outlook was not promising.

The Secretary submitted communications with regard to Jamaica Tobacco, referred from Colonial Secretary from

1. The Imperial Institute.
2. Sir Daniel Morris.
3. Mr. F. V. Chalmers.

These were directed to be circulated.

The Secretary submitted two letters of date 22nd September and 5th October respectively from Mr. Nolan to the Colonial Secretary as regards Jamaica Rum in the United Kingdom.

These were directed to be circulated.

The Secretary submitted a letter from Mr. Cradwick giving particulars of an experiment in draining land and the cultural results.

The Secretary submitted a letter from Mr. R. G. Musgrove, Mississippi, U.S.A., who said that he was Chairman of the group of Jurors who made the cotton award at the St. Louis Exhibition and he desired to have a sample of the Sea Island Cotton grown in Jamaica to report upon its merits, together with minutes from the Director of Public Gardens and the Chairman thereon.

The Secretary was instructed to arrange to send samples which he stated could be done at a trifling expense.

The Chemist submitted the following reports :—

Research in Tropical Medicines by Capt. Wanhill, R.A.M.C.
Training of Distillers at Hope.
Distribution of cane tops.

The last three were directed to be circulated.

The Director of Public Gardens submitted a report on Hope Experiment Station which was directed to be circulated.

The following papers which had been circulated were submitted for final consideration :

1. Papers re Mr. Nolan and Jamaica Rum in the United Kingdom.
2. Proposed Amendment to Jamaica Rum Protection Law, 1904.

   The Board decided to recommend that the proposed referendum on the subject should be taken and that Dr. Cousins should prepare a statement on the matter and the Chairman said he would draft a circular to be issued. The Secretary was instructed to send a copy of the minute on the proposed amendment to the Government and say that the Board recommend that it should be carried through, but that first the two Sugar Planters' Associations and other planters interested in the Rum Industry should be consulted on the matter.
3. Colonial Secretary's letter re Jamaica Scholarship and Agriculture and Dr. Cousins' report relating to same.
4. Draft Estimates Agricultural Services which were passed.
5. Reports Director of Public Gardens and reports Chemist.

The Director of Public Gardens submitted a list of persons who had promised to lecture at the Teachers' Course which was approved of.

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